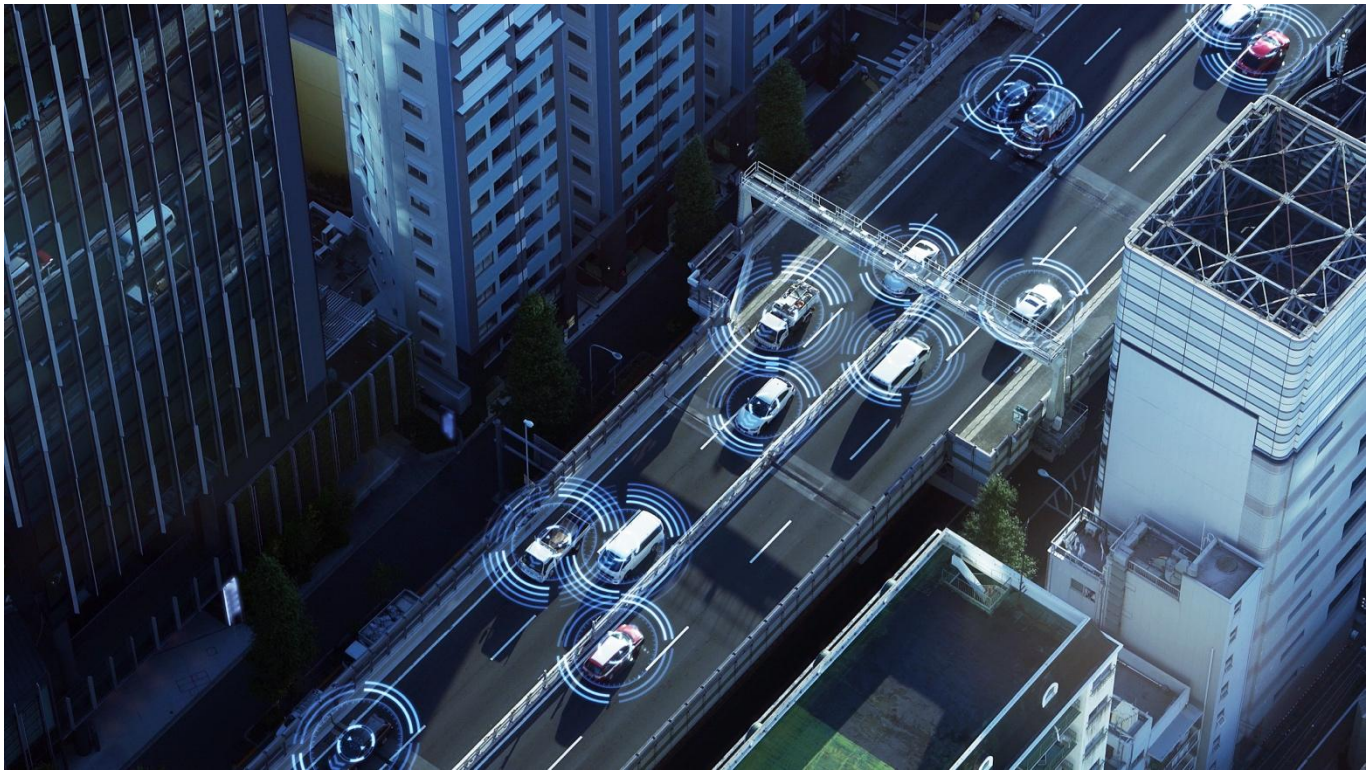
Report
May 2026

Portfolio Report: progress and insights from the LMT portfolio



UK Research & Innovation
Our ref: 245-747-03

steer economic development technopolis group

Report
May 2026

Portfolio Report: progress and insights from the LMT portfolio

Prepared by:

Steer Economic Development
14-21 Rushworth Street
London SE1 0RB

+44 20 7910 5000

www.steer-ed.com

Prepared for:

UK Research & Innovation
Polaris House,
North Star Avenue,
Swindon SN2 1FL

Our ref: 245-747-03

Contents

Figures

Tables

Appendices

List of acronyms and abbreviations

Acronym	Meaning
BSI	British Standards Institution
CAA	Civil Aviation Authority
CCAM	Commercialising Connected and Autonomous Mobility
CCAV	Centre for Connected and Autonomous Vehicles
DBT	Department for Business and Trade
DfT	Department for Transport
DMUs	Diesel Multiple Units
FOAK	Rail First of a Kind
FTE	Full Time Equivalent
HGV	Heavy Goods Vehicle
IMS	Impact Management System
IUK	Innovate UK
LMT	Land and Maritime Transport
MRL	Market Readiness Level
MSP	Monitoring Service Provider
NZP	Net Zero Propulsion
OEM	Original Equipment Manufacturer
PROLECT	Protection and Resilience for Overhead Line Equipment using Computer Vision Techniques
QMS	Quarterly Monitoring Scores
R&D	Research & Development
SME	Small and Medium Enterprise
SORA	Specific Operations Risk Assessment (aviation regulation)
TDD	Transport Decarbonisation Demonstrator
TOC	Train Operating Company
TRA	Temporary Restricted Area (aviation)
TRL	Technology Readiness Level
TVH	Tees Valley Hydrogen Transport Hub
UKRI	UK Research & Innovation
ZEHID	Zero Emission HGV and Infrastructure Demonstrator

Executive Summary

Introduction

The Land and Maritime Transport (LMT) portfolio, which consists of separate innovation programmes delivered by Innovate UK (UKRI) in partnership with the Department for Transport (DfT) and Department for Business and Trade (DBT), represents a significant investment in the future of UK transport innovation and decarbonisation.

This report has been prepared by the independent consultancy Steer-ED, alongside partner Technopolis, who were commissioned in November 2023 to implement the monitoring framework for the LMT portfolio. With £444.7 million allocated across 203 projects, the portfolio encompasses a diverse range of programmes, each targeting different aspects of rail, road, and maritime transport. These programmes vary in their objectives, scale, and technological focus, from feasibility studies and early-stage research to large-scale demonstrators and commercialisation efforts. The LMT portfolio is comprised of a range of programmes which are individually designed and delivered, summarised as follows:

- The **Maritime Decarbonisation programme** is core constituent and scheme of the UK Shipping Office for Reducing Emissions (UK SHORE)[1] and comprises six competitions. In the scope of this research, we are evaluating 87 projects across a total allocated fund of £187.5m[2].
- The **Zero Emission HGV and Infrastructure Demonstrator (ZEHID) programme**, consisting of four funded projects with a total allocated fund of £176.9m.
- The **Commercialising Connected and Autonomous Mobility (CCAM) programme** (only DBT funded programme) consisting of two funded competitions and 19 individual projects, with a total allocated fund of £41.4m.
- The **Tees Valley Hydrogen (TVH) Transport Hub programme** consists of three individual projects with a total allocated fund of up to £12.5m[3].
- The **Rail First of a Kind (FOAK) programme** comprises a large number of smaller projects (69) from three competitions, with a total allocated fund of £16.1m.
- The **Net Zero Propulsion (NZP) programme** comprises a single competition with 14 individual projects, with a total allocated fund of £8.6m.
- The **Transport Decarbonisation Demonstrator (TDD)** comprises one competition and seven individual projects, with a total allocated fund of £1.7m.

While most projects have now concluded, a number remain active, reflecting the complexity and ambition of the work being undertaken. The key achievements to date are summarised in the following narrative within themes relevant to the LMT portfolio.

---

[1] Under UK SHORE, funding and support are delivered through a range of schemes and competitions, including two flagship funding competitions, Maritime Decarbonisation and ZEVI, alongside wider research and development, infrastructure, and accelerator funding mechanisms.

[2] This encompasses projects funded under CMDC Rounds 2–4 and ZEVI projects across three strands: battery-electric vessels and charging infrastructure, shore power technologies, and alternative fuels. These figures exclude CMDC 1, 5 and 6 projects as these were not in the scope of this research.

[3] This figure represents the original allocated spend, not the final spend figures.

Delivery and impact

The majority of projects comprising the LMT portfolio have met or exceeded their planned objectives, with **85% delivering against their targets** (based on the most recent QMS assessments of each project). There has been notable progress in advancing technology readiness, with the **majority of beneficiaries reporting having moved up at least one Technology Readiness Level (TRL)** since application**,** and 17% having reached the highest level (TRL 9), i.e. demonstrating their solutions in operational environments.

Commercial outcomes are also evident, with more than a quarter of projects having launched new products or services, and over a third reporting improved commercial readiness. There was some evidence of intellectual property generation, with 21 Wave 2 beneficiaries reporting 31 patents resulting from their projects, and additional patents anticipated in the coming years. Commercially, many projects are at high Market Readiness Levels (MRLs), with 20% of Wave 2 projects having launched new products and 35% having improved their commercial readiness.

The portfolio's impact extends beyond technical and commercial metrics, as **two-thirds of Wave 2 survey respondents have received coverage in news or trade press**, helping to raise awareness and support wider adoption. In total, over 3,700 media items were identified for 99 of the 178 projects in the past year, averaging approximately 21 items per project. It should be recognised that many technologies are still in the early stages of development, meaning long-term impacts have not yet occurred, and many are unlikely to emerge until after projects have completed.

Partnerships and collaboration

The evidence across the portfolio shows a broadly consistent pattern, with Waves 2 and 3 reinforcing the same overall trends. Collaboration has been a defining strength, with **beneficiaries commonly reporting both the formation of new partnerships and the strengthening of existing ones.** These relationships have broadened access to specialist expertise, facilities and real-world testing environments, helping projects accelerate development and de-risk innovation.

These partnerships have not only facilitated the delivery of project objectives but are also expected to endure, supporting future bids, scaling activities, and the development of robust supply chains. The collaborative approach has brought together industry, academia, and regulators, fostering an environment where innovation can thrive.

Organisational growth and skills development

Organisational growth and skills development have been significant outcomes of the LMT portfolio. The **majority of respondents across all programmes reported that their project contributed positively to organisational skills development,** particularly CCAM beneficiaries. Most respondents reported positive impacts on their organisations' technical, regulatory, and commercial capabilities.

The projects have contributed to job creation, with survey data indicating that **a third of respondents reported the creation of new jobs directly attributable to their projects.** Additionally, **over half of respondents stated that existing jobs had been supported**. Looking ahead, nearly half of CCAM, FOAK, TDD and NZP Wave 2 beneficiaries, and over half of CCAM, FOAK and Maritime Wave 3 beneficiaries **expect further job growth within five years.** This growth is particularly anticipated in high-growth sectors such as CCAM.

This indicates longevity of these roles beyond the fixed funding timescales for the individual programmes.

Challenges and lessons learned

Despite these successes, the LMT portfolio has faced delivery challenges. Some programmes experienced delays driven by infrastructure, supply chain and regulatory constraints. This was most evident across ZEHID projects and two of the three TVH projects, which reported slippage against planned timelines. One ZEHID project (HyHaul) closed in December 2025 after delivering most work packages but failing to meet all milestones due to insufficient customer commitments for fuel cell HGVs. However, Wave 3 evidence indicates improvement in outlook for one ZEHID project following earlier changes in project governance. More broadly, delivery continued across all active projects, with substantial activity achieved, albeit in some cases over slightly longer timeframes than originally envisaged.

Moreover, beneficiary evidence across both Waves 2 and 3 presents a more positive picture. While early delays were widely acknowledged, many projects reported accelerating delivery as implementation progressed. These delays should also be seen in the context of overall performance, with almost three quarters of projects assessed as being on or ahead of schedule.

Administrative burdens remain a challenge, particularly for smaller organisations, alongside ongoing cash-flow constraints for SMEs, reinforcing calls for more flexible funding, standardised reporting and improved digital tools. That said, Wave 3 findings highlight tangible improvements, including more efficient processing of project change requests and issues resolved with the online portal.

Future outlook and long-term impact

As part of evaluating longer-term outcomes, findings across the portfolio show broadly similar patterns of regulatory engagement and emerging societal impacts. Beneficiaries commonly report having engaged with regulatory stakeholders through their projects, with a substantial share indicating that their work has influenced developing regulatory approaches. There is also consistent evidence across Waves that many projects are contributing to solutions with global export potential and that early societal benefits, such as reductions in the carbon impact of transport, are beginning to materialise.

Looking to the future, the portfolio is well positioned to deliver lasting societal benefits. Beneficiaries are optimistic about the potential for their technologies to reduce the carbon impact of transport, achieve global export success, and deliver broader environmental improvements. Engagement with regulatory stakeholders has been high, and a significant proportion of projects have contributed to regulatory updates, particularly in emerging areas such as hydrogen safety and autonomous vehicle standards. For example, through the ZEHID programme, close collaboration with DfT and a cross-industry panel has helped to consolidate industry evidence and inform ongoing DfT work to explore potential updates to HGV weights and length regulations, supporting the future deployment of electric and autonomous vehicles. For the CCAM programme, research has produced insights on the potential users of autonomous buses, which can support decision-making at regulatory level.

The portfolio will continue to focus on real-world demonstrations, stakeholder engagement, and regulatory collaboration, with further research and reporting planned for the coming year.

Moving forward, it is essential to build on the insights and momentum from the three Waves of fieldwork. A series of follow-on activities is recommended, including dissemination of findings, ongoing monitoring, evaluation plan updates, and a follow-on impact evaluation. This evaluation will provide insight into longer-term outcomes, ensure lessons are fully captured, and support robust, evidence-based guidance for future programme design.

Conclusion

In summary, the LMT portfolio has made strong progress in advancing innovation and decarbonisation across the UK transport sector. Its achievements in technology development, partnership building, commercialisation, and organisational growth provide a solid foundation for continued impact. By maintaining a focus on flexibility, collaboration, and stakeholder engagement, the portfolio is well placed to sustain its momentum and maximise its contribution to the transformation of UK transport. A summary of the evaluation findings can be seen visually overleaf.

1 Introduction and methodology

1.1 Steer-ED and Technopolis were commissioned by Innovate UK (IUK), in partnership with the Department for Transport (DfT), to carry out a monitoring study for the Land and Maritime Transport (LMT) portfolio and seven of its constituent programmes, designed to deliver funding for transport innovations.

1.2 This document represents the portfolio report, presenting the evidence collected to date to assess the implementation and effectiveness of IUK's LMT portfolio and to support long-term evaluation of its impact. It brings together findings from three Waves of research across the seven constituent programmes and competitions to date, offering a consolidated view of progress, emerging outcomes, and areas for further learning.

Background

1.3 In January 2018, IUK published the Evaluation Framework Corporate Report (EFCR)[4], which demonstrates its commitment to evaluating its funding programmes to understand and improve the effectiveness and efficiency of its activities and to assesses its impact on business and the economy. In line with guidance in the EFCR, Steer-ED was commissioned in November 2021 to conduct an evaluation scoping project on behalf of the LMT portfolio and its seven grant-funded programmes. The commission resulted in the delivery of a monitoring and evaluation framework. This framework presented logic models for each programme and the portfolio as a whole. It also proposed a comprehensive monitoring and evaluation strategy, including methodologies to be used and metrics to be collected to understand the implementation and impact of the portfolio.

1.4 Following completion of the monitoring and evaluation framework, Steer-ED and Technopolis were commissioned in November 2023 to implement the monitoring framework for the LMT portfolio. The purpose of this commission is to provide robust, evidence-based monitoring and evaluation of the LMT portfolio to track its progress, validate assumptions, and deliver insights into its likely impact. The key stages are as follows:

- **Wave 1:** Delivery of the monitoring plan (June 2024) and the interim monitoring report (November 2024), each provided as separate documents.

[4] IUK-061221-EvaluationFrameworkV2FinalWeb.pdf

- **Wave 2:** Production of six programme level reports[5] (October 2025) and a portfolio level report synthesising findings across programmes.
- **Wave 3:** Production of the Maritime programme report, updated programme level reports for ZEHID, CCAM, TVH and FOAK, along with an updated portfolio report covering all programmes, including those with extended timelines (this report).

Introduction to the LMT portfolio

1.5 The LMT portfolio spans a range of technologies, transport modes (including rail, road and maritime), and objectives. Throughout this report, the following terminology is used to describe the delivery structure:

- The **portfolio** refers to the collection of seven grant funding programmes.
- Each **programme** has been individually designed, with its own funding sponsor, and focuses on a specific technology or transport mode. Programmes are delivered via one or more competitions.
- **Competitions** are calls for applications, where innovation grant funding is offered to support eligible projects.
- Each successful **project** is supported, following a successful competition application, to explore or demonstrate a specific technology. Each project is delivered over an agreed timeframe and to an agreed specification. Appendices A-G cover a selection of programme-specific project case studies and should be read alongside the main body of text within this report.

1.6 The seven grant-funding programmes vary in objectives, size, complexity and duration. Constituent projects can range from single applicant six-month feasibility studies costing approximately £25k to deliver, to four-year multi-partner collaborative research and development (R&D) projects costing millions of pounds. The seven programmes which make up the LMT portfolio are as follows:

- The **Maritime Decarbonisation programme**, a core constituent of the UK SHORE[6], is the largest programme in the portfolio in terms of funding, and comprises six competitions, exploring technologies to support decarbonisation of the maritime industry.
- The **Zero Emission HGV and Infrastructure Demonstrator (ZEHID) programme** is the second largest programme within the portfolio in terms of funding, and comprises four demonstrator projects, exploring decarbonisation of HGVs in an operational context.
- The **Commercialising Connected and Autonomous Mobility (CCAM) programme** comprises two competitions – one covering deployment of connected and autonomous mobility (CAM), and one covering the CAM supply chain.
- The **Tees Valley Hydrogen (TVH) Transport Hub programme** consists of a single competition, demonstrating the use of hydrogen powered vehicles and refuelling in commercial settings within the Tees Valley region.

[5] Wave 2 fieldwork did not include the Maritime programme, as it was subject to concurrent studies. Maritime fieldwork was therefore rescheduled and undertaken according to the Wave 3 timeline.

[6] The UK Shipping Office for Reducing Emissions - programme in the DfT that has allocated £240 million R&D funding to develop clean maritime technologies.

- The **Rail First of a Kind (FOAK) programme** comprises a large number of smaller projects from distinct competition rounds to support innovation in the rail industry. It makes use of public procurement-driven innovation[7] and builds on a legacy of past FOAK competitions.
- The **Net Zero Propulsion (NZP) programme** comprises of a single competition, and explores future propulsion technologies for the transport sector (which could be applicable in the maritime, rail, automotive, or aerospace sectors).
- The **Transport Decarbonisation Demonstrator (TDD)** is the smallest programme in the portfolio in funding terms, and involves working with local authorities to develop place-based solutions to transport decarbonisation.

1.7 Further details about the programmes are provided in Chapter 2. All programmes are funded by DfT, with two exceptions:

- the CCAM programme is funded by the Department for Business and Trade; and
- the NZP programme is funded internally by IUK.

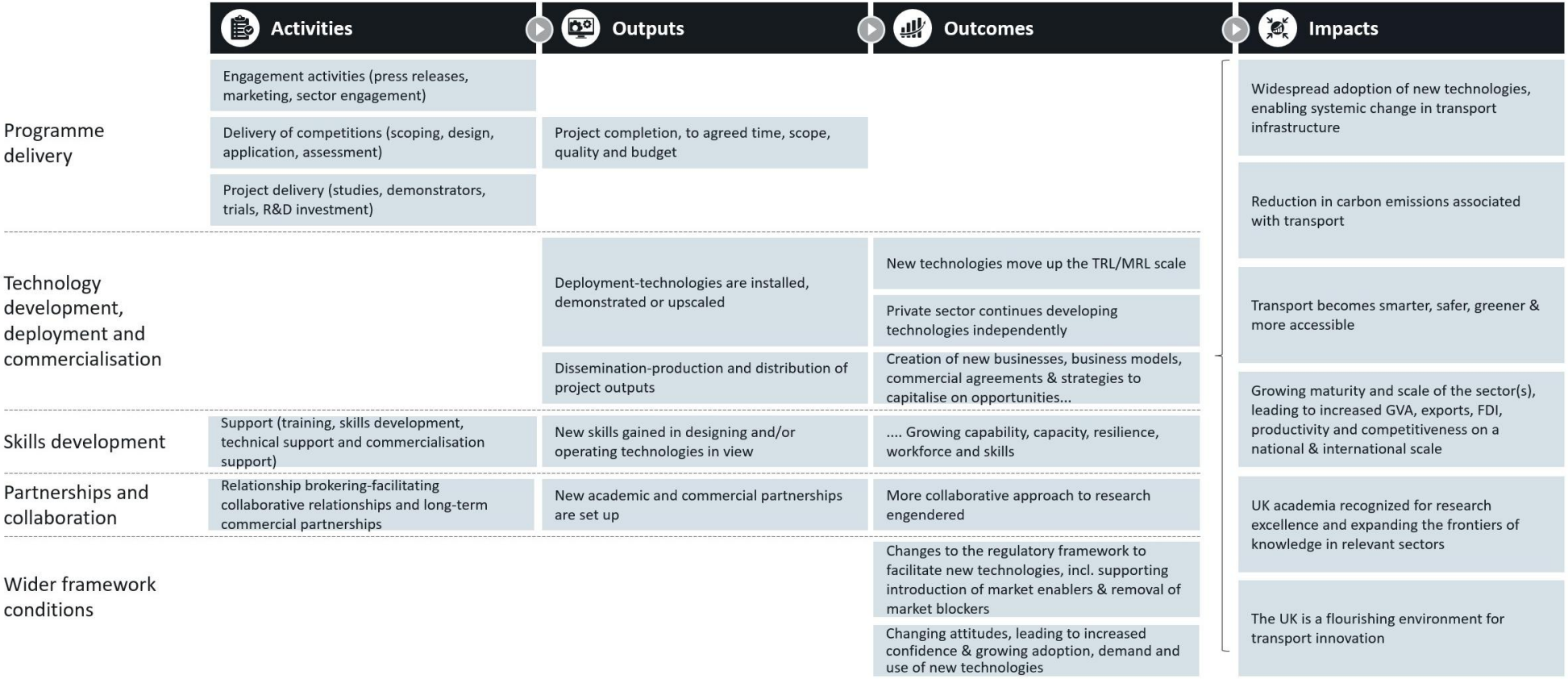
1.8 It should also be noted that several of the programmes contribute to wider departmental strategies that are not delivered through IUK.

The LMT portfolio logic model

1.9 Figure 1-1 presents the portfolio logic model that was developed as part of the original scoping commission. It shows the causal relationships between activities conducted and how those are expected to lead to long-term programme impacts, via outputs and outcomes. The logic model is divided into five themes, reflecting five key underlying mechanisms: programme delivery; technology development, deployment and commercialisation; skills development; partnerships and collaboration; and wider framework conditions. Each of the subsequent chapters of this report is titled after one of these five themes, providing a structured exploration of the causal mechanisms.

[7] The FOAK programme is the only programme in the portfolio which makes use of the IUK 'Contracts for Innovation' mechanism (formerly known as the Small Business Research Initiative). Competitions are funded by UK government departments and agencies to meet specific needs, with the aim that the solution will be procured by the department/agency if suitable.

Figure 1-1: LMT portfolio high-level logic model



Source: Steer-ED and Technopolis, 2024

Methodology adopted for this monitoring commission

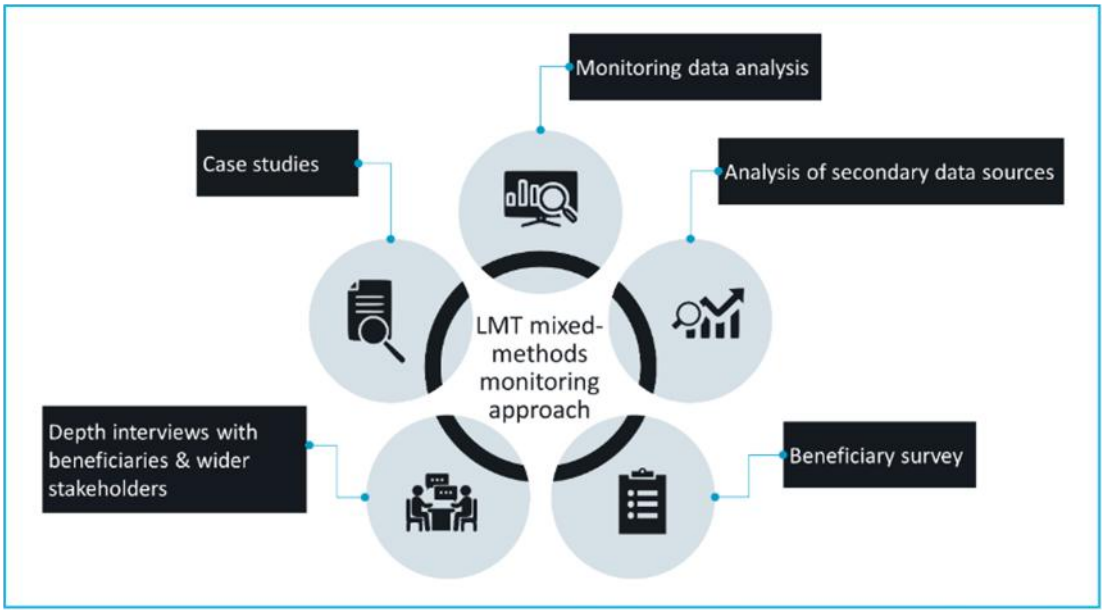
1.10 Fieldwork was conducted over a three-year period and structured into three Waves of activity, referred to as Waves 1, 2 and 3, with the following timescales:

- **Wave 1:** Fieldwork took place between July and August 2024, covering all seven programmes.
- **Wave 2:** Fieldwork took place between July and September 2025. Note, this was not inclusive of Maritime due to concurrent studies at the time.
- **Wave 3:** Fieldwork took place between January and February 2026, focusing on Maritime, extended projects (CCAM, ZEHID and TVH) and the additional FOAK25 competition.

1.11 This report brings together evidence collected across all three research Waves[8], providing a consolidated account of findings to date. It builds on the Wave 2 findings and incorporates newly available evidence from Wave 3.

1.12 Figure 1-2 sets out the five types of evidence collection utilised for this monitoring commission. These evidence strands were selected to provide a broad and deep understanding of the portfolio, triangulating across a range of qualitative and quantitative research methods, and gathering inputs from a range of different perspectives.

Figure 1-2: Sources of evidence utilised within the monitoring approach



Source: Steer-ED, 2024

1.13 A detailed description of the scope and coverage of methods deployed across the portfolio is presented in Appendix H, and is briefly summarised within the following subheadings.

[8] Wave 1 research helped form the foundation for the subsequent Waves. While it provided important context, the findings presented in this report are mainly derived from Waves 2 and 3.

Monitoring data analysis

1.14 Three forms of programme monitoring data are captured by IUK and were provided to Steer-ED for analysis, as follows.

Applicant information data

1.15 Basic 'demographic' data covering organisations awarded funding, providing a comprehensive overview of the competitions that have been run. The data includes each beneficiary's name, project name, project description, competition programme, the total amount of funding, which was initially bid for, the grant funding amount provided, and project start and end dates.

Quarterly Monitoring Scores (QMS) monitoring reports

1.16 These are quarterly assessments undertaken by external monitoring service providers; typically, industry professionals who are knowledgeable about the technology in question and are contracted by IUK to provide an independent assessment of project progress on a quarterly basis. Their assessment covers the project's scope, time, cost, exploitation, risk, and project management. Officers score each of these project aspects as well as providing commentary as to the reasoning behind their scores. This provides an independent account of project progress, which can be triangulated against self-reported information.

Data captured via IUK's impact management system (IMS)

1.17 IMS is a data collection system which is in early implementation across all IUK programmes. It captures data upon project commencement, during project delivery, and following project completion, and is provided in the form of short-answer multiple choice quantitative, or character-limited free-text responses.

1.18 It covers subjects including patents, technology progression and partnerships (amongst others) and provides data collected in a more consistent manner across programmes, with some variation where appropriate. This consistency allows for comparability and offers an additional data point to triangulate with our own data collection.

1.19 IMS data for Wave 2 was available for only four programmes: FOAK (FOAK 2023 competition), CCAM Deployments and Supply Chain, NZP, and TDD. For Wave 3, IMS data was provided for only three programmes: CCAM, FOAK (specifically the FOAK 2025 competition), and Maritime.[9]

Analysis of secondary data sources

1.20 Where appropriate, three sources of secondary data have been analysed at programme level:

[9] The scope and completeness of the data also varied across these programmes. In particular, FOAK beneficiaries were asked fewer questions than CCAM beneficiaries, resulting in uneven data coverage.

- **Crunchbase**[10] is a platform that provides in-depth company information and data. By aggregating data from various sources, it creates comprehensive company profiles that include key information such as funding. For Wave 2, of the ~430 unique organisations participating in LMT projects, we were able to identify 215 (50%) in Crunchbase (while an additional search in Wave 3 identified 25% of Maritime and 18% of FOAK projects).
- **Meltwater** is a media monitoring and analytics platform and was used to assess the public dissemination of LMT projects. The data collection for each project covered the past year, capturing online news and print, as well as social media activity on platforms, blogs, and forums. Wave 2 data collection was conducted between 12 August 2024 and 12 August 2025. Wave 3 data collection, covering the Maritime and FOAK25 programmes, took place between 30 January 2025 and 29 January 2026.
- **Dimensions** is a comprehensive research database that provides patent and publication data. Within the Dimensions database, patent and publications were identified for some of the LMT programmes, but these were limited. For example, only Maritime and FOAK[11] were associated with patents and only Maritime, FOAK and CCAM were associated with publications within the dataset. This is expected to be an underrepresentation, as some patents may not be easily identifiable as being related to a specific project, and therefore may not be captured by the Dimensions database. Dimension data was therefore only included for programmes where patents and publications have been linked.[12]

Beneficiary Surveys

1.21 An online survey of beneficiaries was developed and distributed to all project beneficiaries during each of the research Waves across the full portfolio, amounting to **582 recipients.** Both project leads and partners were invited to complete the survey, meaning that multiple responses could be captured from each project. The survey included a range of multiple choice and free text questions and allowed for the gathering of valuable additional data beyond the core data collected by IUK via IMS, QMS monitoring reports and applicant information data.

1.22 Tailored surveys were developed for each programme, with additional variation depending on whether a beneficiary had responded in the previous Wave. As a result, the number of questions varied slightly across programmes and respondent groups. However, the core survey questions remained consistent, ensuring comparability.

[10] Crunchbase data has been included in Appendix H. Although it provided some useful insights, the number of organisations identified as raising further funding was limited, making it premature to draw conclusions about any link between funding achieved and LMT.

[11] Dimensions data for FOAK22 and FOAK23 were supplied in Wave 2. FOAK25 awards were not available on Dimensions or Gateway to Research, likely because the rail award is more recent. As a result, no linked data on patents or publications for this competition have been included in this report.

[12] This data was based on metadata [as of 01/09/2025 for Wave 2 and 10/02/2026 for Wave 3] from Digital Science's Dimensions platform, available at https://ukri.dimensions.ai/. Access was granted under licence agreement with UKRI.

1.23 The survey response rates for each Wave are shown below[13]:

- **For Wave 1:** The survey was open for a period of approximately three weeks from 15 July 2024 to 3 August 2024 (for six programmes) and for approximately four weeks between 16 September 2024 to 11 October 2024 for the TDD programme. Overall, the survey was issued to 464 recipients across the portfolio (236 responded), resulting in a **response rate of 51%.**
- **For Wave 2:** The survey was open for a period of approximately six weeks from July to September 2025, issued to 220 recipients across the portfolio (145 responded), resulting in a **response rate of 66%.**
- **For Wave 3:** The survey was open for approximately four weeks between January and February 2026, issued to 347 recipients across the portfolio (201 responded), resulting in a **response rate of 58%.**

Depth interviews with beneficiaries and wider stakeholders

1.24 The qualitative research component comprised one-hour, semi-structured depth interviews conducted with programme beneficiaries and a selection of wider stakeholders. The interviews were held using MS Teams and were guided by a topic guide.

1.25 A total of **183 interviews were undertaken with project beneficiaries** (project leads, and in some cases project partners) during the three-year LMT research period (see Appendix H for further breakdown). The number of interviews undertaken varied by programme, in accordance with the number of stakeholders involved in the programme. The Maritime, CCAM and ZEHID programmes were a key focus for beneficiary interviews, due to the extensive number of beneficiaries involved within each.

1.26 Interviews with wider stakeholders took the same format and were conducted with a selection of knowledgeable industry stakeholders (from both commercial and academic institutions), based on recommendations by IUK and programme sponsors. In total, **118 interviews with wider stakeholders** were completed across all three research Waves combined. Priority was given to programmes with the largest funding allocation, and therefore Maritime, ZEHID and CCAM were a key focus for wider stakeholder interviews.

1.27 Interview notes were either manually coded or analysed using the qualitative analysis software Atlas.ti, which was used to process and synthesise findings. Both approaches followed a coding framework aligned with the study's research questions and topic guide to ensure consistency. Insights from these interviews, supported by quotations, are presented throughout this report.

Case studies

1.28 A total of **21 case studies** have been developed for the monitoring commission (two, three or four case studies for each programme). These are presented as vignettes throughout the report and as separate full write-ups within the appendices. The case studies were developed through interviews with project leads and supporting desk research. All case studies have been reviewed by the programme's independent panel of

[13] Survey response totals vary across questions because some beneficiaries did not complete every item. Throughout the report, the base number of responses is shown for each question to aid interpretation. Appendix H provides a detailed breakdown of response rates by programme.

subject-matter experts, selected for their expertise in relation to the programme or technology in question. This provides a valuable external perspective on the importance and potential long-term impact of the technology in question.

Methodological considerations

1.29 The key methodological considerations are as follows, which should be considered against the findings within this report:

- **Heterogeneity of the portfolio:** The programmes within the portfolio vary significantly in terms of scale, technology, and commercial readiness. Applying a consistent methodology across the seven programmes is therefore challenging. To address this, we sought to achieve a balance between providing consistent research tools across the portfolio, while also allowing for some tailoring to reflect the differences between programmes. Individual programme-level reports, detailing programme-specific findings, have also been produced and are being published.
- **Dependency on self-reporting:** although multiple sources of evidence have been examined, including consultation with wider stakeholders and industry experts, there is nonetheless an emphasis on understanding impacts via discussion with – or reporting by – project beneficiaries. Beneficiaries may sometimes emphasise positive outcomes or focus less on challenges, resulting in findings which could over-state the true impact of the portfolio. Wherever possible, the views of wider stakeholders and industry experts have been used to triangulate beneficiary viewpoints to mitigate this risk.
- **Many technologies are still at the early stages of development,** meaning long-term impacts have not yet occurred. Many impacts are unlikely to emerge until several years after projects have completed. For innovation funding, numerous steps occur between initial project funding and measurable market outcomes. The findings gathered at this early stage (even if project have closed) should therefore be considered indicative of a longer-term trajectory rather than conclusive.
- **Survey fatigue among respondents:** Repeated surveys of beneficiaries can lead to fatigue, causing lower response rates or incomplete responses and reduced data quality. This risk has been managed via briefing sessions with beneficiaries and proactive management of communications to ensure stakeholders understand the purpose of the research and benefits of participating. Across the portfolio, the beneficiary survey achieved overall project response rates of 51% in Wave 1, 66% in Wave 2 and 58% in Wave 3 which is considered good representation (programme specific breakdowns are outlined in Appendix H).
- **Response rates across programmes:** The report presents portfolio-level findings across the seven programmes. It should be noted that response rates varied between programmes, meaning analysis is not based on a complete sample of all projects or organisations within each programme. Full details of programme-specific response rates across waves are provided in Appendix H.

Structure of this report

1.30 The remainder of this report aligns with the key themes set out in the evaluation logic model and is structured as follows:

- **Chapter 2: Portfolio overview and current delivery progress** outlines the current status of the portfolio and presents the progress made across the programmes.
- **Chapter 3: Building and strengthening partnerships through programme delivery** focuses on how the programmes have fostered partnerships across industry, academia and government.
- **Chapter 4: Development, commercialisation and deployment of new technologies** explores the progress made by projects in developing new technologies and progressing on the pathway to commercialisation.
- **Chapter 5: Growing organisational maturity and employment through programme delivery** assesses the impact of the programmes on enhancing skills and growing businesses and organisational capacity and capability.
- **Chapter 6: Looking ahead: potential impacts on wider framework conditions and long-term outcomes** discusses the potential long-term impacts of the LMT portfolio on broader industry and regulation.
- **Chapter 7: Conclusions and next steps** concludes the report.

2 Portfolio overview and current delivery progress

Key Messages

- The LMT portfolio comprises seven programmes with distinct objectives and delivery approaches. The portfolio comprises 203 projects, across which a total of £445 million has been invested.
- Most projects have closed (170), but 33 remain active due to delivery extensions, a longer planned timeframe for ZEHID, or additional FOAK projects (FOAK25). Scale and focus vary significantly across the seven programmes.
- Funding ranges from under £60k for concept development to over £60m for major demonstrators, with timelines spanning short-term contracts to multi-year demonstrations continuing into the next decade.
- Most projects met or exceeded objectives. ZEHID and TVH faced delays and re-scoping in some instances, but beneficiaries interviewed indicate challenges have been addressed and progress is strong as delivery has matured.
- Beneficiaries valued clear application processes and strong delivery support from IUK. However, smaller organisations continued to face resource pressures and administrative burdens.
- Common early-stage delivery challenges, including portal issues and delays in processing project change requests, were largely resolved over time.
- Monitoring requirements were generally viewed as proportionate and increasingly evidence-based, with quarterly review meetings widely praised for supporting alignment, delivery momentum, and early risk mitigation.
- Monitoring was also well supported by Monitoring Service Providers (MSPs), though beneficiaries highlighted scope to improve consistency between MSPs.
- Key suggestions for improvement include greater flexibility in timelines and funding, standardised reporting approaches, and streamlined processes tailored to project scale and complexity.

Introduction

2.1 This chapter provides a detailed overview of the LMT portfolio, outlining the objectives, timelines and key features of the portfolio. It also reflects on beneficiaries' delivery experience, including barriers, enablers and lessons learned. The chapter draws on insights from analysis of the beneficiary survey, project monitoring data and conclusions drawn from depth interviews with project beneficiaries.

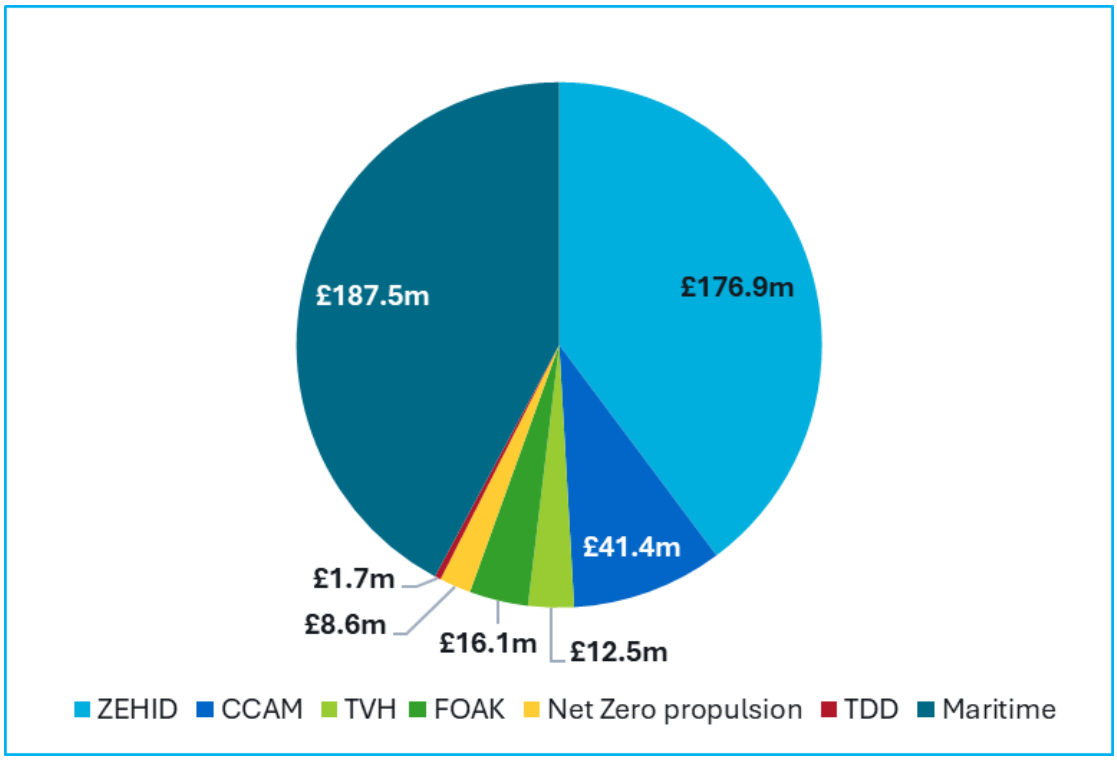
Portfolio overview and programme delivery status

Overview of portfolio

2.2 A total of **£444.7 million** is being allocated across the portfolio, supporting 203 projects across all three Waves. A breakdown of funding by programme is presented in Figure 2-1. While programmes differ in objectives and the technologies they prioritise, they also vary significantly in scale, project number, and funding levels.

2.3 For instance, the grant funding provided by IUK ranges from £59,450 for the Axle Mounted Motor for Retrofit to Diesel Multiple Units (DMUs) within the FOAK programme, to £62.65 million for Project Electric Freightway under the ZEHID programme. Notably, Maritime comprises 87 projects in the scope of this research[14] and accounts for 42% of total portfolio funding, while ZEHID comprises three projects and accounts for 40% of total funding.

Figure 2-1: Funding by programme as of 2026



Source: Steer-ED analysis of project monitoring data (March 2026)

2.4 Table 2-1 summarises the programmes, detailing the number of projects, competitions, and sources of funding. This underscores the diversity across programmes in terms of overall investment scale and funding source. Notably, CCAM is the only programme within the LMT portfolio that receives funding from the Department for Business and Trade (DBT).

[14] This encompasses projects funded under CMDC Rounds 2–4 and ZEVI projects.

Table 2-1: Summary of programme funding

Programme	Number of competitions	Number of projects	Grant funding (£m's)	Source of funding
ZEHID	3	4[15]	£176.9	DfT, IUK
CCAM	2	19	£41.4	DBT, DfT
TVH	1	3[16]	£12.5	DfT
FOAK	3	69	£16.1	DfT
NZP	1	14	£8.6	IUK
TDD	1	7	£1.7	IUK, DfT
Maritime	6	87	£187.5	DfT
Total		**203**	**£444.7**	

Source: Steer-ED analysis of project monitoring data (March 2026)

2.5 The programmes within the portfolio each have distinct characteristics and deliver a wide range of activities. These differences reflect variations in strategic focus, technology maturity, transport modes, and delivery approaches. Appendix I provides a brief overview of each programme, highlighting their objectives, delivery mechanisms, and areas of innovation.

Progress with Delivery

2.6 Of the 203 projects in the portfolio, **170 have now closed**, with the remaining **33 still active** (Table 2-2).

Table 2-2: Project status, open or closed

Programme	Number of open projects	Number of closed projects
ZEHID	3	1
CCAM	2	17
TVH	2	1
FOAK	26	43
NZP	0	14
TDD	0	7
Maritime	0	87
Total	**33**	**170**

Source: LMT project list, Steer-ED analysis (March 2026)

2.7 These active projects include 26 FOAK projects, three ZEHID projects, two TVH and two of the 17 CCAM projects. Of the projects still open, they are generally entering a second phase (in the case of ZEHID, the demonstration phase) or continuing due to extended

[15] As of December 2025, the HyHaul project has closed.

[16] Note that one of these projects was terminated in March 2025, while a second was suspended in March 2026. The suspension occurred after the Wave 3 fieldwork and drafting of this report and so is not reflected in subsequent analysis.

timelines, while the 26 active FOAK projects form part of the FOAK25 competition, which concludes in March 2026.

2.8 The first projects began in October 2022 (under FOAK22), and the last scheduled end date is March 2031, reflecting the long-term nature of the three active ZEHID projects.

2.9 Some projects have required timeline extensions, particularly in the CCAM and TVH programmes.

- **CCAM:** Most CCAM projects (16 out of 19) have been granted extensions ranging from two months to a year (averaging six months). Originally expected to conclude by April 2025, eight of these projects were still ongoing as of early November 2025. All are now expected to complete by the end of March 2026. Extensions were granted where projects required additional time due to external delivery challenges or where further funding supported the delivery of additional outputs.
- **TVH:** Two of the three projects, ZEHyDA-2 and the Teesside International Airport Hydrogen Refuelling Hub, also extended their timelines, though without additional grant funding.

2.10 Two projects have also been terminated due to ongoing delivery challenges:

- **TVH:** The Tees Valley Hydrogen Vehicle Ecosystem (HYVE), was terminated in March 2025 after early delivery challenges, including the withdrawal of key partners and difficulties in securing early customer commitments. In March 2026 (after the current Wave of research) the Teesside International Airport Hydrogen Refuelling Hub was also suspended, due to delays in delivery.
- **ZEHID:** The HyHaul project has closed. Although progress was delivered across four of the programme's five work packages, the project was unable to secure sufficient customer commitments for fuel cell HGVs and thus did not meet the milestones for this work package.

Project timing

2.11 Figure 2-2 shows monitoring officers' score for project timing (charts showing data by programme can be found in the respective reports). Across the portfolio, **72% of projects scored either a four or five**, indicating that the project was **either meeting or running ahead of its planned timetable**. This represents an improvement upon Wave 1, where 66% of projects achieved these scores. The latest QMS data from Wave 3 (March 2026) shows a broadly consistent position, with **68% of projects reported as meeting or exceeding their planned timetable.**

2.12 However, in **Wave 2 the remaining 28% of projects received a QMS score signalling risk**; either milestones were at risk of being missed or had slipped by three months or more. These risks were particularly concentrated within the ZEHID and TVH programmes, where all four ZEHID projects and two TVH projects reported slippage, a pattern also observed in Wave 1.

2.13 Wave 3 findings echo this picture. **QMS data indicates that a similar proportion of projects (32%) continued to report being at risk or having experienced milestone slippage of three months or more**. The overall assessment for ZEHID and TVH projects remained largely unchanged, with only one ZEHID project reporting an improved outlook.

2.14 Delays across the ZEHID programme in Wave 2, as reported by beneficiaries, were largely driven by infrastructure-related challenges, including late-stage planning issues, complex

grid connection requirements, and difficulties securing or coordinating key delivery partners. These issues often led to slippage in charging infrastructure timelines, compounded in some cases by changes in project leadership or delivery partners, and by limited availability of suitable vehicles or suppliers. For example, for Project Electric Freightway, grid connection costs and complexity, such as the need for costly feasibility assessments, were a key barrier. Wave 3 findings generally reinforced infrastructure delays as a persistent constraint on ZEHID delivery.

> *"[In terms of charging depots at public sites] We're about to start building them but come across grid connection costs. You can't just drive a cable over a bridge; you need an extra £60k and a three-month feasibility assessment to assess the strength of the bridge"* – Wave 2 ZEHID beneficiary

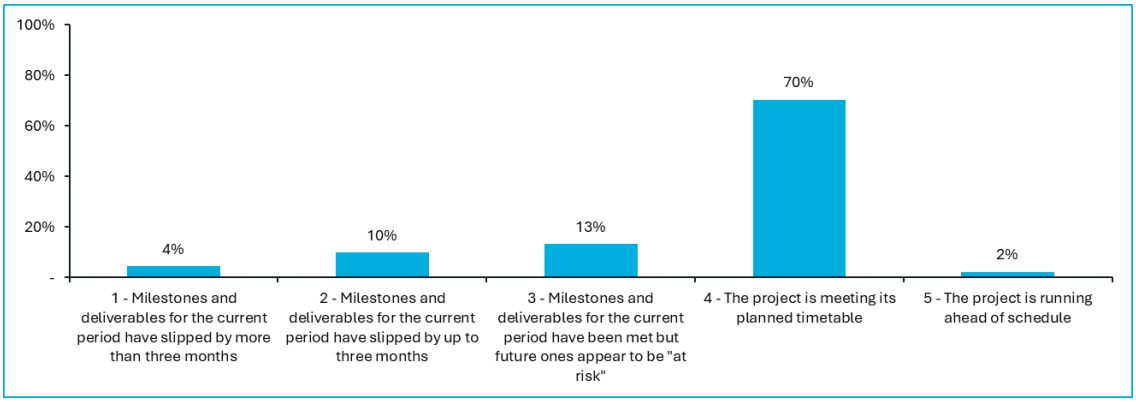
2.15 As ZEHID projects progressed into the deployment phase, Wave 3 also highlighted emerging challenges around the alignment of infrastructure delivery and vehicle readiness. In some cases, this misalignment resulted in deferred vehicle orders or completed infrastructure without deployable vehicles. However, beneficiaries reported that progress had improved more recently. For example, one project noted that delays initially arose from attempting to manage all infrastructure delivery activities in-house; following a revised delivery approach, both progress and confidence increased.

> *"Our biggest challenge has been aligning vehicles being built with infrastructure being ready."* – Wave 3 ZEHID beneficiary

2.16 For TVH projects, delays were largely driven by two factors: the limited availability of operational airside vehicles and the time required to convert these vehicles to hydrogen, alongside the prolonged process of securing planning permission for the refuelling site at Teesside International Airport. For projects involving public transport infrastructure, such as TDD, access to local authority journey data emerged as an additional challenge, significantly slowing delivery. This data was critical for TDD because the programme aimed to pair businesses with local authorities to demonstrate R&D solutions through place-based trials, making accurate journey information essential for planning and validating these interventions.

2.17 Wave 3 QMS findings are consistent with these reported challenges, with affected projects continuing to report being at risk or having experienced slippage. In particular, delays associated with securing planning permission were found to have knock-on effects on subsequent milestones.

Figure 2-2: Most recent QMS score for the timing of LMT portfolio projects (n=91)



Source: QMS data (IUK), Steer-ED analysis (August 2025)

2.18 While QMS data indicates that a proportion of projects remain at risk or have experienced slippage, beneficiary interviews across both ZEHID and TVH present a more positive picture of progress. In part, this discrepancy may reflect timing effects between formal monitoring and beneficiary reporting. For example, the latest QMS data for ZEHID projects was reported between February and June 2025, whereas beneficiary interviews were conducted in mid-September. While beneficiaries acknowledged initial delays, many reported that progress had since accelerated and that projects were now advancing within the agreed funded period.

> *"Over the course of project, there has been a general increase in the use of hydrogen and curiosity about it. The view we have is that by getting this project over the line, starting to refuel, albeit at a smaller scale, we can start to catalyse the market because people can see a use case happening day in, day out."* – Wave 2 TVH beneficiary

2.19 Wave 3 ZEHID beneficiary interviews similarly highlighted improving momentum, with several beneficiaries shifting their focus toward the data-capture phase and expressing optimism about the insights this stage will generate.

> *"I mean, we've already learned a lot so far and I know once we start to see the data, we'll be able to build in a nice robust total cost of ownership."* – Wave 3 ZEHID beneficiary

2.20 In addition, differences in perspective may reflect varying levels of optimism and experience. Project leads, who are closely involved in delivery, may take a more positive view of progress, particularly where issues are perceived as resolved or improving. Monitoring officers, by contrast, draw on oversight across multiple projects and may therefore apply a more comparative assessment when judging progress against milestones.

Project spend

2.21 Most projects in Wave 2 closed within budget, with **67 projects (74%) reporting under- or overspend within 10%** (Figure 2-3). However, nine projects show more significant budget variance, with over- or underspend exceeding 21%. This marks a notable improvement

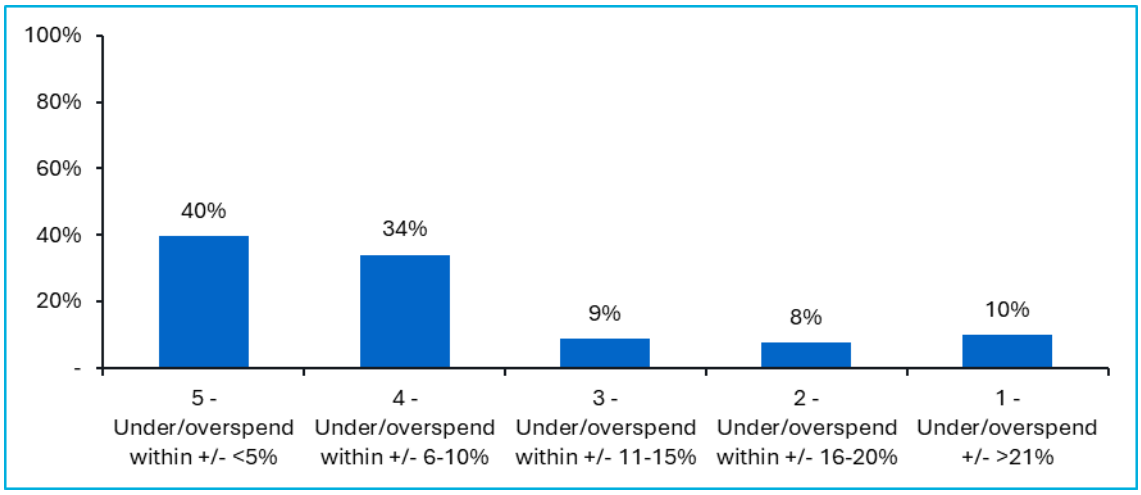
from **Wave 1, earlier in the delivery phase, where only 60% of projects were within the 10% threshold of the agreed spend profile at that point in time**, and 27% exceeded a 21% variance.

2.22 Wave 3 findings largely reflect this position, although with some increased pressure on budgets. **In Wave 3, 61% of projects reported under- or overspend within 10%, indicating a slight reduction compared to Wave 2**. QMS data show that the proportion of projects with significant budget variance exceeding 21% remained unchanged at 11%. However, a larger share of projects (17%) reported a variance of between 11% and 15%, suggesting that more projects are experiencing moderate levels of budget variance, rather than a rise in significant overspend.

2.23 Among the Wave 2 projects reporting over- or underspend above 21%, three were CCAM projects and three were ZEHID projects. For ZEHID, underspend was largely driven by delivery delays, which resulted in fewer claims being submitted, as noted in the MSP reports. This picture was also affected by incomplete claims data, with some participants yet to submit claims despite verbally confirming their spend, making it difficult to determine the true level of underspend. Among projects active in Wave 3, the outlook had improved, with all ZEHID projects reporting a reduction in budget variance.

2.24 For CCAM projects, budget variance was partly linked to resource constraints and delivery delays. However, QMS data also indicates that variance was influenced by gaps in financial forecasting, with forecasts either not submitted by all partners or provided in formats that limited their usefulness. Where CCAM projects reported overspend, some addressed this through Project Change Requests (PCRs) to recover additional costs, while others submitted virement requests to reallocate grant funding from partners reporting underspend. Wave 3 findings indicate an improved position overall, with only one CCAM project continuing to report a significant budget variance of over 21%.

Figure 2-3: QMS scores for the cost of LMT portfolio projects in Wave 2 (n=91)



Source: QMS data (IUK), Steer-ED analysis (August 2025). Wave 2 data excludes scores for Maritime.

Project scope

2.25 As shown in Figure 2-4, Wave 2 findings indicate that most projects have delivered or are on track to deliver against all anticipated objectives, **with 74 projects (85%) meeting or surpassing their objectives**. Notably, five projects, within FOAK and NZP, identified and pursued additional opportunities beyond those outlined in their original proposals. These

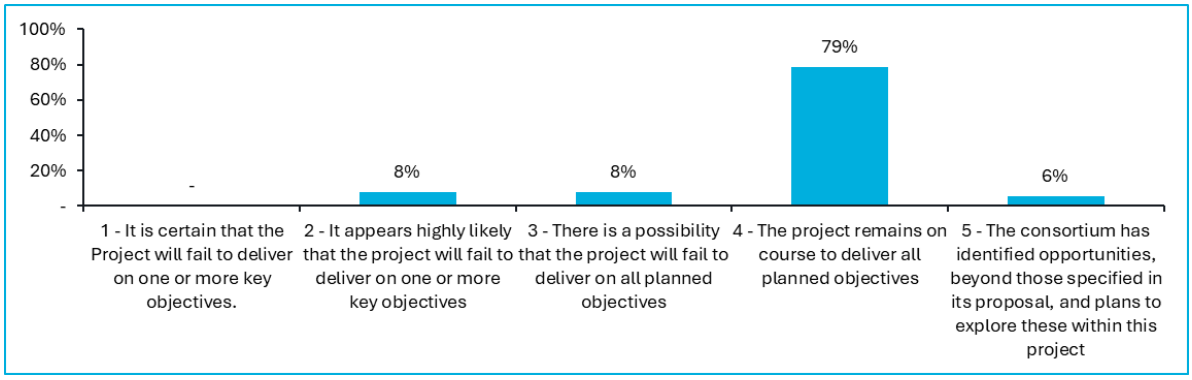
included the technological approach exceeding expectations, such as achieving significant improvements in innovation design, along with added functionality and further product refinements. This is consistent with **Wave 1 results, where 87% of projects also met or surpassed their objectives.**

2.26 Wave 3 findings reinforce this overall outlook. **In Wave 3, 79% of projects were assessed as either on course to meet, or surpassing, their objectives**. In addition, several projects, particularly within the Maritime programme, reported ambitions extending beyond their original scope. Three projects outlined plans to pursue additional opportunities, including progression to major client projects using developed modelling software, completion of full deployment, further evaluation of asset longevity, and development of a tyre pressure monitoring system. Taken together, these findings suggest that delivery performance has remained strong as projects have matured and approached closure.

2.27 However, among the projects assessed in Wave 2 as falling short of their original scope, a large share were in the ZEHID programme. As discussed earlier in this chapter, under-delivery was mainly driven by infrastructure shortfalls, particularly delays to or reductions in charging provision, alongside issues such as partner withdrawals, scope changes, and difficulties securing vehicles or customer demand. Wave 3 QMS data indicates an improvement in this position, with two of the three active projects reporting upgraded scope assessments. In addition, beneficiary interviews across both Wave 2 and Wave 3 suggest that projects remain committed to delivering planned vehicle procurement and infrastructure, albeit within extended timelines aligned to their original objectives.

2.28 Delays were also noted within the NZP programme in Wave 2. While 10 NZP projects achieved their planned objectives by closure, two received a QMS score of two, signalling a high likelihood of missing key milestones. Interview feedback echoed these concerns, highlighting slower progress in trials reliant on third-party involvement or certification windows, particularly among projects focused on net zero propulsion for aircraft. Several partners also reported difficulties in securing airfields willing to host trials, which contributed to narrower scope delivery.

Figure 2-4: Most recent QMS score for the scope of LMT portfolio projects (n=90)



Source: QMS data (IUK), Steer-ED analysis (August 2025)[17]

[17] One project did not have a score for Scope in final MSP report.

TDD case study vignette showcasing progress against initial delays

The IONA Drone Delivery Initiative (see Appendix D.I), funded through the TDD programme, is trialling an unmanned, fixed-wing, tilt-motor electric drone in Argyll and Bute, Scotland.

Initial delays:

Regulatory delays initially hindered progress. The Specific Operations Risk Assessment (SORA) is a framework that aims to provide a structured and internationally aligned approach to assessing and mitigating risks associated with drone operations. Implementation in the UK was originally planned for Q3 of 2024 but slipped to April 2025. This postponement restricted the approval of higher-risk drone operations (including Beyond Visual Line of Sight, BVLOS) and limited data collection for operators with high complexity operations.

Further, Temporary Restricted Areas (TRAs) under the UK Airspace Change Programme remain unapproved, with some applications pending for over 18 months. Without TRAs, operations are confined to ~1.5 km line-of-sight or require observers every 3 km, reducing cost-efficiency. TRAs are also time-limited and non-renewable for the same purpose, making them unsuitable for sustained logistics services.

Progress despite delays:

- Developed detailed operational checklists and safety logs to support future BVLOS trials.
- According to lasts QMS data, scored a four: "on course to deliver all planned objectives."
- Secured strong stakeholder engagement from councils, logistics providers, and community businesses, highlighting demand for improved rural logistics.
- Achieved increased market visibility and reputation through the project, such as via attending a regional conference.

Insights from project application process and administration

Application process

2.29 Across the portfolio, most beneficiaries found the application process to be appropriate and straightforward. This sentiment was consistently echoed across programmes, suggesting a broadly positive experience. Findings from Wave 3 beneficiary interviews also reinforced this assessment.

"The [interview] experience was very good, and they [IUK] were very helpful." – Wave 2 TVH beneficiary

"The process through Innovate UK is really good. We work across grant funding organisations in Europe, UK and Scotland and Innovate UK's process is by far the smoothest." – Maritime Wave 3 Beneficiary

2.30 While experiences varied by organisation and programme, several common themes emerged across the portfolio, helping to explain both the strengths of the application process and areas where beneficiaries experienced challenges.

2.31 A key enabler of positive experiences was prior familiarity with IUK grant programmes. Beneficiaries with previous experience reported that understanding the structure, requirements, and expectations of the process reduced uncertainty and made the application easier to navigate.

> *"Everything has been seamless and helps [... we have] background working with IUK."* – Wave 3 FOAK beneficiary

2.32 In contrast, resource requirements were frequently raised as a challenge, particularly by smaller organisations. These applicants often found the process onerous, especially when compared to larger firms that had dedicated grant-writing resources. This disparity in capacity meant that smaller organisations were at a relative disadvantage in managing the demands of the application. Duplication of information was also a common concern, with beneficiaries noting that similar content was required across the application form and the IUK portal, adding unnecessary complexity and effort.

> *"I mean, for an SME with six staff, it is a total utter nightmare of making these applications because it's so time consuming."* – Maritime Wave 3 Beneficiary

2.33 Beyond resourcing, beneficiaries also raised concerns about how applications were assessed, particularly the balance between the written and interview stages. One striking example involved a beneficiary who ranked last in the written stage but first in the interview, indicating a potential mismatch in how requirements were interpreted or weighted. In response, beneficiaries suggested that written submissions and interviews should be assessed through a more integrated scoring approach rather than treated as separate exercises.

2.34 These observations regarding application format and assessment were echoed in Wave 3 interviews. Beneficiaries suggested refinements to the assessment stage, including introducing interviews earlier in the process to help strengthen application quality. Across programmes, there were also calls for greater involvement of industry experts on assessment panels, with beneficiaries arguing that operational and technical expertise is essential to fully assess the innovation potential and practical impact of proposals.

2.35 In addition to these cross-cutting themes, several programme-specific themes were also evident:

- **Application requirements:** Some beneficiaries highlighted challenges with the application requirements. In CCAM, some felt that certain questions were not well-suited to non-business organisations. Others noted that the rigour of the process and evidence requirements did not scale with competition size, meaning smaller bids faced the same scrutiny as large, multi-million-pound projects. This created perceptions of disproportionate effort. FOAK beneficiaries reported challenges in developing exploitation plans during the bid stage, largely due to limited information

on commercialisation prior to engaging with market stakeholders. While they acknowledged the benefit of having an initial vision, they recommended a lighter-touch requirement as more realistic during early bidding.

- **Timelines:** Across the programme, the application process was generally considered appropriate. However, some beneficiaries highlighted challenges with the December–January application window, which coincided with holiday schedules and year-end activities. This issue was particularly pronounced among TDD beneficiaries, where local authorities, forming a significant proportion of partners for TDD, needed to be secured early to prepare bids effectively. This was also strongly echoed by Maritime beneficiaries. One wider stakeholder noted that short application windows may encourage applicants to adapt existing activities to fit competition criteria, rather than developing genuinely new projects.

"Lots of these technologies and companies are already doing things and almost some of them are shoehorning what they want to do in so they can get funding for it. [....] I don't know if it's intentional or by accident, but it almost feels that it's [the application window] so short that, you've almost got to have the project ready and planned." – Maritime Wave 3 Wider Stakeholder

- **Feedback:** In general, most stakeholders described interview panels as focused and constructive. However, NZP beneficiaries in particular noted that written feedback on unsuccessful applications was lacking in detail, making it difficult to improve the quality of future bids for other UKRI competitions.

"Get immensely frustrated with the bid process... feedback is a problem." – Wave 2 NZP beneficiary

- **Clarity and guidance:** Beneficiaries in the TVH programme praised the clarity of the programme outline and the professionalism of the interview process. FOAK participants also valued the pre-allocation briefing, which provided clear guidance on competition requirements and partner selection, helping teams shape their proposals effectively.

Support, delivery and grant management

2.36 Across all programmes, beneficiaries consistently highlighted positive engagement with IUK throughout the delivery phase. This support was seen as both accessible and proactive, contributing to a strong working relationship between IUK and project teams. In the TVH programme in particular, beneficiaries emphasised the value of IUK-led events designed to foster collaboration and knowledge sharing, with one noting that IUK had played an active role in connecting them with potential clients interested in deploying hydrogen vehicles.

"I really want to stress how hugely impressed I have been with the Innovate UK team... Their commitment and dedication has been amazing and they have done themselves, and Innovate UK, credit." – Wave 2 ZEHID beneficiary

"They set up some good events around networking with people that wanted to be part of the project. They also did some good workshops, with all the suppliers and people that were interested in hydrogen to understand what we were doing." – Wave 2 TVH beneficiary

2.37 This positive assessment of IUK support was reinforced in Wave 3 interviews across programmes, with beneficiaries consistently describing high levels of professionalism, responsiveness, and clarity in guidance provided during delivery.

"[Of IUK] On a scale of 1 to 5, 5 for professionalism." – Wave 3 ZEHID beneficiary

"Innovate UK have been great, they have been very helpful, easy to get hold of, supportive, provided all the guidance we needed." – Wave 3 CCAM beneficiary interview

2.38 Experiences of delivery timelines, however, were more mixed. In FOAK, some beneficiaries felt that greater flexibility would have helped accommodate unforeseen delays, such as site access issues or the procurement of bespoke components. Conversely, others found that the presence of clear milestones and deadlines served as a motivator, helping engineers stay focused and deliver innovation within live operational environments.

"I found the process very, very clear because the objectives were set [but] the timescales were challenging" – Wave 2 FOAK beneficiary

2.39 Wave 3 Maritime beneficiaries echoed this latter perspective, highlighting IUK's flexibility and pragmatic approach to delivery. In particular, IUK's willingness to accommodate evolving project directions, where still aligned with decarbonisation objectives, was seen as supportive of R&D activity, recognising the inherently iterative nature of innovation.

"When you're scoping out a project, particularly if it's a longer project, you don't quite know what direction it goes in. There seems to be good pragmatism that that's fine, which again doesn't necessarily exist everywhere." – Maritime Wave 3 Beneficiary

2.40 In terms of delivery processes, some beneficiaries reported challenges in the early stages of delivery when submitting PCRs. In Wave 2, delays in processing PCRs had knock-on effects for partners' ability to submit claims in a timely manner. However, these experiences largely reflect earlier delivery phases. Since then, significant operational improvements have been implemented. For example, over the past 12 months within the ZEHID programme, all PCRs have progressed to approval within Innovate UK's standard 30-day Service Level Agreement.

2.41 Financial management processes were viewed as straightforward and well-supported. IUK was commended for providing sufficient guidance at the outset of projects, particularly in setting up the funding portal, budgets and forecasts. This initial support helped establish a clear framework for managing grant finances. While some Wave 2

ZEHID and FOAK beneficiaries experienced early IT-related issues with the portal, interviewees noted that these problems have largely been resolved, a view consistently reflected in Wave 3 interviews.

2.42 Despite this, views were more mixed on the flexibility of grant management processes. Across the TDD programme, beneficiaries who faced supply-chain or approval delays felt that there was limited flexibility around extensions or budget rollovers. This was attributed to DfT funding requirements, which constrained IUK's ability to accommodate changes. As a result, some teams found it difficult to adapt their activities and timelines to overcome challenges and demonstrate real-world impact.

2.43 Wave 3 ZEHID interviews added further nuance, highlighting challenges linked to the timing of grant agreements. For some organisations, later contract signing conflicted with internal business planning and financing cycles, requiring co-investment approvals to be re-secured. This misalignment was seen as an added administrative burden, particularly for projects spanning multiple financial years.

2.44 Cash flow emerged as a recurring pressure across several programmes, particularly for small and medium enterprises (SMEs). Beneficiaries noted that managing resourcing and planning activities around quarterly claims and slower payment cycles, often paid in arrears, was a significant burden. This pressure was especially pronounced in NZP, where start-ups and micro-SMEs formed a large share of beneficiaries, and was also echoed by Wave 3 Maritime and FOAK interviewees, who highlighted the challenge of retrospective reimbursement and grants not fully covering evolving costs.

"Start-ups do not have much cash… a partial upfront amount would be very helpful." – Wave 2 NZP beneficiary

---

2.45 Beneficiaries across the portfolio shared a range of lessons and recommendations based on their experiences with support, delivery, and grant management processes:

- **Grant management:** Some project leads in the NZP programme recommended partnering with a university to manage grant administration, helping to streamline processes and free up technical staff for delivery. For ZEHID projects that have partnered with Imperial College London for data gathering and analysis, this was also echoed. In future, this could be replicated across the portfolio, especially for participating SMEs who have noted challenges in onerous administration. A dedicated contingency fund for overspend or unforeseen costs was also suggested to improve project resilience.
- **Portal functionality:** One CCAM beneficiary proposed introducing email notifications for claim approvals to reduce the need for daily portal logins and improve usability.
- **SME cash flow:** Several NZP beneficiaries recommended more flexible funding mechanisms for smaller firms, such as monthly or milestone-based claims. Modest upfront advances were also suggested to help cover early build and test costs, easing financial pressure during initial project phases.

Monitoring and reporting

2.46 Beneficiaries generally found the monitoring requirements to be proportionate and increasingly focused on evidence-based submissions. Rather than relying on lengthy

narrative reports, projects were encouraged, particularly in FOAK, to provide tangible outputs such as photographs, artefacts and data, which was seen as a more practical and meaningful approach.

2.47 Central to positive experiences of monitoring was the role of MSPs, who received widespread praise across all programmes. Interviewees consistently highlighted the quality of support provided, noting the enthusiasm and pragmatism MSPs brought to keeping projects on track. MSPs were regarded as an essential link between project teams and IUK, helping to sustain momentum and ensure compliance. This positive perception mirrors findings from Wave 1, indicating that MSPs have delivered consistent value across both phases and programmes.

"We get good support. We have an excellent monitoring officer from Innovate UK who helps us and we have good contacts directly within the organisation." – Wave 2 CCAM beneficiary

"MSPs were usually very well informed and knew what they were doing. They were enthusiastic and there to help you." – Wave 2 FOAK beneficiary

"The monitoring officer has been an asset, guiding us to make sure we're not doing anything stupid." – Wave 1 ZEHID beneficiary

2.48 Positive views of MSPs were reinforced in Wave 3 interviews, with beneficiaries again emphasising professionalism and engagement. A further theme to emerge was the value of continuity: having the same monitoring officer throughout the project lifecycle was seen as beneficial, as it enabled MSPs to understand the full project journey and provide more tailored and informed support.

"Our monitoring officer has been extremely kind, [...] making sure we are meeting the required industry standard." – Wave 3 FOAK beneficiary

"Monitoring Officers are generally very interested. They're innovation people and, we've had the same Monitoring Officer, which has been quite cool. [They] raise really useful points which have helped our projects." – Maritime Wave 3 beneficiary

2.49 Despite this strong overall picture, some beneficiaries identified inconsistencies in reporting expectations across different MSPs. Preferences around reporting formats were perceived to vary, which some found frustrating. In response, beneficiaries, particularly within FOAK, recommended introducing more standardised reporting templates that could be uploaded directly to the portal, helping to streamline processes and reduce administrative burden. Similar concerns were echoed in Wave 3, particularly among Maritime beneficiaries.

"There's some inconsistency on reporting. Maybe, so some monitoring officers want more reporting than others. Maybe some more consistency there would be good." – Maritime Wave 3 beneficiary

2.50 Monitoring requirements were also felt to be more demanding where projects were subject to multiple reporting and evaluation processes. In ZEHID, this was especially burdensome at the consortium level, where reporting requirements were sometimes duplicative. Data sharing emerged as a key pressure point, requiring projects to navigate multiple agreements and manage evolving or unclear expectations across partners. Wave 3 interviews brought this into sharper focus, with one beneficiary noting that telemetry data requirements, in particular, lacked clarity and evolved over time.

"Now, before we say yes to a grant, if we get offered the grant, we do now look in and go cool. We do have the resources to administer this grant. And that is not innovation. That is not entrepreneurship. That is not small business. That is just the antithesis of all those things. If the numbers change, the numbers change. You're learning as you go." – Wave 2 ZEHID beneficiary

2.51 While reporting requirements created pressure for some, FOAK beneficiaries noted that the structure they imposed was helpful, strengthening accountability and supporting more transparent discussions with monitoring officers.

"[timescales] were always going to be tough but that's actually where the structure [...] and reporting [... has been] very useful because you hold yourself to account, [... and can] have honest conversations [...] with monitoring officer about where we're at on the timeline." – Wave 3 FOAK beneficiary

2.52 Experience of monitoring across the portfolio also varied by organisational capacity. Projects with less experience of IUK grants, particularly smaller organisations, reported greater difficulty navigating monitoring requirements. In programmes like CCAM, first-time project managers and those unfamiliar with grant-funded projects reported uncertainty around what to submit. Beneficiaries in TDD suggested that clearer signposting, including examples and templates, would help reduce confusion and improve compliance.

2.53 The administrative burden associated with quarterly grant claims was also highlighted by beneficiaries across the portfolio. Among TVH beneficiaries, one organisation noted that the requirement for an independent auditor's report was particularly costly for smaller entities, suggesting that more cost-effective alternatives could be considered. Similar concerns were echoed in NZP and ZEHID programmes, where the process was seen as disproportionately demanding for smaller organisations. Wave 3 interviews also highlighted the fact that larger organisations are not exempt from these pressures, with one beneficiary reporting challenges with extensive legal reviews and internal approvals.

"The independent auditor's report is quite challenging, quite costly. That's the part that could probably be done better and more economically." – Wave 2 TVH beneficiary

"The first person you employ is an engineer, not an accountant." – Wave 2 ZEHID beneficiary

"I didn't envisage the amount of separate legal agreements that were needed, I've never spent as much time with our legal team." – Wave 3 ZEHID beneficiary

2.54 Despite these challenges, quarterly review meetings were widely praised. Beneficiaries in CCAM and TVH noted that the meetings provided regular opportunities to present progress, assess risks and address challenges in a timely manner. These meetings were seen as instrumental in maintaining momentum and alignment between project teams, MSPs and IUK.

2.55 However, some programme-level communication gaps remained. Within TVH, beneficiaries noted that earlier clarity on the conclusion of the HYVE project would have been beneficial, given its interdependencies with wider hydrogen transport initiatives. A related concern was reported in ZEHyDA-2, where limited information was available about the progress of the Refuelling Hub project, an initiative expected to supply hydrogen to one of the ZEHyDA-2 sites.

2.56 Overall, monitoring was regarded as effective and reasonable, but with scope to improve consistency and reduce unnecessary process friction.

Conclusion

2.57 The LMT portfolio represents a significant commitment to advancing innovation and decarbonisation in UK transport. It combines diverse programmes with distinct objectives and technologies, enabling progress on multiple fronts, from zero-emission freight to early-stage propulsion and local decarbonisation initiatives. Findings across all three Waves demonstrate how this breadth has enabled innovation across modes while fostering collaboration between industry, government and research partners.

2.58 Delivery has not been without challenge. Timelines have shifted in several areas, driven by external factors such as infrastructure complexity, planning requirements and supply chain constraints. These issues underline the realities of implementing ambitious projects in live environments, where dependencies and unforeseen hurdles can affect progress. Wave 3 findings confirm that some of these pressures have persisted as projects have moved into later delivery and deployment phases. Despite this, projects have continued to move forward, adapting to circumstances and maintaining focus on objectives within revised timelines. This resilience reflects both the commitment of project delivery teams and the support provided by IUK and monitoring providers throughout the process.

2.59 Experiences with the application and grant management processes have been broadly positive, with beneficiaries valuing clarity and responsiveness. Wave 3 consultees continued to highlight the professionalism and accessibility of IUK support. At the same time, feedback highlights a desire among beneficiaries to reduce administrative burden and introduce greater flexibility for smaller organisations. Lessons on cash flow management, reporting consistency and claim processes, reinforced in Wave 3 interviews, highlight areas in which refinement may strengthen future programmes and enhance accessibility for a wider range of participants.

2.60 Monitoring and reporting requirements were generally found to be clear and reasonable. Regular review meetings helped maintain alignment and address risks early, while an increasing emphasis on evidence-based reporting supported more meaningful oversight.

Wave 3 findings reaffirmed the central role of MSPs in sustaining momentum and supporting delivery, while also pointing to scope for greater consistency in reporting expectations and clearer coordination where projects interface with wider programme-level initiatives.

2.61 Overall, delivery progress has been strong but required adaptation to overcome delays and operational challenges. Insights from beneficiaries across all Waves underscore the importance of clear processes, responsive support and collaborative mechanisms in sustaining momentum as projects mature. Lessons around timelines, grant management and reporting will be critical in shaping future delivery models and ensuring the efficient achievement of programme objectives.

3 Building and strengthening partnerships through programme delivery

Key Messages

- Partnership development was a priority and an explicit requirement for all programmes, except FOAK, and therefore represents a central theme across the portfolio.
- Survey evidence indicates strong partnership outcomes. In Wave 2, 77% of beneficiaries reported that their projects had resulted in the creation of new partnerships, while 69% of beneficiaries indicated that existing relationships had been strengthened. In Wave 3, this shifted towards consolidation, with lower reported rates of new partnerships (62%) and higher rates of strengthened relationships (74%).
- Most partnerships evolved from pre-existing networks, with funding acting as the catalyst to formalise new collaboration and define roles, responsibilities and delivery structures.
- Intermediary organisations such as IUK Business Connect, Cenex and the Niche Vehicle Network played a role in connecting potential collaborators and aligning project objectives within some programmes.
- Beneficiaries reported that partnerships enabled access to specialist technical expertise, testing and demonstration facilities and real-world operational environments that would otherwise have been inaccessible.
- Partnerships also supported commercialisation, providing clearer routes to market, improved understanding of customer needs and enhanced credibility with investors and industry partners.
- Many partnerships are expected to endure beyond project completion, with many beneficiaries planning future collaboration through joint bids, scaling activities and building new supply chain and customer connections.

Introduction

3.1 This chapter sets out the role that project delivery has played in building and strengthening partnerships between industry, academia and regulators. It explores the mechanisms through which new partnerships were formed, and the portfolio's contribution to strengthening these relationships. It goes on to describe beneficiaries' accounts of the types of partnerships formed and their anticipated (or realised) benefits.

Overview of partnership formation across the LMT portfolio

3.2 A key objective of the LMT portfolio is to encourage a more collaborative approach to research through fostering new academic and commercial partnerships. As a result, applicants from all programmes, excluding FOAK, were explicitly required to deliver projects in partnership with at least one other organisation. Participating organisations could include businesses, charities, academic institutions, public sector organisations and research and technology organisations.

3.3 While partnership was not required for the FOAK programme, it has nonetheless fostered significant collaboration opportunities and benefits, which are also discussed in this chapter. Table 3-1 below summarises the average size of project consortia across programmes in Wave 2. In Wave 3, all programmes maintained the same number of partners, with the exception of FOAK, which included a total of 69 partners due to the addition of FOAK25 projects. However, the average number of partnerships per FOAK project remained unchanged at one.

Table 3-1: Average number of partnerships per programme

Programme	Average consortium size	Smallest consortium	Largest consortium	Total partners
ZEHID	13.5	5.0	19.0	54
CCAM	5.0	2.0	10.0	95
TVH	4.0	3.0	5.0	12
FOAK	1.0	1.0	1.0	69
NZP	3.0	2.0	6.0	42
TDD	2.9	2.0	4.0	20
Maritime	4.5	2.0	15.0	387

Source: LMT project list, Steer-ED analysis 2025 (Wave 2) and 2026 (Wave 3, maritime only)

3.4 Across all research Waves, beneficiaries were asked the same survey question: *"To what extent has the project contributed to creating new relationships/partnerships or strengthen existing ones?"*. Responses therefore reflect partnership outcomes over the course of the project up to the point of each survey, rather than only since the previous survey.

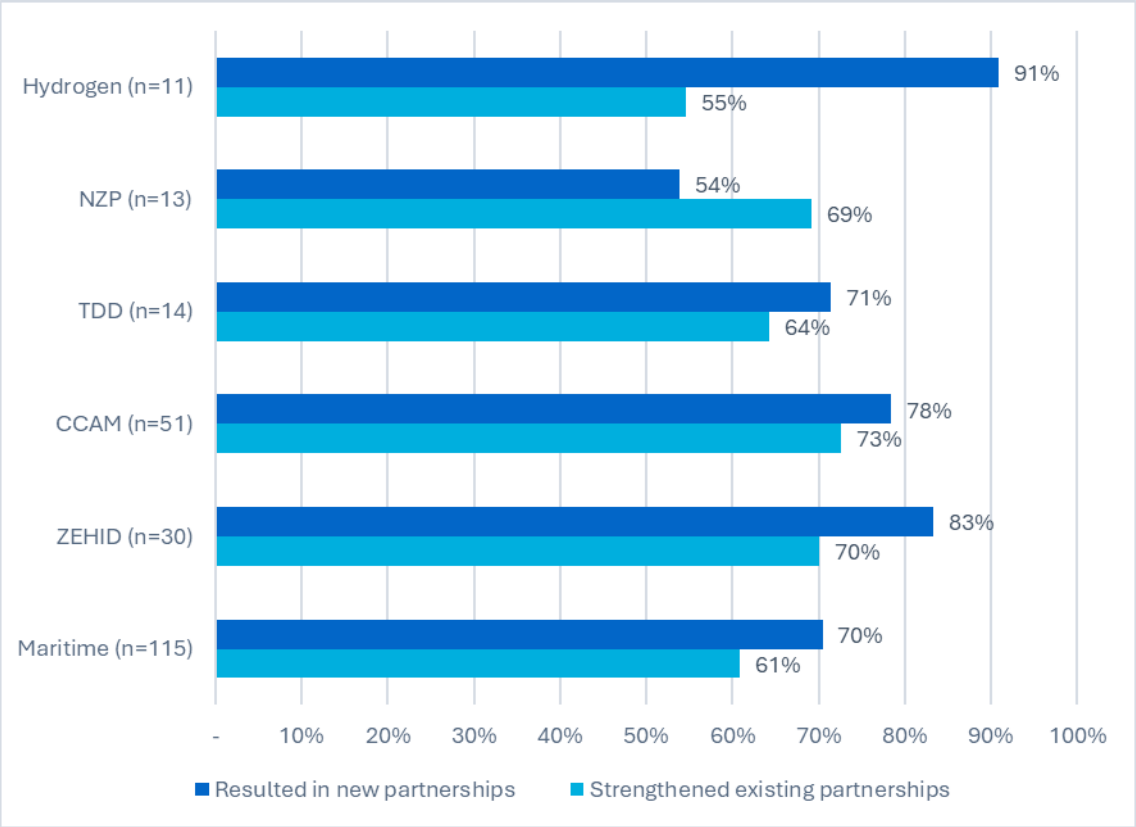
3.5 At a portfolio level, beneficiary survey results indicate that projects across all programmes have successfully facilitated collaboration. In **Wave 2, 77% of respondents reported creating new partnerships**, while **69% noted strengthening existing relationships**. In **Wave 3**, the balance shifted slightly, with a lower proportion reporting the **creation of new partnerships (62%)** and a higher proportion reporting **strengthened relationships (74%)** (noting that NZP and TDD are excluded from Wave 3 beneficiary survey data).

3.6 Analysis of these results suggests that new partnerships are more likely to be established earlier in delivery and therefore captured in earlier surveys, while existing relationships strengthen as projects progress. This is reflected in the increase in beneficiaries reporting strengthened partnerships from **Wave 1 (65%, n=138) to Wave 2 (70%, n=119)**. Although

the proportion reporting strengthened partnerships is **slightly lower in Wave 3 (62%, n=204)**, overall, the findings highlight the portfolio's impact in fostering connections between organisations.

3.7 At a programme level, Figure 3-1 illustrates the extent to which Wave 2 beneficiary survey respondents reported that their projects led to partnership development.

Figure 3-1: Percentage of respondents who reported that the project had contributed to creating new relationships/partnerships or strengthened existing ones, by programme. (Sample size (n=234), samples vary by programme)



*The FOAK programme is excluded from this analysis, as partnership development was not a requirement.

Source: LMT Beneficiary survey, Steer-ED Analysis, 2025 (Wave 2) and 2026 (Wave 3, maritime only). Question: "To what extent has the project contributed to creating new relationships/partnerships or strengthen existing ones? Please select the most appropriate statement(s)." The graph includes those responding the project had 'Resulted in creation of new relationships/partnerships' and/or the project had 'Strengthened existing relationships/partnerships.

3.8 As Figure 3-1 shows in Wave 2, beneficiaries in the TVH, ZEHID and CCAM programmes reported the highest rates of new partnership formation. **Compared to Wave 1, the proportion of respondents reporting that their project had contributed to creating new relationships declined slightly** across most programmes, suggesting that opportunities for forming new partnerships were concentrated in the early stages of delivery. **The most notable decrease occurred in NZP, where reported new partnership formation fell from 73% (n=15) in Wave 1 to 54% (n=13) in Wave 2.**

3.9 In contrast to this overall pattern, the TVH programme saw an increase in reported new partnership formation between Wave 1 and Wave 2. **The proportion of beneficiaries reporting new partnerships rose from 75% (n=8) in Wave 1 to 91% (n=11) in Wave 2,**

alongside an increase in strengthened relationships from 50% to 55%. This suggests that, for TVH, partnership formation continued beyond the early stages of delivery.

3.10 Wave 3 findings show further variation across programmes. ZEHID and CCAM continued to report the highest rates of new partnership formation, at 93% and 75% respectively. However, compared to Wave 2, declines were observed in both TVH and CCAM, while ZEHID showed an increase. For **TVH, this marks a shift away from new partnership formation (57%, n=7) towards strengthening existing relationships**, reported by a higher proportion of beneficiaries (71%, n=7).

> *"I think the project has built us a better relationship with our supply base. They have actually supported us a lot more than I expected. We have developed good relationships with them, and in terms of that growth, the project definitely helped us."* – Wave 3 TVH beneficiary

3.11 In terms of programmes reporting strengthened partnerships, **all programmes except TDD reported higher proportions of strengthened relationships in Wave 2**, with NZP showing a particularly strong increase from 47% (n=15) in Wave 1 to 69% (n=13) in Wave 2. In Wave 3 trends were mixed where CCAM (73% in Wave 2, n=51 to 69%, n=32) and ZEHID (70% in Wave 2, n=30 to 59%, n=27) reported declines in strengthened partnerships. For some programmes, ZEHID in particular, this may reflect that many partnerships have now progressed primarily through the operational deployment phase and are focused on data-sharing, leaving limited scope for further strengthening. By contrast, TVH beneficiaries reported an increase in strengthened relationships from 55% (n=11) in Wave 2 to 71% (n=7) in Wave 3.

> *"All project partners are enjoying working together and have developed good relationships through the project. The partners can rely on each other to keep the promised timelines and deliverables."* – Wave 2 TVH beneficiary survey respondent

3.12 Although FOAK did not require partnership development (and is therefore excluded from Figure 3-1), Wave 2 survey evidence indicates positive collaborative outcomes**. In Wave 2, 73% (n=26) of respondents reported strengthening existing relationships**, with beneficiary interviews corroborating these findings. **Wave 3 survey evidence shows a slight decline to 61% (n=23).**

Types of partnerships formed, and how they have been used across programmes

3.13 In Wave 1, several key types of partnerships were identified as central to project delivery across the LMT portfolio. Evidence gathered in Wave 2 confirmed that these partnership types remained relevant, with no new categories emerging. In Wave 3, however, evidence from the Maritime programme identified an additional partnership type - partnerships with universities. Overall, the main partnership types observed across the LMT portfolio were:

- **Partnerships with potential customers:** relationships with organisations that may become future customers of the technology under development. These partners

typically supported testing in real-world environments or helped define product requirements. Such partnerships provided valuable insight into customer needs and increased confidence in the technologies being developed.

"We are benefitting commercially from the partnership and are actually working through contracts at the minute with a couple of organisations. Whilst conversations or relationships were a little bit tentative in the early stages, now we are very much working hand in hand with project partners to commercialise" – Wave 2 CCAM beneficiary

- **Partnerships to provide technical support or additional capacity:** relationships with specialist consultants, testing facilities or academics offering advice or technical expertise in specific areas of technology development. Beneficiaries also reported forming partnerships with technical experts and subcontracts to address skills and capacity gaps.

"We have observed an increase in the technical maturity of the lab demonstrations of the product because of how we work with different project partners." – Wave 2 CCAM project partner

- **Partnerships with potential suppliers:** relationships with organisations capable of manufacturing the technology or its components, essential for future commercialisation.

"I think the project has built us a better relationship with our supply base. They have actually supported us a lot more than I expected. We have developed good relationships with them, and in terms of that growth, the project definitely helped us." – Wave 3 TVH beneficiary

- **Partnerships with regulators:** Relationships with regulatory or semi-regulatory bodies (such as classification bodies or those with in-depth knowledge of the regulatory environment; for example, IUK, DfT and Lloyd's Register). These were often informal rather than formal project partnerships but played a key role in ensuring technologies complied with current and forthcoming regulations.
- **Partnerships with universities:** Within Maritime projects, universities and industry partners collaborated to combine research and delivery. Universities typically contributed simulation and testing, while industry partners provided vessels, infrastructure and operational data. In several cases, these relationships were new and subsequently evolved into longer-term collaboration.

How programmes have resulted in new and strengthened partnerships

3.14 Interviews with project beneficiaries identified mechanisms through which partnerships were established. Across all Waves, beneficiaries noted that formalising partnerships often depended on funding and structured project frameworks provided by the LMT programme. This support enabled beneficiaries to strategically select partners based on

project-specific supply and demand requirements. For example, ZEHID beneficiaries reported initiating partnerships to meet specific needs, such as procuring subcontractors for civil works or securing charging partners for infrastructure requirements. A small number of Wave 3 ZEHID beneficiaries also highlighted instances where Innovate UK facilitated engagement, including with the start-up ecosystem.

3.15 Project leads frequently reported that they had prior knowledge of partners and their expertise, but projects helped cement and formalise these relationships, enabling effective collaboration towards shared goals. These Wave 2 findings reinforce observations from Wave 1, confirming that pre-existing networks and prior collaborations played a key role in building trust and reducing start-up times. Several beneficiaries emphasised that without IUK funding, partnerships would not have materialised due to the significant time, resource and financial investment required.

> *"The project wouldn't have happened without the funding. There is no way the partners would have been brought together. It means our partner would never have had the opportunity to bring the vehicles to start testing and developing in the UK."* - Wave 2 CCAM beneficiary

3.16 IMS data provided further context on partnership formation. In Wave 2, 25% of TDD beneficiaries and 20% of CCAM beneficiaries reported receiving support from the IUK Business Connect Service, which facilitates connections between innovators and potential partners. In Wave 3, approximately 10% of CCAM beneficiaries and 16% of Maritime beneficiaries reported receiving support from this service. Additionally, 22% of Wave 3 Maritime beneficiaries reported using the Catapult Centres, established by Innovate UK to support partnership development between project beneficiaries and relevant Catapult Centres.

3.17 Most TDD and CCAM beneficiaries interviewed reported identifying new partners through existing professional networks. In some programmes, such as NZP, external organisations (for example, Cenex and the Niche Vehicle Network) played a more active role, introducing collaborators, aligning expectations, and guiding teams to the next stage of project support. Similarly, many Maritime beneficiaries reported that they were able to establish sufficient partnerships through other mechanisms, such as showcase events, expansion across the CMDC consortia, and existing networks.

Beneficiary perspectives on the benefits of partnerships

3.18 Across Waves 1, 2 and 3 beneficiaries were asked to describe the benefits they had experienced from partnerships formed or strengthened through their projects. Across the portfolio, several key advantages were reported, either already realised or anticipated for the future.

Access to testing facilities and real-world assets

3.19 Access to testing facilities such as, live rail networks, fleets, depots and other operational sites was considered especially valuable for projects involving live demonstrations. In the FOAK programme, for example, partnerships with train operating companies (TOCs) enabled technology trials on the live rail network. These trials provided critical insights,

allowing teams to validate their solutions and refine functionality under real-world conditions. Similarly, within the NZP programme, collaborative partnerships accelerated access to facilities, data, and testing platforms, helping to advance technology readiness levels.

3.20 In Wave 3, ZEHID beneficiaries also highlighted operational learning as a key benefit of partnerships. For example, shared insights from early megawatt-charging deployments, such as Menzies learning from Kuehne+Nagel's site, have helped accelerate readiness, reduce delivery risks, and strengthen collaboration as projects move into Phase Two.

Creation of commercial opportunities

3.21 Partnerships with potential customers and collaborators also helped to create clearer routes to market and enabled beneficiaries to gather intelligence on customer requirements, helping ensure technologies were aligned with market needs. Some beneficiaries noted that partnerships opened additional opportunities, such as securing follow-on contracts, developing memoranda of understanding, and fostering more productive supply chain interactions, often supported by the credibility of engagement with IUK or regulatory bodies. This credibility also served as a market signal, enhancing industry recognition and trust.

"We are now engaged with the Hydrogen Energy Association, and we are talking to quite a few hydrogen product producers, hydrogen infrastructure equipment suppliers, different vehicle OEMs that we were not talking to before. It has really linked us to a lot of people in the hydrogen space that will help us going forward into the future to be able to offer our customers a solution to this." – Wave 2 TVH beneficiary

---

CCAM case study vignette showcasing partnership development and the benefits to the project/organisation

Building upon previous Nissan research, evolvAD (see Appendix A.I) is a £3.8 million initiative funded via the CCAM programme that aimed to develop an automated vehicle (AV) capable of safely driving in residential, urban, and rural environments. The five project partners focus on high-definition map generation and validation, alignment with multiple complex operational design domains and improving interactions in complex urban environments with vulnerable road users. The project was supposed to run for 21 months, between July 2023 and March 2025, but was granted a 12-month extension until March 2026 to deliver an additional work package focused on commercialisation of the technology.

Nissan's role is to lead the development of the connected and autonomous vehicles (CAV) trialled for the project: however, working with partners allowed it to expand the technology and build knowledge in the following areas:

- Apply advanced machine learning techniques to generate high-definition maps of aerial imagery (Connected Places Catapult).
- Use facial recognition technology and help decipher pedestrian intentions e.g., what is the probability of a pedestrian crossing the road (Humanising Autonomy).
- Providing onboard cybersecurity and an advanced safety case for taking the driver out of the vehicle (SBD Automotive).

- Developing vehicle system validation processes utilising infrastructure on the Smart Mobility Living lab .

According to Nissan, one of the key project outcomes was building stronger rapport with its partners, universities and other experts from the wider CAM community. For instance, the team held conversations and shared experience with Zenzic and the Advanced Propulsion Centre UK - two organisations who worked together to launch a new future mobility accelerator. Nissan also worked closely with government and trade bodies, including with IUK, Auto Council, the Society of Motor Manufacturers and Traders, DfT and DBT, leading to increased understanding of national regulatory practices and how to provide critical insights to policymakers. They also worked with Leeds University, Cranfield University and Nottingham University through the project, and will continue to preserve these relationships in future

The Nissan research team built better understanding of the work and expertise of their project partners, which helped them gain wider insight on which organisations they might potentially want to include in future projects. This was considered particularly important as Nissan approaches their planned commercialisation stage. The project is also now attempting to identify local partnerships that can support commercialisation activities.

Knowledge and skills development

3.22 Partnerships also provided access to technical expertise that was not available internally, including capabilities such as machine learning. Beneficiaries reported that this support helped improve the likelihood of project success, ensured regulatory compliance, and enhanced customer satisfaction. For example, some TVH beneficiaries gained a deeper understanding of the hydrogen ecosystem and contributed to knowledge exchange activities, including seminars and training sessions with their partners.

Maritime case study vignette showcasing partnership development and benefits

The retrofit of the 20m Mercurio Crew Transfer Vessel (CTV) to 100% electric propulsion (Appendix G.III) demonstrated the technical feasibility of zero-emission operations in the offshore wind sector.

Strong partnerships were central to the project's success. Vessel operators, propulsion and battery suppliers, offshore wind stakeholders and investors worked collaboratively to de-risk system integration and enable validation. Close collaboration across partners, including MJR Power & Automation, Blackfish Engineering, Artemis Technologies, and Goodchild Marine Services, was a major strength. This enabled iterative design improvements and ensured that the retrofit responded directly to operational requirements offshore.

The commercial benefits of partnership have been equally significant. The project has strengthened investor confidence, supported new vessel orders, and catalysed the creation of 'Charge Offshore' during CMDC 1, a dedicated commercial pathway to scale electric CTV deployment. Charge Offshore, a specialist maritime electrification company, now provides a focused platform to commercialise learnings from the retrofit, attract further investment, and accelerate market adoption.

3.23 The wider benefits of partnership working, including technology development, commercialisation outcomes and enhanced learning are explored in more detail in the subsequent chapters.

Longevity of partnerships

3.24 Across all programmes, beneficiaries reported plans to maintain and expand collaborations through joint funding bids, scaling innovations, building new supply chain and customer connections and taking on operational roles in future projects. For example, some CCAM beneficiaries had begun bidding for automated mobility funding in the UK and Europe. TVH beneficiaries reported that the programme had opened access to the wider hydrogen ecosystem, creating potential collaborations with major Original Equipment Manufacturers (OEM), customers, and supply chain partners not initially involved.

> *"The design time that has been spent so far has been put to good use to building supplier relationships. Personally, I know the hydrogen business is going to take off at some point and it has given us a commercial and technical advantage over our competitors when it does so."* – Wave 3 TVH beneficiary interview

3.25 Several beneficiaries also highlighted the expansion of their wider innovation ecosystems as a lasting benefit of partnership working.

> *"Through the project we have got relationships with universities, we have got relationships with people who do digital twinning and related technology. The whole ecosystem is bigger because of the project - including customers and supply chain. And the biggest thing we have done as a result is to develop new use-cases."* – Wave 2 CCAM beneficiary

3.26 Within ZEHID, as the programme entered its demonstration phase, partnerships were expected to deliver practical benefits such as resource-sharing initiatives, including optimising charging infrastructure for hauliers. However, a small number of beneficiaries indicated that their collaborations may not continue beyond the programme. This was typically due to differences in commercial objectives or because the partnership was specific to ZEHID delivery requirements and not needed in future contexts. This issue, where collaborative relationships can sometimes sit in tension with commercial interests, was explored further in Wave 3. Some beneficiaries reported that they were now committed to longer-term contracts that, in a competitive environment, they would ordinarily avoid. While this was recognised as a trade-off, it was generally viewed as acceptable given the strategic value of programme participation.

> *"Weakness for us is we've got long contracts that we don't normally have because we'd like to keep the pressure on [operators] for the whole time, so that's the trade-off. But in terms of doing the right thing at the right moment in time, I think everybody would look at that project as an absolutely peak bit of work for them personally and maybe for the company as well."* – Wave 3 ZEHID beneficiary

Conclusion

3.27 The LMT portfolio has played a central role in fostering stronger partnerships across the transport sector. Partnership working was an explicit requirement for all programmes, except FOAK, and evidence shows that projects formed new collaborations and strengthened existing ones. Although FOAK did not require partnerships, there is some evidence that they still emerged organically. Across the portfolio partnerships brought together industry, academia, regulators and supply chain partners in ways that have enhanced credibility, opened commercial opportunities, enabled access to technical expertise and provided testing facilities to support technology development.

3.28 LMT beneficiaries reported a wide range of benefits from these partnerships, including improved routes to market, accelerated technology readiness, and opportunities for knowledge exchange. These strengthened partnerships are expected to generate enduring value for the sector by enabling organisations to collaborate more effectively, and support the development, scaling and adoption of transport innovations.

3.29 The nature of partnership benefits evolved over time. New relationships were most commonly formed in the early stages of delivery, while the results of later research Waves increasingly reflected the consolidation and strengthening of existing collaborations. Many beneficiaries expect these partnerships to generate ongoing value beyond the lifetime of LMT funding, supporting future innovation, scaling and commercialisation. However, the evidence indicates that not all partnerships will necessarily endure, since they are not intended to be long-term, such as those designed to meet specific programme or demonstration needs.

4 Development, commercialisation and deployment of new technologies

Key Messages

- LMT programmes have successfully advanced technologies. The majority of Wave 2 LMT beneficiaries (72%) reported having progressed one or more levels on the Technology Readiness Level (TRL) scale during their projects (so far), with 18% having reached TRL 9 (actual system proven in operational environment).
- Progress with commercial readiness is less widespread so far, with 39% of Wave 2 beneficiaries having seen an increase in their Market Readiness Level (MRL).
- 13 beneficiaries reported in the Wave 2 survey that they already had patent applications resulting from their LMT project (18 patents in total), while at least 28 expected to hold additional patents within 3 years (another 75 patents). Patenting suggests sufficient commercial viability to warrant the cost of protecting the idea.
- A subset of LMT projects have already achieved commercial outcomes. More than one-quarter (29%) of LMT beneficiaries surveyed in Wave 2 indicated that their projects had already resulted in a new product or service being launched, while 38% said their project had helped to make products more commercially ready.
- £78m in additional turnover is already reported as a result of projects.
- There has also been widespread dissemination of LMT project activities and solutions. In Wave 2, Media items (news reports, trade press, social media) were found for 99 of the 178 projects in the LMT portfolio. This included 3,740 media items in total (an average of 21 items per project).

Introduction

4.1 This chapter explores the extent to which LMT projects have been successful in developing and deploying technologies and progressing towards commercialisation.

TRL progression across programmes, and mechanisms driving this

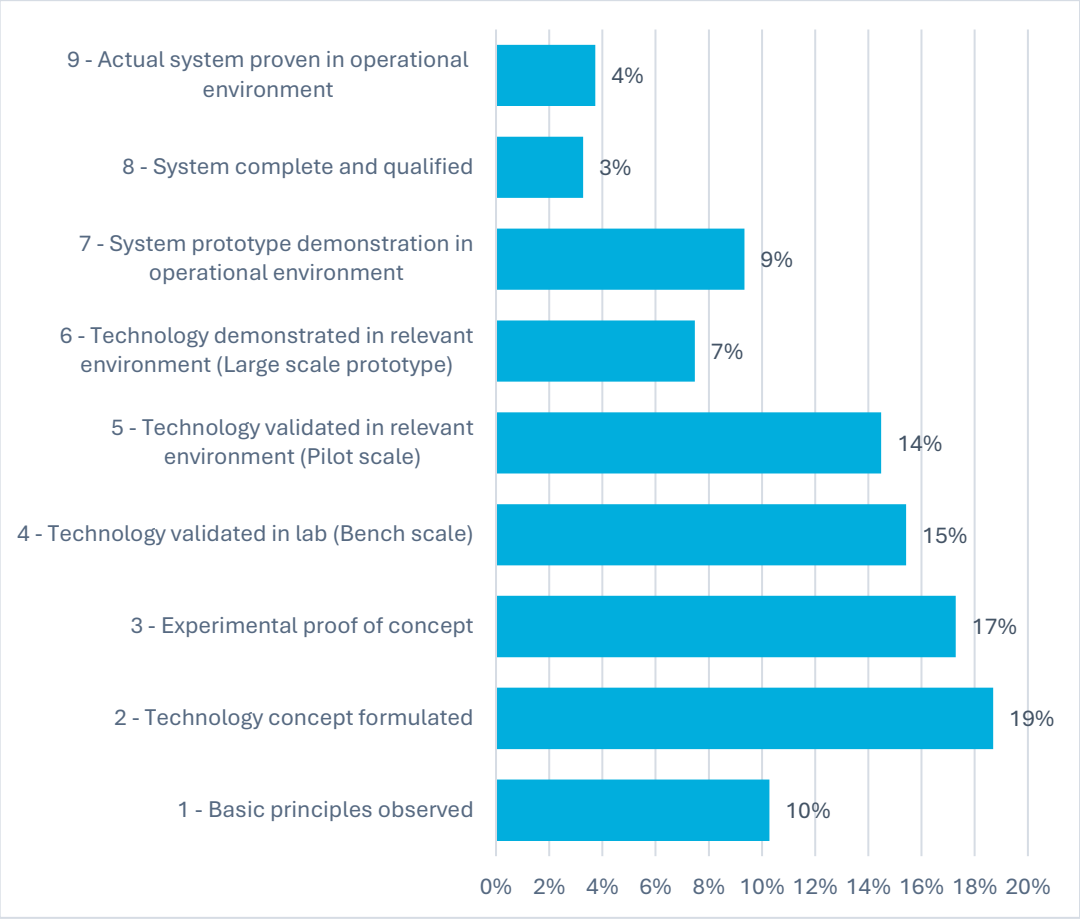
4.2 The TRL scale provides a recognised approach for assessing the stage of technological development of an innovation. It runs from the early principles stage of a project (TRL1 = 'basic principles observed') through laboratory testing (TRL6 = 'technology demonstrated in relevant environment') to the technology being ready to deploy (TRL9 = 'actual system proven in operational environment'). As such, although subjective, self-assessed TRLs

provide a valuable indication of the technological advancement that has been made via projects. It should be noted, however, that reaching high TRL levels does not necessarily equate to commercial readiness (TRL measures technical maturity, while commercial readiness requires that a product can be manufactured reliably at scale, is economically viable, and is aligned with market needs). Commercial progress is discussed later in this chapter.

4.3 Projects across the LMT portfolio, and even within individual programmes, were diverse in terms of their starting TRL. IMS baseline data on the TRL of supported products was only recorded for 31 CCAM and 214 Maritime beneficiary organisations (and no others in these or other LMT programmes). However, the Wave 1 survey asked all beneficiaries to recall the TRL of their technology at the time when they completed their funding application[18].

4.4 The spread of responses is shown in Figure 4-1. Between 3% and 19% of beneficiaries fell within each of the TRLs 1 to 9 at the time of application, but with **most concentrated at TRLs 1 to 5** (these lower level TRLs account for 76% of beneficiaries).

Figure 4-1: Reported TRL of LMT projects at time of application (n=214)



Source: LMT Beneficiary Survey, Technopolis analysis, 2024 (Wave 1*). Question: With reference to the TRL scale, what was the TRL of the technology when you completed your application? Includes responses from the following programmes: Maritime (75), CCAM (63), ZEHID (28), FOAK (24), NZP (15) and TVH (7). *TDD beneficiaries were not surveyed in Wave 1 and so their responses to the same questions from the 2025 (Wave 2) survey are used (2 responses). Excludes 16 responses who selected 'unsure'.

[18] TDD beneficiaries were not surveyed in Wave 1, but they were asked the same question in the Wave 2 survey and those responses have been incorporated in to the analysis.

4.5 Interviewees across Waves consistently reported that project activities had helped them to progress up the TRL scale, and they were able to express clearly how the project activities being undertaken were helping to advance the technology in question. Some examples are given below for illustration.

"The testing showed that the orientation we had was not as tolerant to air entrainment in the cooling system as we thought it was. So that led to a significant re-design of the whole system to make it more resilient to air and to be more robust in service." – Wave 3 TVH beneficiary

"A lot of progress was made, we are now deploying parts of our advanced driver assistance systems, and that is a very rapidly growing area of the business for us. We are very much focused on the verification and validation and testing of these systems, so that we can support technology providers and OEMs in understanding how safe their system is." – Wave 3 CCAM beneficiary

"The ZEHID projects have supported improvements to our pre-existing software products. Transport management systems and routing information have been added into the software." – Wave 2 ZEHID beneficiary

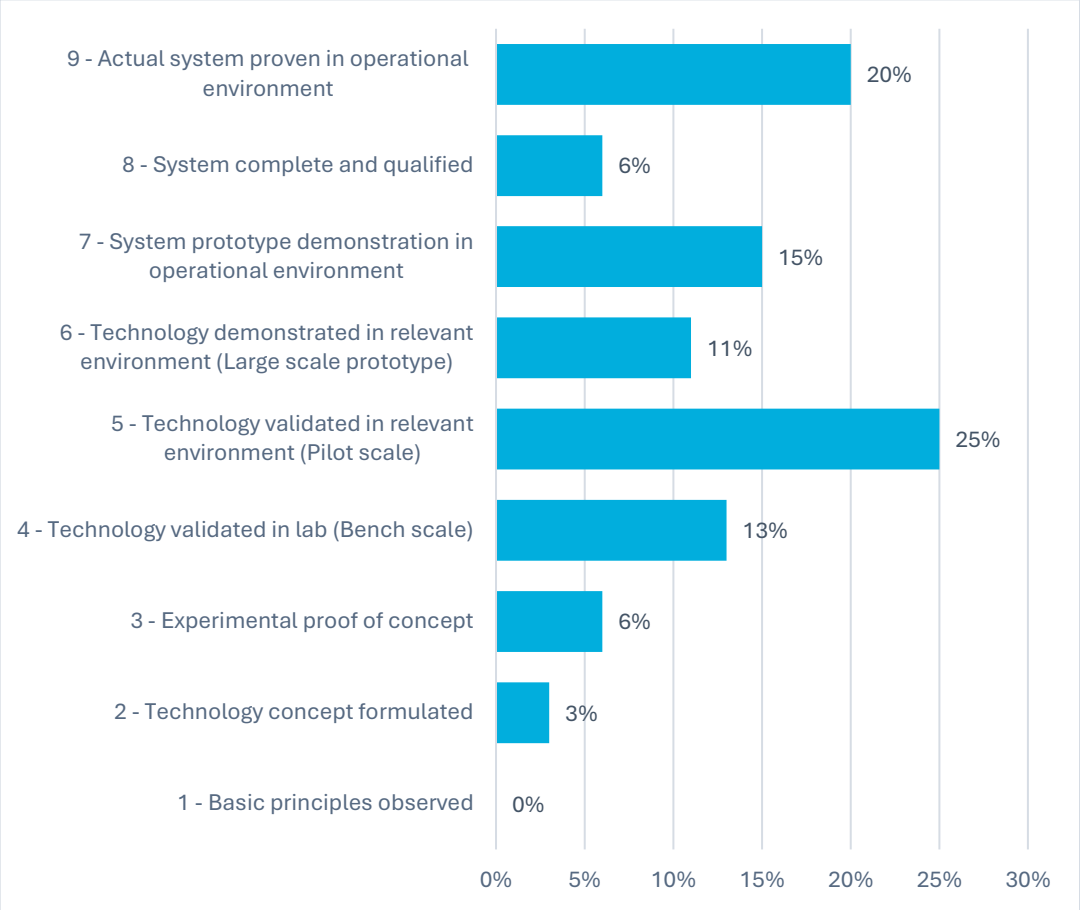
---

4.6 In the Wave 2 beneficiary survey, respondents were asked to report on the current TRL of their technology. As shown in Figure 4-3, **more than three-quarters (77%) reported being at level 5 (piloting outside the lab) or above, including 20% at TRL9 (system proven in operational environment)**. This is clearly a very different profile from the position reported above at the start of projects (although note that the populations responding to the two surveys are not exactly the same).

4.7 Respondents to the Wave 3 beneficiary survey were also asked to update on the current TRL of their technology[19]. Similar results were obtained to Wave 2, with nearly three-quarters (74%) reporting being at TRL 5 or above, including 18% at TRL 9.

[19] Responses from Maritime (99), CCAM (28), FOAK (23), ZEHID (21), and TVH (5). Excludes 18 who selected 'unsure'.

Figure 4-2: Reported TRL of LMT projects at Wave 2 (n=127)

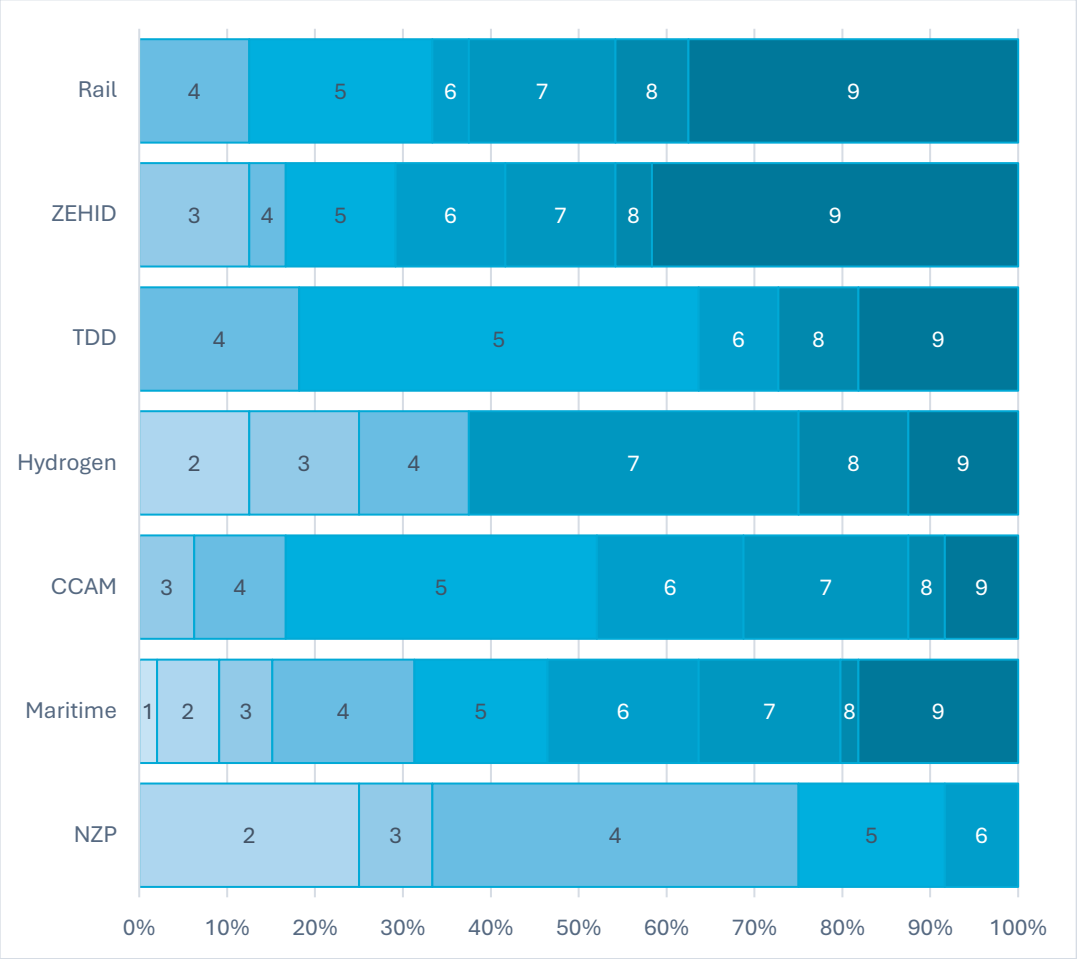


Source: LMT Beneficiary survey, Technopolis analysis, 2025 (Wave 2). Question: What is the TRL of the technology now?' Includes responses from CCAM (48), ZEHID (24), FOAK (24), NZP (12), TDD (11), and TVH (8). Excludes 11 who selected 'unsure'.

4.8 There was some variability across the different programmes in terms of TRLs reported by those responding in Wave 2 (see Figure 4-3). Rail and ZEHID beneficiaries reported a current TRL of 7.0 and 8.9 on average (respectively), while TDD, TVH, CCAM and Maritime[20] beneficiaries reported slightly lower averages (between 5.7 and 5.9). The average TRL reported by NZP beneficiaries was 3.8.

[20] Maritime beneficiaries were not surveyed for Wave 2. The responses shown for this programme are taken from the Wave 3 survey.

Figure 4-3: Reported current TRL of LMT projects, by programme (n=226)



Source: LMT Beneficiary Survey, Technopolis analysis, 2025 (Wave 2*). Question: With reference to the TRL scale, what is the TRL of the technology now? Includes responses from CCAM (48), ZEHID (24), FOAK (24), NZP (12), TDD (11), and TVH (8). Excludes 11 who selected 'unsure'. *Figures for Maritime (99) are from Wave 3, as not surveyed in Wave 2.

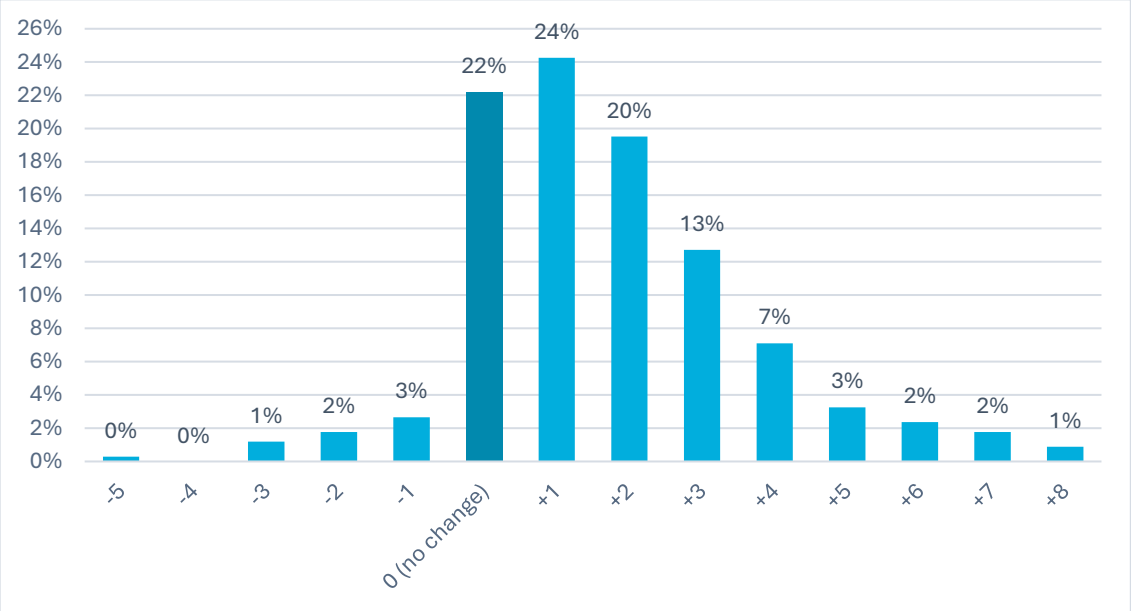
4.9 Based on combining responses (for specific organisations in specific projects) across the three Waves of beneficiary survey, one can look at the change in TRL during LMT projects.

4.10 The majority of LMT beneficiaries **(72%) report having progressed at least one TRL** during their LMT project (so far, where projects are ongoing). Many have moved several levels, with for example **28% reporting a shift of three or more TRLs** (see Figure 4-4).

4.11 For those reporting **no (positive) TRL change (22%)**, qualitative evidence suggests that this is often because of issues with technical viability or problems with suppliers, or that there had been some development relating to a particular component, but not sufficient to alter the TRL of the technology overall. In these cases, useful learning will still have been generated, even though there has not been TRL progression.

4.12 In **6% of cases, the results suggest a decrease in the TRL (of between 1 and 5 levels).** This might occur, for instance, if the operational environment (e.g. regulations or market needs) has changed, or if new technical challenges or gaps were discovered during the project that necessitated the revisiting of earlier stages (e.g. issues may have been revealed when testing in an operational environment that meant further development is needed).

Figure 4-4: Change in reported TRL of LMT projects (since application) (n=338)



Source: LMT Beneficiary Survey, Technopolis analysis, 2024 (Wave 1), 2025 (Wave 2) and 2026 (Wave 3). Question: What was the TRL of the technology when you completed your application, and what is the TRL of the technology now? Analysis only includes beneficiaries that answered the question for the point of application (their earliest response was used) and also provided a more recent updated assessment (their most recent response was used). Includes responses from Maritime (141), CCAM (75), FOAK (53), ZEHID (37), NZP (15), TVH (9) and TDD (2).

4.13 Based on these same respondents (who have provided TRL assessments at two points in time), the average TRL at application was 4.0, while the average latest TRL reported is now 5.7, meaning an **increase of 1.7 TRLs on average overall** (Table 4-1). These results are in line with other recent IUK programme evaluations, with a 2023 meta-analysis finding an increase of 1.7 TRLs on average across different programmes.[21]

[21] In 2023, IUK commissioned a meta-analysis of 16 recent IUK evaluations, including findings relating to TRL progression (covered in 7 of these). Five evaluations reported on the average TRL increase from the start to the end of projects (finding increases of 0.9 to 2.3 TRLs, or 1.7 TRLs on average across the five evaluations). The two other evaluations reported on the proportion of projects that had seen an increase of at least one TRL during the course of the programme (84% and 90% respectively).

Table 4-1: Average reported TRL of LMT projects (application to most recent) (n=338)

Programme	Average TRL at application	Average current TRL	Change in average
FOAK (n=53)	4.2	6.4	+2.2
ZEHID (n=37)	5.1	7.1	+2.0
TDD (n=2)	2.5	4.5	+2.0
CCAM (n=75)	4.2	5.7	+1.6
Maritime (n=141)	3.7	5.3	+1.6
NZP (n=21)	2.4	3.7	+1.2
TVH (n=9)	6.6	6.4	-0.1
Total (n=338)	**4.0**	**5.7**	**+1.7**

Source: LMT Beneficiary Survey, Technopolis analysis, 2024 (Wave 1), 2025 (Wave 2) and 2026 (Wave 3). Question: What was the TRL of the technology when you completed your application, and what is the TRL of the technology now? Only includes beneficiaries that answered the question for the point of application (their earliest response across survey Waves was used) and also provided a more recent updated assessment (their most recent response was used).

Intellectual property

4.14 Patents provide an indicator of invention and innovation, because they suggest that there is sufficient commercial viability to warrant the cost of protecting the idea (as companies typically only patent inventions that they believe have market value). It can provide one sign of progress towards the commercialisation and deployment of technologies.

4.15 Wave 2 Dimensions data showed 21 patent applications and one granted patent associated with LMT grants. Eleven of the applications and the one patent granted all related to one Rail project[22]. The remaining 10 applications related to five Maritime projects.[23]

4.16 Identifying patents from this source relies on these patents acknowledging the relevant grant. The Wave 2 beneficiary survey therefore also asked respondents about patents relating to technologies developed under the project. They were asked specifically how many patents were held at the start of the project and how many were now held at the time of the survey, as well as how many they expected to hold in three years' time.

4.17 Across the LMT portfolio:

- 24 beneficiaries (17% of 145 responding to the survey) reported holding a patent when they applied for the grant (with 111 patents reported to be held in total24).
- **13 beneficiaries (9% of 145) reported patents resulting from their LMT project so far (18 patents in total).**

[22] The 'Automating freight access right management and spot bidding using novel and modern software to drive modal shift from road to rail' project.

[23] This data was based on metadata [as of 01/09/2025 for Wave 2] from Digital Science's Dimensions platform, available at https://ukri.dimensions.ai/. Access was granted under licence agreement with UKRI.

[24] This total excludes two outliers (where respondents reported 100 and 600 existing patents), which appear to be mis-entered answers.

- 28 beneficiaries (19% of 145) expected to hold additional patents (75 in total) within 3 years' time, as a result of completing their project.

4.18 This demonstrates that for a subset of beneficiaries their technology had already developed (or was expected to soon develop) to a point where it was sufficiently advanced and commercially valuable to patent. This group includes representation from all 6 LMT programmes that were part of the Wave 2 survey (13 CCAM, 5 NZP, 5 FOAK, 3 TDD, 2 ZEHID and 1 TVH beneficiary).

4.19 Note that in Wave 3, Maritime beneficiaries responding to the survey reported 84 patents held when they applied (held by 24% of 115 respondents), 16 patents resulting from their project so far (10% of respondents), and 86 additional patents expected within 3 years (26% of respondents).

Information dissemination

4.20 Dissemination of knowledge and learning, including via the production and distribution of project outputs is one of the expected outcomes from the LMT portfolio, with this then helping to support further developments, changes in attitudes, increased confidence and growing adoption of relevant technologies and solutions.

4.21 **Two-thirds (66%) of Wave 2 survey respondents[25] indicated their projects had been featured in news reports or trade press**, while 38% had been featured in blogs and 15% in academic journals. Table 4-2 shows programme breakdowns.

Table 4-2: Reported featuring in press, blogs and academic journals (n=260)

Programme	News reports and trade press	Blogs	Academic Journals	Total respondents
ZEHID	29 (97%)	18 (60%)	2 (7%)	**30**
CCAM	36 (71%)	22 (43%)	13 (25%)	**51**
TVH	6 (55%)	1 (9%)	0 (0%)	**11**
FOAK	14 (54%)	6 (23%)	0 (0%)	**26**
NZP	6 (46%)	4 (31%)	1 (8%)	**13**
TDD	6 (43%)	0 (0%)	0 (0%)	**14**
Maritime	75 (65%)	47 (41%)	23 (20%)	**115**
Total	**172 (66%)**	**98 (38%)**	**39 (15%)**	**260**

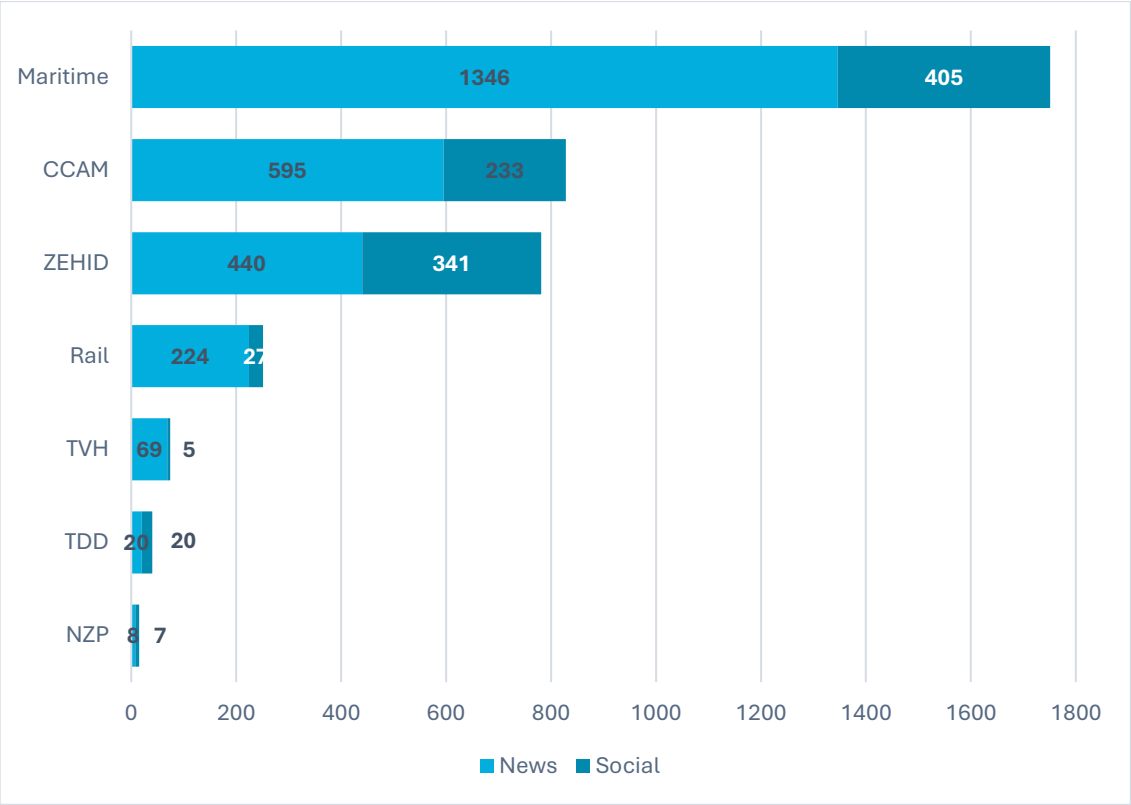
LMT Beneficiary Survey, Technopolis analysis, 2025 (Wave 2*). Question: Has the project been featured in any new reports or other publications (e.g. trade press, blogs, articles etc)? (please tick all that apply). *Figures for Maritime are from Wave 3, as not surveyed in Wave 2.

4.22 Mentions of LMT projects in the media (news media, trade press, industry publications, social media, blogs and other sources) were also explored in Wave 2 using the Meltwater platform, with searches undertaken for each of the LMT projects based on keywords and covering the period between August 2024 and August 2025. Media items were found in that year for 99 of the 178 projects across the LMT portfolio. Figure 4-5 below shows that this included **3,740 media items in total, so an average of 21 items per project (all**

[25] Maritime beneficiaries were not surveyed for Wave 2. The responses shown for this programme are from the Wave 3 survey.

projects). Across the portfolio, most of the media items found were news items (72%), while social media posts accounted for 28%.

Figure 4-5: Media coverage of LMT projects



Source: Meltwater platform. Technopolis analysis. Date range between 12th August 2024 and 12th August 2025. Search based on key words (usually project title or acronym and lead organisation's name).

The analysis suggests that projects that are more user-facing (e.g. demonstrations that seek to develop public trust and acceptance) tended to gather more press than those focused on optimising systems or particular developments (where the intention is more likely to be to dissemination of developments within the industry). For example, the most media items (100+ in each case) were identified for the following nine projects.

Table 4-3: LMT projects with 100+ media items each recorded August 2024 – August 2025

Programme	Project Name	Number of media items	Brief project description
Maritime	**Multipurpose eFoiler Platform**	376	Demonstrating a 100% electric water taxi and luxury yacht, manufactured at UK shipyards
Maritime	**AirWing Maximised Thrust Wind Propulsion Demonstration**	370	Demonstrating a novel auxiliary wind propulsion system (a rigid wingsail) on cargo ships, which reduces carbon emissions and fuel costs
CCAM	**Project Harlander**	368	Developing an automated passenger shuttle service in Belfast
ZEHID	**eFREIGHT 2030**	300	Demonstrating how battery-electric HGVs can replace conventional HGVs at scale (82 HGVs and 37 charging locations)
Maritime	**Port of Aberdeen: Shore Power in Operation**	244	Providing at-scale demonstration of a landside and vessel-side shore power system
ZEHID	**Project Electric Freightway**	231	Installing ~200 eHGV chargers at motorway services and depots, with 140 eHGVs using the network
ZEHID	**HyHAUL**[26]	229	Deploying up to 30 hydrogen fuel cell electric trucks and 3 hydrogen refuelling stations along the M4 corridor to demonstrate integration
FOAK	**DreamSuite**	**192**	Deploying an innovative train seating concept for sleeper trains and long-distance day trains
CCAM	**StreetCAV**	**116**	Creating a 'plug-and-play' roadside connectivity solution, demonstrated through a self-driving shuttle service in Milton Keynes that carries passengers through the city centre to a range of destinations

Source: Meltwater platform. Technopolis analysis. Date range between 12th August 2024 and 12th August 2025. Search based on key words (usually project title or acronym and lead organisation's name).

4.23 In interviews across all Waves, project partners regularly highlighted that they were working closely together to disseminate any emerging findings by developing project-specific webpages, producing social media content or attending industry conferences. Interviews also suggested that a substantial amount of further media activity was planned where projects were ongoing (e.g. in final demonstration phases). For example:

"We work on our LinkedIn profile, and we have our own dedicated section on our website, trying to showcase our capabilities, and the specific project work that we have done. As part of the project

[26] Note that the project shares the same name as the lead company, meaning that some of the identified media may not relate to this specific ZEHID project.

deliverables, we also had to produce a white paper, and we are trying to do marketing online as well as trying to look at forums and conferences." - Wave 2 CCAM beneficiary

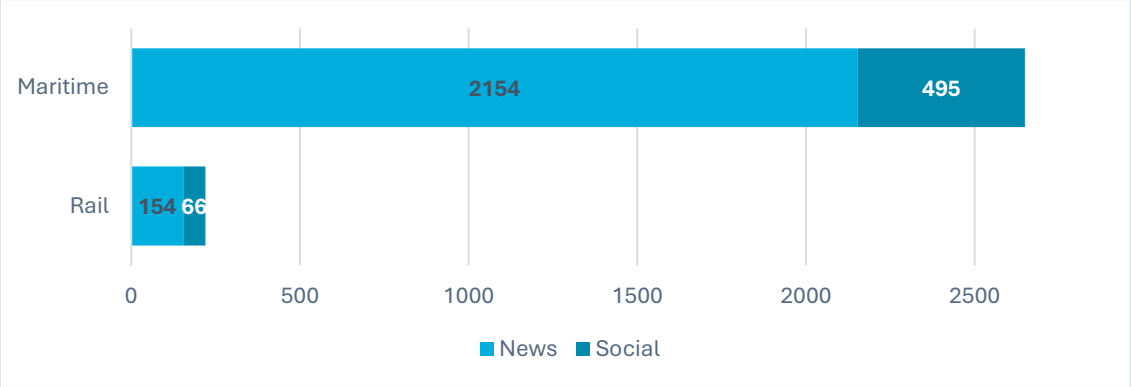
"We've presented 35 times in 18 months – our audience is growing, we're getting more questions and wider interest (including from fuel card providers, Original Equipment Manufacturers (OEMs), payment providers, ancillary software systems)." – Wave 2 ZEHID beneficiary

"One of the important outcomes of the project from university perspective was that we shared and disseminated the knowledge we generated to our students, which is really good. We can get all students to understand the project, understand the concept of hydrogen vehicles operating in an airport environment. Also, over the project period, we attended different workshops, including a decarbonisation workshop in London, so we got the opportunities to present the key findings of our research to an external audience. – Wave 3 TVH beneficiary

4.24 Additional analysis of media outputs in Wave 3 looked at the most recent data for just the Maritime and FOAK programmes, covering the period from 30 January 2025 to 29 January 2026. This analysis also includes an additional 26 FOAK projects awarded in 2025.

4.25 Media items were found in the past year for 48 of the 87 Maritime projects. Figure 4-5 below shows that this included 2,649 media items in total, so an average of 30 items per project (all projects). Most of the media items found were news items (81%), while social media posts accounted for 19%. A total of 220 media items were then also found for 37 of the 70 Rail projects, an average of three per project (all projects). These included 70% news items and 30% social media.

Figure 4-6: Media coverage of Maritime and Rail projects, 2025



Source: Meltwater platform. Technopolis analysis. Date range between 30 January 2025 and 29 Jan 2026. Search based on key words (usually project title or acronym and lead organisation's name).

Commercial progress made by organisations

4.26 Beyond technological progress, a key objective of the LMT programmes is that the technologies being developed eventually become commercially viable products that not only achieve market success but also address key transport challenges facing society.

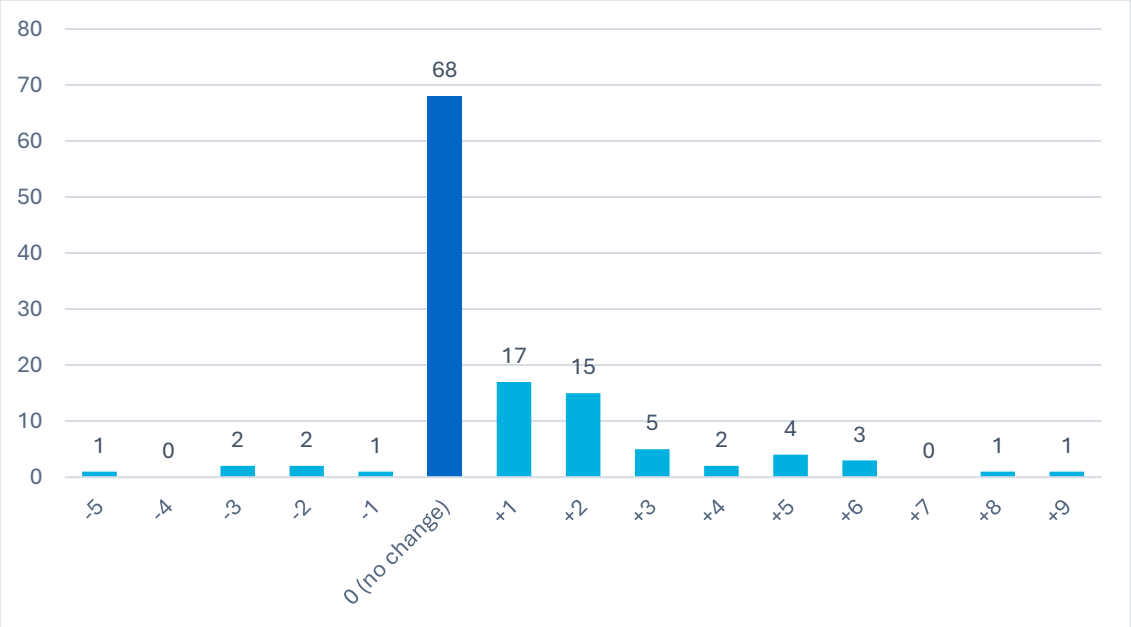
4.27 Market Readiness Level (MRL) is a scale that assesses the commercial viability and market acceptance potential of a new product, service or technology, measuring how

prepared it is for launch and adoption by customers. It ranges from MRL1 ('unsatisfied needs have been identified') to MRL10 ('business model is defined coherently'). By assessing aspects like customer demand, competitive positioning, business viability and market fit through a structured framework, MRL identifies the steps needed to achieve successful commercialisation.

4.28 IMS baseline data on the MRL levels of supported products at the start of LMT grants was only recorded for 30 CCAM and 246 Maritime beneficiaries, and no other beneficiaries or LMT programmes. Subsequent rounds of IMS data collection have captured an updated view of MRL levels for some of these beneficiaries (there are 122 cases where both a baseline and subsequent MRL assessment are available).

4.29 Comparing the two (baseline and most recent assessment), **in 39% of cases there has been an increase in MRL** (of between one and nine levels). In 56% of cases there has been no change (so far) and in 5% of cases there has been a decrease in MRL (of between one and five levels). On average, beneficiaries reported an increase of +0.8 in MRL since application.

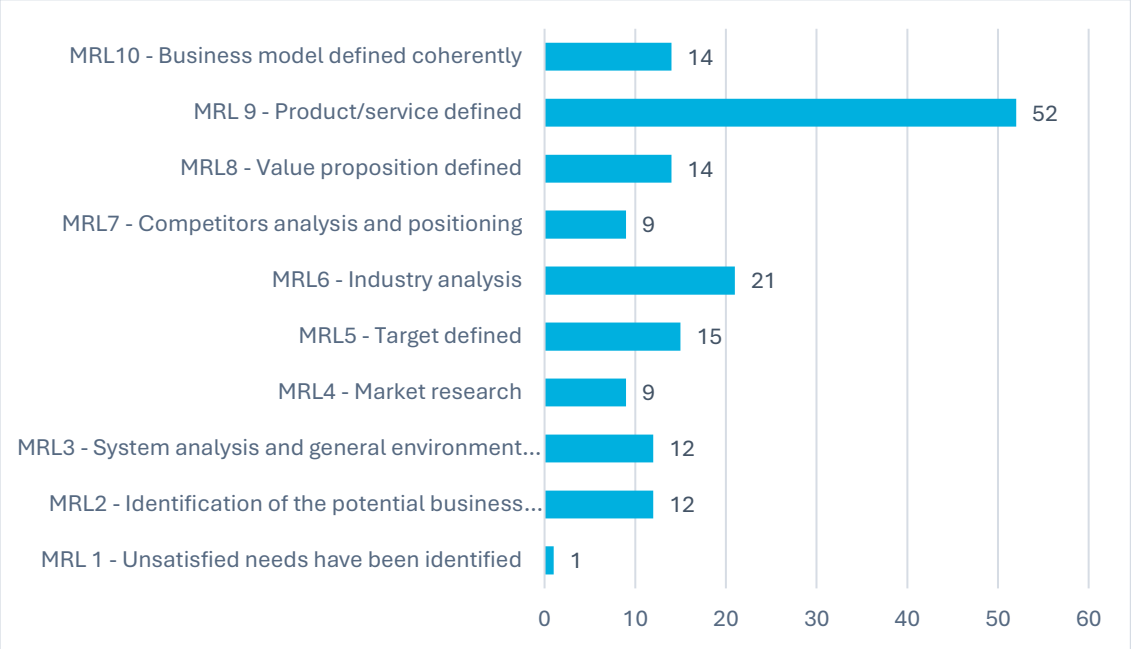
Figure 4-7: Change in reported MRL of LMT projects (since application) (n=122)



Source: Analysis of IMS data, 2026. Question: "In relation to this Innovate support, what is the MRL of the product or service to date?" Note that IMS data for this question was available for only a subset of competitions. Only beneficiaries that reported a baseline MRL and a subsequent MRL (with the latest available used for the analysis) have been included (26 CCAM beneficiaries and 96 Maritime beneficiaries).

4.30 As shown in Figure 4-8, the latest IMS data (regardless of whether a baseline position was captured) demonstrates that projects are now operating at MRLs spanning the entire range, from MRL1 to MRL10 for the two programmes with data. Notwithstanding, there are a sizeable proportion of beneficiaries reporting that they are at the higher MRL range, with **50% reporting MRL8 ('value proposition defined') or above.**

Figure 4-8: Reported current MRL of CCAM and Maritime projects (n=159)



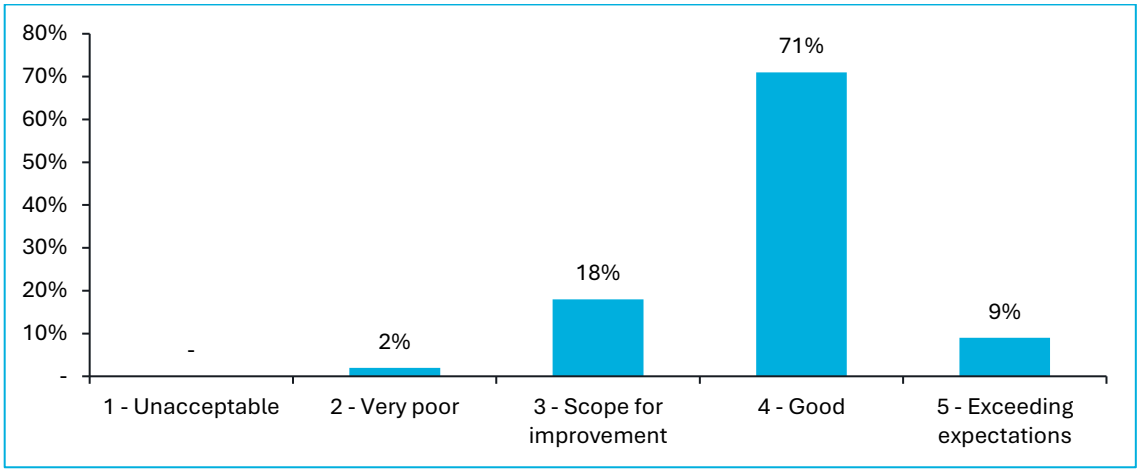
Source: Analysis of IMS data, 2026. Question: "In relation to this Innovate support, what is the MRL of the product or service to date?" Note that IMS data was available for only a subset of LMT programmes – CCAM and Maritime – and not all projects within these programmes.

4.31 As such, while some beneficiaries are already close to commercialisation or have a clear pathway mapped out, and are therefore engaging proactively in business development activities, others at lower TRLs (the majority of projects) reported through interview that they were still concerned with developing the technology itself and had not yet turned their attention to commercialisation activities.

4.32 From the latest available QMS monitoring reports, **108 of the 135 LMT projects assessed were found to have made good progress in terms of exploiting the technology developed during the project**[27]. Only 23 projects were assessed as having room for improvement; three projects were rated as very poor (see Figure 4-9).

[27] Question: How strong is the business case and concept for commercialisation for the technology?

Figure 4-9: Monitoring officer reports of project exploitation (n=135)



Source: QMS monitoring service provider reports (IUK), Technopolis analysis. Latest available QMS report used (July 2025).

"[Funding] is important, company's not a big company, it's an SME, and a chunk of funding on a project which is a new commercial area for us and a new product area for us, it just reduces the risk significantly." – Wave 3 FOAK beneficiary

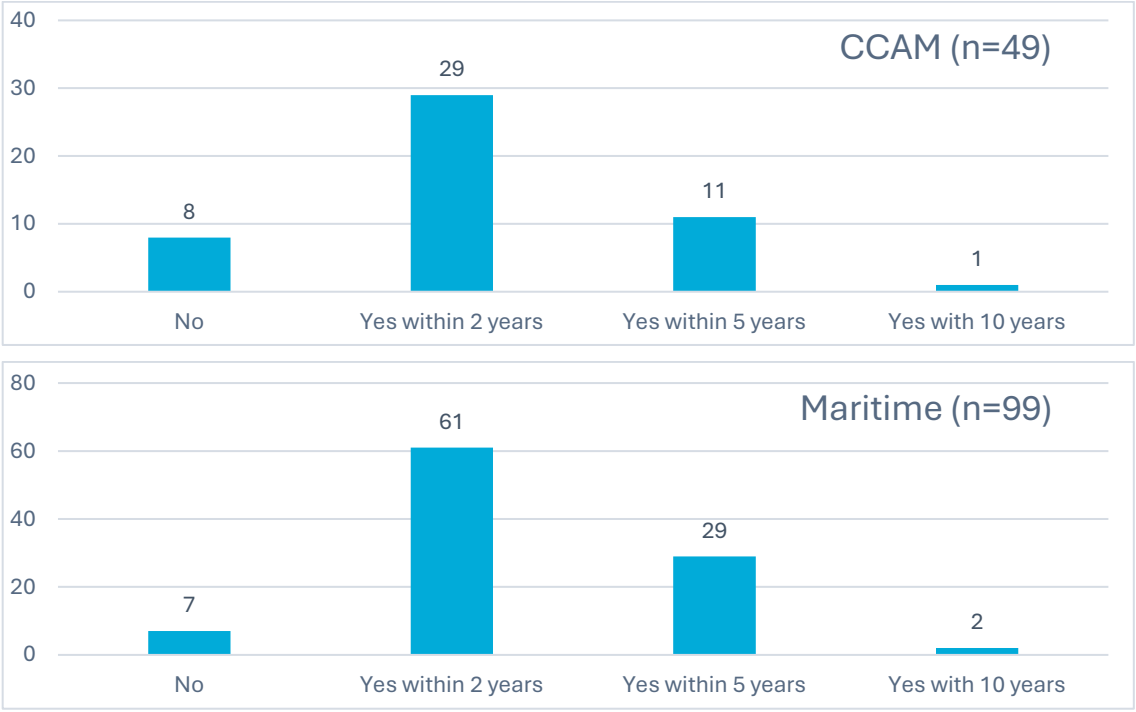
"We are seeing a lot of commercial opportunities coming through and we are not that far away from being able to address those with essentially a commercial product, and one or two of these opportunities are in the UK, but there are quite a few overseas as well." – Wave 3 CCAM beneficiary

"One of the partners within the project is the end customer. They have won two additional contracts because of this technology and now they are looking to roll it out in other areas of their organisation." - Wave 2 CCAM beneficiary

4.33 The pathway to commercialisation, and progress made to date, was further interrogated via both IMS data and the beneficiary survey.

4.34 IMS data is only available for a sub-set of LMT programmes. However, this indicates that 29 CCAM beneficiaries (59% of those responding) and 61 Maritime beneficiaries (61% of those responding) expect their project to result in new products, services, or processes being brought to market within the next two years (see Figure 4-10).

Figure 4-10: Project beneficiaries' views on whether the project will result in new products, services or processes



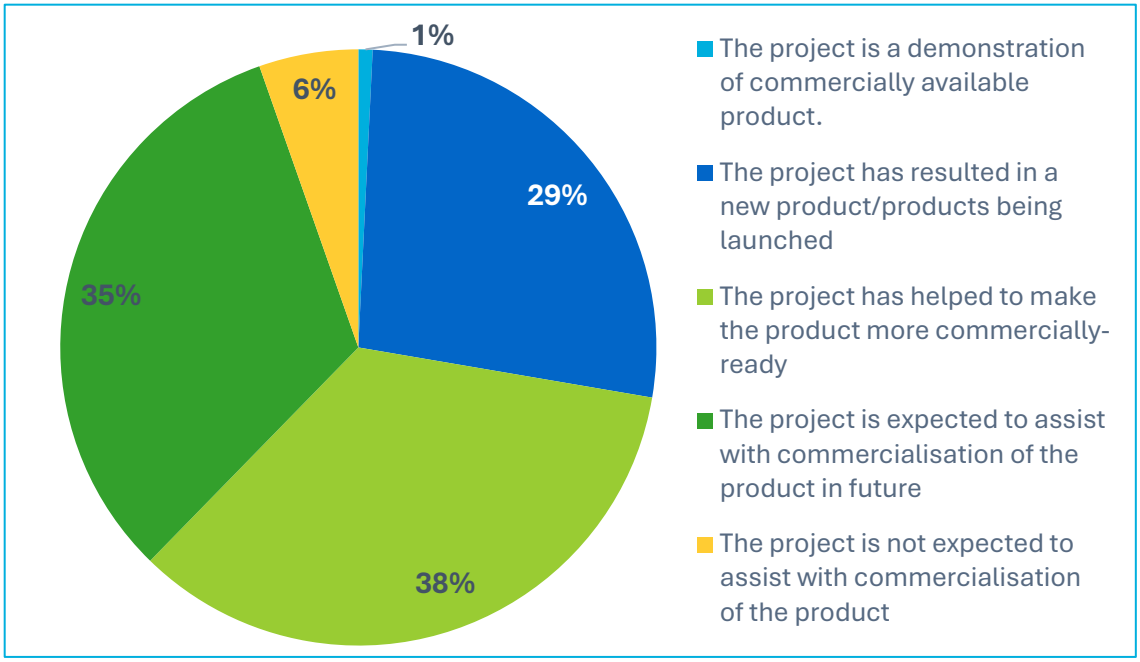
Source: Analysis of IMS data, 2026. Question: "As a result of this IUK support, does your business expect to launch any new or significantly improved products, services or processes?" Note that IMS data was available for only a subset of programmes - CCAM and Maritime beneficiaries were asked this particular question (and not all provided a response). The most recent (in-flight / closure) response has been used. Note also that 63 respondents selected 'not applicable'.

4.35 IMS data (latest responses as of 2026) shows responding companies reporting that **over £1.11bn in private funding was leveraged**[28] as a result of the LMT support through the CCAM programme and **over £20m** for the Maritime programme.

4.36 Wave 2 survey respondents across the LMT portfolio were also asked about progress in terms of getting products to market. **29% of respondents indicated that their projects had already resulted in a new product or service being launched** (or that the project was demonstrating an already commercially available product).

[28] £1 billion of this total was reported by one company that had recently completed a series D investment round.

Figure 4-8: Progress of LMT projects in terms of helping to get products to market (n=119)



Source: LMT Beneficiary Survey, Technopolis analysis, 2025 (Wave 2). Question: 'Which of the following statements best represents current progress in terms of helping to get the product to market?" Excludes 11 who answered 'unsure'.

4.37 By way of example, one of the survey respondents mentioned they had developed a new product called the H360-S, a radar sensor that delivers 360-degree coverage without moving parts. The radar sensor eliminates mechanical components like motors, minimises the risk of failure and lowers maintenance requirements, making it a cost-effective solution for automotive systems.

"The H360-S is the world's first solid-state 360 radar sensor for robotics and autonomy applications. The H360-S can replace multiple traditional sensors with one high-performance yet low-cost device." - Wave 3 CCAM beneficiary survey respondent

4.38 Similar results were obtained from the Wave 3 survey (n=174), with 18% reporting that their project had already resulted in a new product or service, 36% saying it had helped to make the product more commercially ready, and 42% reporting that it is expected to assist with commercialisation of the product in future.

"It's de-risked primarily the speed with which we've been able to engage industry partners and other stakeholders, [...] The fact we are awarded a FOAK project comes with a lot of credibility [...], it's thrown open doors way beyond what I would have thought possible." – Wave 3 FOAK beneficiary

"Post CMDC three we have commercialised. So, we are a business that is making revenue. We've made about 1.5 million in revenue demonstrating pioneer delivering payload capabilities." – Wave 3 Maritime beneficiary

4.39 Two further examples of commercial progress are presented below, taken from the in-depth case studies of particular projects.

CCAM case study vignette showcasing progress towards commercialisation

Project Harlander (see Appendix A.II) is a collaborative project led by Belfast Harbour, with ANGOKA, British Telecommunications, eVersum, Oxa and HORIBA MIRA. The project is funded through the CCAM: Deployment programme.

Electric autonomous vehicles offer a route to provide clean, efficient and affordable public transport that aligns with net zero targets and connectivity to other modes of transport. The Harlander project focuses on deploying two autonomous electric passenger shuttle buses on public roads between the Titanic Halt train station and key destinations across Belfast's Titanic Quarter and the Titanic Belfast exhibition. These areas have a high demand for public transport and experience significant congestion due to limited access points.

The project is now close to completion and has resulted in notable commercial progress for the partners in the consortium:

- eVersum has developed a new Level 2 autonomous vehicle platform with high passenger capacity and disabled access that could be used across the UK (fully integrated with the Oxa Driver and AV stack). The project team reports that there are now potential buyers for the vehicle. They also add that the Autonomous Drive integration carried out in the vehicle provided valuable experience in getting to operational readiness and meeting regulatory requirements in the UK.
- HORIBA MIRA developed a safety assurance case for lvl4 autonomous vehicles which is now on the market. This demonstrates their capability to lead full end-to-end safety assurance programmes for future automated vehicle deployments.
- Oxa is building on the success of Harlander by pursuing other projects with consortium partners. The company has discovered new directions for its business and is focusing on near-term passenger transportation deployments in off-road environments such as airports and ports, where there is further potential to commercialise outputs from the Harlander project.

Overall, a key enabler was a project management team that was able to keep the partners working together, especially when their internal strategic direction changed. This ensured that the project kept progressing to meet its objectives, despite technical challenges along the way and the early withdrawal of a project partner.

"By participating in Harlander project Oxa has significantly strengthened its relationships with key OEM and ecosystem partners like eVersum, Belfast Harbour, Angoka etc which enabled successful collaboration in the delivery of the projects and provides a clear path for expansion on a regional scale beyond this initial public transport service e.g. industrial deployments" – Case study beneficiary

NZP case study vignette showcasing a project which has made notable commercial progress

Hitachi Rail used NZP support to turn a compact battery enclosure and cooling concept for low-floor regional trains into a contract-ready design (see Appendix C.I). Working with DB ESG and the University of Birmingham, the team combined modelling with large-scale fire tests to evidence safety, then translated results into full manufacturing drawings that fit within UK loading-gauge constraints. The commercial payoff followed quickly: the design underpinned a tri-mode train contract with Grand Central and has been carried into further bids, while the safety findings have been shared with industry bodies.

Progress was helped by a clear customer need, early operator input, and a consortium that joined platform engineering, safety, and testing. The main hurdles were practical; limited UK capacity for rail-scale battery fire testing and the administrative overheads typical of regulated projects. Even so, the grant de-risked the expensive evidence base and shortened the path from idea to a product operators can buy.

4.40 IMS data includes self-reported information on additional turnover generated as a result of LMT projects, as well as the additional turnover that is expected to be generated in the next five years. The latest available response from each beneficiary has been used. The beneficiaries responding to the questions on turnover[29] reported an **additional £78m of turnover generated already as a result of their projects, with an additional £2.5bn expected over the next five years.** IMS asks for additional details, but few provided further information on the sources (or potential sources) of this turnover.

4.41 It is important to note that this is self-reported future turnover data, and therefore somewhat speculative. The question also required respondents to separate out additional turnover resulting specifically from the LMT projects, which may have been challenging in some cases.

Barriers and enablers to technological and commercial development

4.42 The potential barriers to commercial development were discussed with both beneficiaries and wider stakeholders, who collectively pointed to a wide range of hurdles that might prevent technologies from achieving commercial success.

4.43 Across the portfolio, the key barriers mentioned included the following (similar issues were highlighted across the different Waves of fieldwork).

- **A need for regulatory clarity, or for regulatory mechanisms to incentivise change.** For example, CCAM consultees pointed to the need to define the secondary legislation related to the Automated Vehicles Act, ZEHID beneficiaries noted the need for reconsideration of current weight and length restrictions on HGVs (given the extra weight of current battery technologies compared with diesel alternatives), and TVH beneficiaries mentioned difficulties with securing planning permission for hydrogen infrastructure, while FOAK beneficiaries and stakeholders pointed to a range of

[29] 179 beneficiaries answered this question, although 118 of these entered ‘zero’.

regulatory uncertainties including renationalisation of rail and fragmented responsibilities across different public bodies.

- **A need for follow-on grant funding.** Consultees, including for FOAK, ZEHID, NZP and CCAM programmes highlighted the need for further grant funding to continue to develop technologies that were not entirely market ready, as well as the need for greater information and certainty on potential future funding routes and for this to be available directly after the current programmes.

"We're seeing some of the technologies coming out of FOAK being deployed but then staying stagnant without further FOAK funding. I could probably name three companies that do that." – Wave 2 FOAK wider stakeholder

"I think if the funding was not there, it would not have happened. It would have been far too expensive for all operators to even consider being involved, there is a massive gap currently [between the cost of diesel and hydrogen trucks]." – Wave 2 TVH beneficiary

"Once the project ended, we essentially no longer had budget to continue it ... there wasn't a clear follow-on funding pot to move to" – Wave 2 NZP beneficiary

---

- **A need for greater industry and public acceptance.** This was noted in particular for CCAM and TVH programmes, where there was felt to be a real need to provide reassurances around safety, but was also a broad topic of discussion in other programmes. For instance, FOAK beneficiaries felt that frontline staff can be reluctant to change established practices (reflecting, as they see it, the rail sector's risk-averse culture and safety-critical priorities). Across the portfolio many demonstrators are still underway, which are expected to provide greater confidence in the technologies concerned, which may assist with wider acceptance.

"I think the cost will be difficult for the public to conceptualise and accept if we don't make the benefits of the technology clear. It is important to think about how we lay the groundwork for accepting the technology and tackling the cost barriers via subsidies and grants."- Wave 2 CCAM wider stakeholder

"The big question is how the public will accept the technology. We have seen a split in passenger reaction. Some think it is fantastic and want it rolled out, others are much more hesitant. There is a very slow shift in the acceptance of autonomous vehicles. Once that changes, the commercial aspect will become more viable." - Wave 2 CCAM beneficiary

---

- **A lack of infrastructure.** Consultees for both the TVH and NZP programmes mentioned the high costs and lack of availability of hydrogen as a barrier to development and commercialisation. This creates a lack of incentives for fleet operators to move to hydrogen-powered vehicles.

"There is a lot of support available through hydrogen allocation rounds to support green hydrogen and make it more affordable. Once it is affordable, people will buy it." – Wave 2 TVH beneficiary

"We as the manufacturers are doing everything that can be done to make the technology more commercially viable, but we are at a junction where we need the infrastructure to start growing in the UK, because it is a chicken and egg scenario, where if trucks become cheaper customers will not buy them, because the infrastructure is not there, on the other hand if the infrastructure is there, but the trucks are not cheaper, no one will buy them." – Wave 2 TVH beneficiary

TVH case study vignette showcasing a project which has faced barriers to commercialisation

The ZEHyDA-2 project (see Appendix E.I) hopes that the development and demonstration activities within the programme will lead to further similar projects and contracts elsewhere.

However, localised operations (where local refuelling sites can be used) may continue to be the main focus in the shorter term. The project lead believes that to move beyond these, a national hydrogen infrastructure would be needed, and this would probably need a big public policy push (as has been seen in Germany and other Northern European countries). Currently, the UK has just two or three hydrogen hubs (including the Tees Valley), whereas some other countries have dozens of sites.

In the more immediate term, a key enabler for achieving some of the intended project outcomes is the availability of hydrogen supply at Teesside International Airport, which was to be provided through the recently suspended Refuelling Hub project within the same programme. The supply of hydrogen at TIA is outside the ZEHyDA-2 project team's control, and the demonstration of real-world operations at TIA can only proceed if this supply is in place.

4.44 Whilst beneficiaries and wider stakeholders were more readily able to identify barriers than enablers to commercialisation, the following factors emerged through Wave 2 and Wave 3 interviews:

- **Projects which are already at an advanced stage:** projects which have entered LMT programmes at a relatively high TRL were considered lowest risk, and most likely to achieve technological and commercial success.
- **Real-world access:** easy access to sites, fleets, depots, and communities enabled rapid progress in technology and commercial readiness.
- **Projects where potential customers are involved as partners:** projects which were able to demonstrate involvement of a potential customer within the partnership demonstrated a clearer pathway towards commercialisation. In some cases, beneficiaries anticipated that the project partner would be the first customer of the product (if the demonstration is successful), thus providing initial revenue for the company while also offering an opportunity to spread the word. The ability to iterate technology based on direct customer feedback was also effective in demonstrating the use case.
- **Absence of regulatory blockers:** projects for which there is no regulatory dependence for the technology to be commercially viable were more likely to

demonstrate a clear pathway to commercialisation. In contrast, the presence of regulatory challenges (or lack of regulatory clarity), along with supply-side dependencies, posed challenges to establishing a pathway to commercialisation.

FOAK case study vignette showcasing a project which has made notable commercial progress

The Cross Freight project (see Appendix B.II) developed a modern software platform to automate freight access right management and enable service planning, replacing fragmented, out-of-date spreadsheet-based systems. The platform was designed to support a modal shift from road to rail, improve efficiency, reduce operational errors, and unlock underutilised rail freight capacity.

The project successfully delivered a baseline product that has been commercialised with Network Rail and is now in national use. Building on this foundation, the technology continues to evolve through ongoing development and further investment by Hack Partners. Through the project, Hack Partners established partnerships with seven of eight Freight Operating Companies, safeguarded three jobs, and created a pipeline of several follow-on revenue-generating opportunities.

The primary barrier to broader commercialisation is changing entrenched behaviours within legacy processes, including resistance from staff accustomed to existing manual practices. Key enablers include close engagement with end users, iterative development, and FOAK-facilitated access to commercial stakeholders, which helped to build trust, develop a strong use-case and accelerate adoption.

TDD case study vignette showcasing a project which has made notable commercial progress

The Paua PINS project (see Appendix D.II) set out to tackle a simple but pressing problem: many fleet depots already have EV charging infrastructure, but it sits idle for much of the day.

The project launched a digital platform enabling fleets to book charging sessions at underused depot charge points, onboarding 12 depots during the programme. Early adopters reported charging cost reductions of more than 50% compared with public networks, providing clear commercial validation. Revenues began flowing before the project concluded, and the business has since built a growing sales pipeline.

Progress was not without friction. Concerns about insurance, liability, and operational complexity meant some large depots were hesitant to participate, while insurance frameworks for cross-operator use remained underdeveloped. These barriers slowed adoption and highlighted the need for regulatory clarity. On the other hand, several factors acted as strong enablers; Cenex's role in convening partners, supportive LAs willing to trial depot sharing, and the production of a best-practice white paper that gave the platform market credibility. The result is a product now live in the market, with paying customers and a clear growth trajectory.

Maritime case study vignette showcasing a project which has made notable commercial progress, plus commentary on the barriers and enablers

Led by ACUA Ocean Ltd, Hydrogen Innovation – Future Infrastructure & Vessel Evaluation and Demonstration (see Appendix G.II), involved the design, build, and certification of the UK's first hydrogen-powered autonomous Small Waterplane Area Twin Hull vessel, the uncrewed surface vessel Pioneer, along with a mobile hydrogen bunkering station.

The project delivered major technical breakthroughs, including first-of-its-kind regulatory approvals under Workboat Code 3, allowing the vessel to enter commercial service and begin generating revenue soon after certification.

The project faced significant challenges including a mid-project shift from liquid to gaseous hydrogen, difficulties with one of the consortium partners, and working through an under-developed regulatory landscape.

Despite this, the project succeeded through strong engineering capability, collaborative engagement with Lloyd's Register and the Maritime and Coastguard Agency, and support from an otherwise helpful and experienced consortium.

UKRI support was the key enabler for the project's success, and ACUA Ocean have stated that without CMDC funding the project would not have taken place.

Conclusion

4.45 LMT programmes have successfully advanced technologies, with widespread reporting of advances in TRLs during projects. Combining information from across survey Waves shows that 72% of beneficiaries have progressed at least one TRL during their project, while many moved several levels (a movement of +1.7 TRLs on average). 77% reported in the Wave 2 survey now being at level 5 or above, including 18% at TRL 9.

4.46 Reaching high TRL levels does not necessarily equate to commercial readiness. However, IMS data reveals that 39% of CCAM and Maritime respondents have also seen an increase in their MRL (of between one and nine levels, +0.8 on average). In their latest reporting, 50% now sit at the higher MRL range (MRL 8 – Value proposition defined, or above). Across the full portfolio, 29% of Wave 2 survey respondents indicated that their projects had already resulted in a new product or service being launched, and the latest available IMS data suggests that an additional £78m in turnover has already been generated as a result of LMT projects.

4.47 A number of barriers to further progress and commercialisation remain however, with beneficiaries commonly reporting a need for greater regulatory clarity, stronger incentives to support market transition, follow-on funding to bridge commercialisation gaps, and wider industry and public acceptance of emerging technologies.

5 Growing organisational maturity and employment through programme delivery

Key Messages

- 86% of Wave 2 respondents across all programmes reported that the project had contributed positively to organisational skills development (supported by 85% of Wave 3 respondents).
  - This was particularly high for CCAM, where 94% of Wave 2 respondents stated the project had a positive impact on organisational skills
- Projects were reported to have enhanced technical and regulatory understanding, improved market knowledge, and provided access to new equipment and testing facilities.
- Projects were reported to have led to technology improvements, better understanding of government-funded schemes, stronger partnerships, deeper insights into market needs and new contract opportunities.
- 33% of Wave 2 beneficiary survey respondents stated that new jobs had been created as a result of their projects (echoed by 31% of Wave 3 respondents).
  - This was particularly high for FOAK, where 46% of Wave 2 beneficiaries reported new jobs created
- 58% Wave 2 beneficiary survey respondents reported existing jobs being supported (echoed by 58% in Wave 3).
  - This was particularly high for Wave 2 programmes: FOAK (77%), TDD (75%) and NZP (73%)
- 46% of Wave 2 beneficiaries expect to have additional Full Time Equivalent (FTE) employees in five years' time (supported by a further 65% of Wave 3 beneficiaries).

Introduction

5.1 This chapter sets out the impact that projects have had on lead and partner organisations. As shown in the high-level logic model (Figure 1-1), previously outlined in the Introduction chapter, delivery of LMT projects is expected to stimulate growth in the capability, capacity, resilience, workforce and skills of beneficiary organisations. This will ultimately lead to growth in the maturity and scale of the relevant sectors, with corresponding economic benefits. This chapter sets out the mechanisms by which

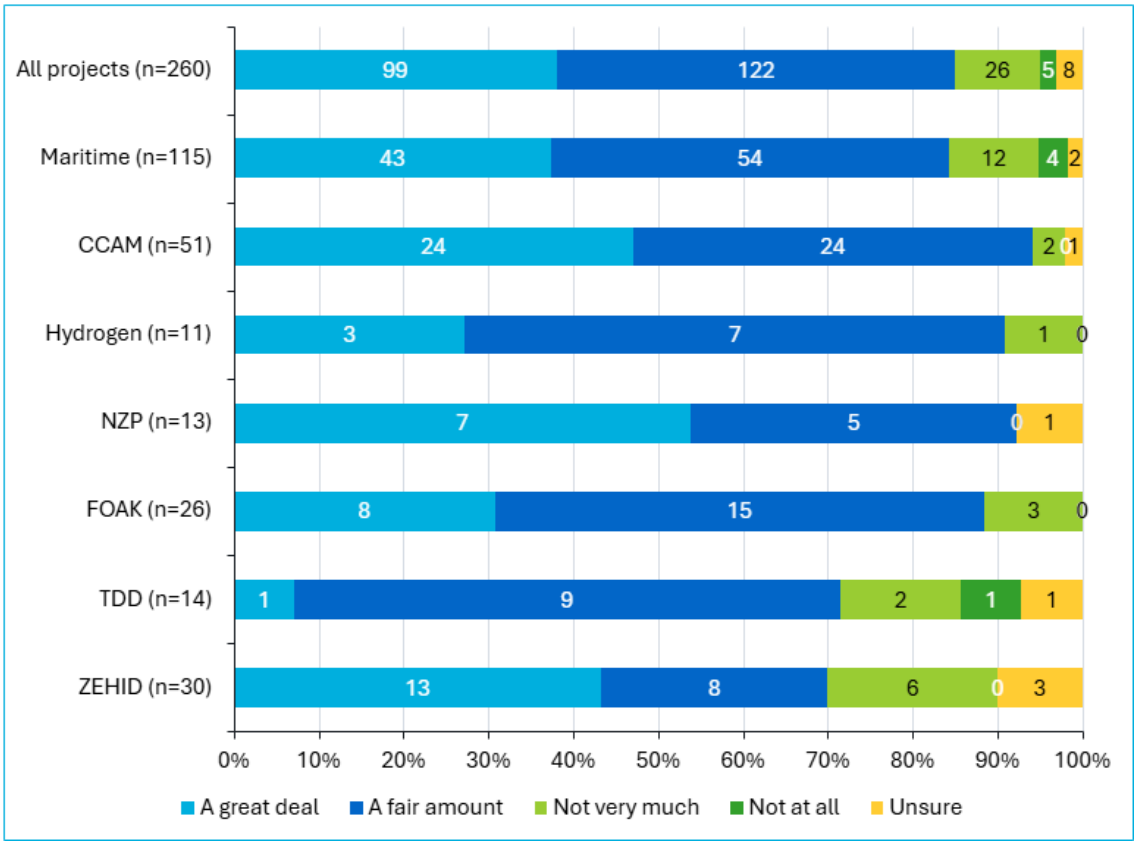
activities have impacted organisational skills and maturity, and the role of the programmes in creating and safeguarding jobs.

How projects have contributed to skills development among partner organisations

5.2 As shown in Figure 5-1, the majority of project beneficiaries reported that the project has positively contributed to skills within the organisation. **86% of Wave 2 respondents across all programmes reported that the project had contributed 'a great deal' or 'a fair amount' to organisational skills (echoed by 85% of Wave 3 respondents)**. This was particularly high in CCAM where 24 out of 51 Wave 2 respondents said CCAM had strengthened organisational skills 'a great deal' while an additional 24 reported improvements of 'a fair amount'. This amounted to 94% of Wave 2 respondents stating CCAM had a positive impact to organisational skills.

"The project has had a strong positive impact on skill development within our organisation. It has led to the creation of new knowledge in cutting-edge technologies, the development of a bespoke test platform, and the establishment of innovative processes. These advancements have significantly enhanced our technical capabilities and research expertise." - Wave 2 CCAM beneficiary survey respondent

Figure 5-1: Projects' reported contributions to organisational skill growth, by programme (n=260)



LMT Beneficiary Survey, Steer-ED analysis, 2025 (for Wave 2) and 2026 (Wave 3, maritime only). Question: To what extent has the project had a positive impact on skill levels within your organisation? This could include

for example commercial, technical, or regulatory knowledge/skills. (Answer options: a great deal, a fair amount, not very much, not at all, unsure)

5.3 Across the programmes, evidence from beneficiary surveys and interviews reinforced that programmes have supported organisational skill development. A variety of mechanisms contributed to this progress, including:

- **Enhancing technical and sector understanding:** Beneficiaries consistently claimed that the project increased their knowledge on their programme-specific technology and deepened their understanding of associated challenges and solutions. Some beneficiaries noted that this enhanced capability enabled them to deliver more services in house, plan more strategically and respond more effectively to emerging industry issues. Many beneficiaries also had access to new equipment or testing facilities, which further supported the development of technical skills, technology design capabilities and implementation processes.

"The project has increased our knowledge, understanding and capabilities specifically on hydrogen combustion. We have been able to develop the technology and test equipment to increase these capabilities, which will be of massive help in future" – Wave 2 TVH beneficiary survey respondent

"The engineering team have certainly been engaged and learned a lot through this process. It's really key that they understand the technical aspects of the vehicle, how we manage the battery technology, how we get the best out of it, how we cascade that information correctly to the drivers as the end users." – Wave 3 ZEHID beneficiary

"That's a massive skill that's come in-house that again, we wouldn't have been able to do without this innovation funding. Not only does it save Chartwell cost, but it also offers us an opportunity to offer it as a service to other customers." – Wave 3 Maritime beneficiary

---

- **Enhancing regulatory understanding:** Across the programmes, beneficiaries often claimed that the project helped their understanding of the regulatory environment, requirements and emerging standards. Beneficiaries said this has strengthened their understanding for future projects, with some indicating it has given them a competitive advantage by equipping them to respond to policy change more effectively. These insights were also said to have informed both design and implementation processes. Some CCAM beneficiaries further highlighted that this improved understanding has enabled organisations to participate in wider policy conversations with both central and local government.

"I think there is a much greater understanding of what will be expected of organisations like ours in the future and how the legislation will apply to us. We are a lot wiser to those things. Beyond the immediate project team, it has also given us an opportunity to educate people in senior director roles, on what is likely to come towards them in future." – Wave 2 CCAM beneficiary

---

- **Understanding of market needs and client base** (as discussed in Chapter 4): Multiple beneficiaries stated that their projects provided valuable insights into market requirements and client expectations. This deeper understanding has helped them better position and pitch their technologies, identify target clients and establish partnerships with potential future customers.

"FOAK has given us another product offering that we didn't have before the project. So, it's increased our…technology capability and in terms of who our clients are." – Wave 2 FOAK beneficiary

"We increased our awareness of commercial issues involved in developing this kind of project, which will be applied to future projects" - Wave 2 TVH beneficiary survey respondent

- **Understanding of government-funded schemes:** Multiple programme beneficiaries said their understanding of the processes and procedures involved in government-funded initiatives had improved, including managing public funding effectively. Several also expressed greater confidence, interest and readiness in applying for future schemes.

"I think the whole process of doing this has given us confidence that we can deliver. We can deliver for the UK government and, you know, spend the grant money within the time window effectively." – Maritime Wave 3 Beneficiary

- **Improvements in organisational practices and project management skills:** Across most programmes, beneficiaries reported embedding project processes – such as managing risk, stakeholders and budgets – into their daily operations. For example, one FOAK beneficiary said, their project management teams have adopted structured reporting and monitoring approaches demonstrated by IUK officers, improving efficiency and oversight. Beneficiaries also emphasised the importance of agility and flexibility, learning to adapt quickly, adjust processes, and redesign products when plans could not be set in advance, strengthening their ability to operate in fast-paced, non-linear environments.

"Our commercial progress in terms of our wider rail product portfolio, is massively significant […and] in terms of wider benefits, there's been new methods as, as you do these things, you improve your processes and methods, and we've got more documentation and planning in place." – Wave 3 FOAK beneficiary

"The knowledge gained from the project has enabled us to enhance and change some of our internal processes, which in turn changed our service that we provide to our customer. At the end of every project, we do a lessons learnt exercise, and we use this to improve our processes for both applying for and delivering future R&D projects." – Wave 3 CCAM beneficiary

NZP case study vignette showcasing how a project has resulted in the maturing and skills development of the organisation(s) involved

Talos used HiPERMod (see Appendix C.II) to move from a consultancy mindset to a product-orientated business. The project funded new engineering hires, specialist modelling tools, and a build-and-test programme that took its dual-flux motor from early concepts to a working motorcycle demonstrator. In the process the team learned to balance simulation with physical validation and to hold scope when partners failed, rebuilding the plan after two collaborators went into administration. They also developed internal processes for testbed testing, documentation, and IP management, filing patents to protect the core design. "Where we were three years ago, external investors would not really be interested in the company because it was nothing proven. It was just some ideas. IUK has taken that risk with us and now we're in a much better position." – Case Study Beneficiary

The demonstrator became a credibility anchor with OEMs and investors, helping Talos to secure £1.8 million in follow-on funding and to plan the next steps toward higher TRLs. In short, the project accelerated skills growth in powertrain design and controls, strengthened delivery discipline, and built the commercial acumen needed to engage fabricators and scale manufacturing.

5.4 During interviews, some programme beneficiaries identified challenges in skills shortages, highlighting the value of innovation programmes in addressing these gaps. Some beneficiaries and wider stakeholders indicated skill gaps in commercialisation pathways and routes to market. For example, some FOAK beneficiaries suggested that additional advisory support from IUK would be beneficial in facilitating closer collaborations between innovators and end users. Other beneficiaries highlighted skill gaps in operational roles (notably, FOAK and ZEHID). For example, ZEHID beneficiaries remarked that the sector has an ageing driver workforce and limited new entrants, whilst FOAK wider stakeholders and beneficiaries reported skill gaps including, low digital literacy, limited software skills and unfamiliarity with artificial intelligence and automated processes that can slow the adoption of new technologies. Beneficiaries highlighted that the skills developed through projects are crucial in addressing such gaps.

"We're deep in telematics field and yet need skills. From vehicles to energy to executives." – Wave 2 ZEHID beneficiary

How programmes have contributed to growth in organisational maturity amongst partner organisations

5.5 The skills developed through projects were reported to have strengthened organisational maturity and capability across beneficiary organisations. Many beneficiaries reported that the project enhanced their credibility and raised their industry profile, leading to greater visibility within their specific sectors. This increased visibility has translated into tangible

benefits, including new contracts, business opportunities, and enhanced engagement with partners and potential clients.

5.6 Beneficiaries also reported that their organisations are better equipped to scale their product (as illustrated in the TDD case study vignette) and to develop new technologies, services, and products, building on the skills and insights gained through the programme. These capabilities stemmed from practical experience and learning throughout project development.

5.7 Beneficiaries further highlighted that integrating product learning into future workstreams has improved strategic decision-making, guided product development, and driven ongoing innovation, meaning they can respond to client requests 'much quicker'. A notable example includes the early identification and securing of test assets, sites, and permissions – now recognised as a critical success factor for future projects.

5.8 In addition, some FOAK and TVH beneficiaries reported that their participation in the project has enabled them to explore opportunities to adapt and transfer their products into new sectors, broadening their potential market reach and commercial viability, and opening pathways for cross-sector innovation.

"[FOAK project has helped] build our internal skills [...] and by doing these proof of concepts, we've also been able to [...] think about what we could be doing in the wider context of rail and potentially how we can use our skills and demonstrate what we could do for other areas that we may not have previously worked in." - Wave 3 FOAK beneficiary

---

5.9 Collectively, these developments demonstrate a deepening of organisational capability, capacity, and readiness to meet future challenges with greater confidence. They serve as evidence of growing organisational maturity, driven by strategic learning, enhanced credibility, and the integration of new skills into core operations.

TDD case study vignette showcasing how a project has resulted in the maturing and skills development of the organisation(s) involved

HomeRun (see Appendix D.III) entered the TDD programme with a proven concept for school travel planning but limited organisational experience working at county scale.

This shift demanded new technical skills in data engineering, validation, and visualisation. It also required a stronger grasp of local authority governance, procurement, and reporting processes to ensure outputs aligned with decision-making cycles. By the end of the project, HomeRun had not only delivered a live platform used across 550 schools but also built the internal capacity to scale the approach elsewhere. The team described the programme as a turning point, helping them to mature from a pilot-stage start-up into a credible data partner for councils nationwide.

The role of programmes in creating and safeguarding jobs

5.10 Across all programmes, beneficiaries reported that the project had enabled job creation and safeguarding, supporting organisational skill development[30].

- In the beneficiary survey, **33% of Wave 2 respondents stated that new jobs had been created as a result of their projects** (between 1-50), supported by **31% of Wave 3 respondents** (between 1-42). Meanwhile **a higher proportion (58% in both Wave 2 and Wave 3), stated that existing jobs had been supported** (between 1 and 250 for Wave 2 and 1-160 for Wave 3).
- Across all programmes, this amounted to beneficiaries reporting that:
  - **181 jobs had been created** in Wave 2, **with 63 jobs reported as created** in Wave 3; and
  - **689 jobs had been supported** in Wave 2, **with 119 jobs reported as supported** in Wave 3.

5.11 Table 5-1 sets out the proportion of beneficiary survey respondents who reported jobs being created or supported as a result of the project, by programme. It is important to recognise this is only for the subset of beneficiaries who responded to the survey and were able to provide a numerical answer. This may reflect several factors:

- Respondents may not be responsible for making hiring decisions
- Some projects are still developing and therefore it may be difficult to be definitive about the organisational impact
- Perhaps most importantly, it can be challenging to disentangle the various factors that have led to a decision to hire a new employee, and therefore attribution to this programme specifically is challenging to conclude.

[30] Job creation and safeguarding were also evident in the Wave 1 findings. Specifically, 29% of Wave 1 survey respondents reported that their projects had created between one and three new jobs, while 57% indicated that between one and six jobs had been supported. These figures reinforce the notion that the LMT programme contributes to both job creation and retention. However, it is important to note that these findings are based on a cross-sectional snapshot of Wave 1 data and do not reflect a longitudinal comparison across multiple Waves.

Table 5-1: The percentage of beneficiaries reporting that jobs have been created and supported by programme (n=145)

Programme	Beneficiaries reporting new jobs created	Beneficiaries reporting existing jobs supported
Maritime (n=115)	29%	52%
ZEHID (n=26)	35%	39%
CCAM (n=51)	35%	67%
TVH (n=11)	27%	55%
FOAK (n=26)	46%	77%
NZP (n=13 and 11)*	39%	73%
TDD (n=6 and 8)*	17%	75%
Total	**31%**	**55%**

*Sample sizes varied between questions on jobs created and jobs supported and are reflected by the sample size range.

LMT Beneficiary Survey, Steer-ED analysis, 2025 (Wave 2) and 2026 (Wave 3, maritime only). Question: Has the project resulted in the creation of new jobs, and/or existing jobs being supported? (Answer options: new jobs created - specify number, Existing jobs supported – specify number, None, Unsure)

5.12 These findings were corroborated by interview data, in which beneficiaries reported that projects had facilitated the hiring of new individuals, thereby enhancing the organisation's skills and knowledge base. Across all programmes, beneficiaries also reported that the project supported existing jobs, and in addition enabled some staff to accelerate their career through receiving more responsibilities and opportunities. More broadly, some Maritime beneficiaries highlighted wider labour-market benefits, noting improved employability of UK graduates within the maritime sector and positive spillover effects for the wider skills ecosystem, even where employment growth within individual organisations remained constrained.

"We are an SME, employ 100 people and run from one location. However, the project has moved us from a small SME operator to something larger. Our brand exposure also increased significantly because of it." - Wave 2 CCAM beneficiary

"Having that funding come in has allowed us to go through an entire process of recruitment cycle, talk to the young graduates coming out of the universities, and also talk to highly professional and skilled professionals." – Wave 3 FOAK beneficiary

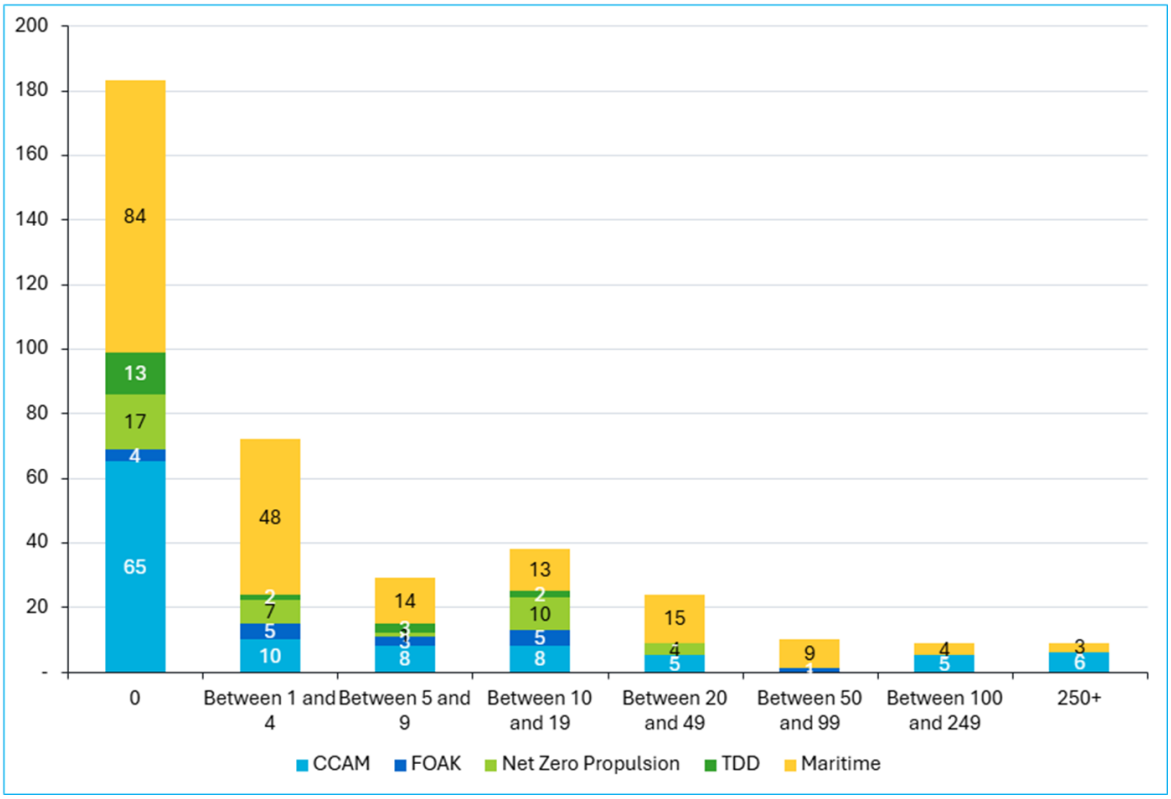
"We have taken on more engineers, and we have developed their skills. We have taken on graduates who have been able to work with our senior engineers and are getting increasingly confident and competent." – Wave 3 CCAM beneficiary

"One part of the project is to design training courses for seafarers to operate ships that have future fuels installed. So that they'll graduate with the right certificates to operate ships." – Wave 3 Maritime beneficiaries

5.13 Figure 5-2 provides a view of anticipated future job creation (in five years' time), collected via IMS data in Wave 2. This data does not cover all programmes (due to early status of IMS data collection). However, within the data collected:

- **46% of Wave 2 beneficiaries[31] said that, as a result of IUK support, they expect to have additional Full Time Equivalent** (FTE) employees in five years' time (supported by 65% Wave 3 beneficiaries[32]).
- Anticipated FTE was particularly notable in CCAM. While projections varied widely – from 1 to 1,000 additional FTEs per organisation – Wave 2 beneficiaries anticipated 2,177 additional jobs. This trend was reinforced in Wave 3, where CCAM beneficiaries anticipated a further 6,308 additional jobs.

Figure 5-2: Expected number of FTE employees in five years' time, as a result of IUK support, CCAM, FOAK, TDD and NZP only (n=374)



Source: Analysis of IMS data, 2025 (Wave 2) and 2026 (Wave 3, maritime only). Question: As a result of this Innovate UK support, how many more or less Full Time Equivalent (FTE) employees do you expect to have in your business in five years' time?

5.14 Despite this, while beneficiaries predominantly reported positive impacts and future outlook in regard to job creation, it is worth noting that one FOAK beneficiary, who leads two FOAK25 projects, raised concerns about the long-term sustainability of roles created through the project. Specifically, concerns were expressed regarding the ability to retain staff once project funding ends. The beneficiary suggested that Innovate UK could provide

[31] IMS data was available for four programmes in Wave 2: CCAM, FOAK, TDD and NZP.

[32] IMS data was available for three programmes in Wave 3: CCAM, FOAK and Maritime.

additional post-competition support to help small companies bridge the funding gap and maintain their teams beyond project completion.

Conclusion

5.15 Across all programmes, the beneficiary survey and interviews evidenced that **projects have strengthened the capability, capacity, resilience, workforce, and skills of beneficiary organisations**. The majority of beneficiaries reported positive impacts on skill development, including enhanced technical and sector knowledge, regulatory understanding, market insight (including beyond their sector), and improvements to internal practices. These gains have enhanced organisational maturity and, in some cases, increased credibility and industry profile within their respective sectors.

5.16 Furthermore, **the respective projects have played a role in employment outcomes across all programmes**. A third of beneficiaries reported the creation of new jobs as a direct result of their projects, while over half of respondents in both Waves indicated that existing jobs had been supported. These outcomes were corroborated by both survey data and interviews, which highlighted that projects facilitated both the hiring of new staff and the upskilling of existing employees. In some cases, stakeholders noted that the programmes support for existing jobs has led to accelerated career progression, opportunities for graduates and greater organisational growth.

5.17 Looking ahead, **nearly half of CCAM, FOAK, TDD, NZP and Maritime beneficiaries, expect further job growth within five years,** particularly in sectors such as CCAM, where substantial future job creation is anticipated. These findings indicate that the programmes play a role in organisational improvements, as well as in promoting employment opportunities and longer-term growth.

6 Looking ahead: potential impacts on wider framework conditions and long-term outcomes

Key Messages

- While it remains too early to assess long-term outcomes, early evidence indicates that the LMT programme is beginning to build trust, awareness, and adoption of new technologies.
- Engagement with regulatory stakeholders has been widespread and consistent. In Wave 2, 63% of beneficiaries reported contact with regulators and 37% reported contributing to regulatory development; in Wave 3, 61% reported regulatory engagement and 32% reported regulatory influence.
- Several beneficiaries noted that their projects provided regulators and standards bodies with new safety and performance evidence, particularly in areas such as hydrogen fuel propulsion for aviation, rail battery systems and maritime certification pathways.
- Looking ahead, beneficiaries remain optimistic about the potential broader impacts of their projects. In Wave 2, over 80% of respondents anticipated carbon reduction, export potential and wider environmental benefits. Wave 3 findings show a similar pattern, with the same three impacts most commonly cited (83%, 80% and 74%, respectively).
- Interview evidence reinforces these expectations and highlights additional anticipated benefits, including improved safety outcomes, operational efficiencies and emerging supply-chain resilience, particularly for ZEHID.
- Persistent barriers to achieving long-term outcomes, identified in Wave 1 and corroborated in Wave 2, include limited enabling infrastructure, regulatory challenges and the need for coordinated action.

Introduction

6.1 This chapter discusses the role that projects have played in influencing trust in, and adoption of, new technologies, as well as their contributions to the regulatory environment. It then considers evidence suggesting potential longer-term outcomes that may be delivered by the portfolio.

The role of projects in driving adoption of new technologies

6.2 Through the depth interviews, beneficiaries reflected on the extent to which they had observed changes in the acceptance of, and willingness to use, the technologies they are developing among users and operators. Across programmes, most beneficiaries reported a positive trend in awareness, trust, and openness towards emerging technologies. However, many noted that it remains too early to fully assess long-term adoption outcomes.

6.3 Beneficiaries across all Waves highlighted the role of projects in building customer and operator trust. The most frequently cited mechanism was real-world demonstration, which allowed technologies to be observed in operation and provided tangible evidence of feasibility and performance. These demonstrations were viewed as particularly important where technologies challenged established operating models or long-standing industry practices.

> *"This technology [zero emission HGVs] disrupts a century-old system, making demonstrator projects vital to proving its viability and overcoming resistance."* – Wave 2 ZEHID beneficiary

6.4 Activities such as trials and collaborations with industry partners enabled potential customers and stakeholders to experience the technology first-hand, improving understanding and willingness to adopt. For example, in the FOAK programme, partnerships with organisations such as Network Rail were instrumental in enabling demonstrations on live tracks. Similarly, in Wave 3, under the Maritime Programme, Edwards & Renouf's APS Marine Coating was trialled on commercial fishing trawlers, with operators reporting weekly fuel savings of 50–70 gallons. This direct demonstration of operational benefits was reported to support acceptance of novel marine technologies within the sector.

6.5 Active engagement and dissemination were also identified as important enablers of adoption. Beneficiaries reported that sustained communication with industry users, potential customers, and the public, helped to increase understanding and build confidence in new technologies.

> *"Absolutely, there is more acceptance of AVs. Some of the work that has been funded by CCAV has helped that because it has created greater exposure, but also if we look at other territories around the world, what's happening in North America, China, Japan, North Korea, people are getting greater levels of exposure to these technologies, which means they are becoming more accepted."* – Wave 3 CCAM beneficiary interview

6.6 Some beneficiaries also reported early evidence of shifting attitudes among operators. For example, Hitachi (HZC), a ZEHID beneficiary, reported undertaking 600 interviews to track feelings, thoughts and attitudes towards zero emissions HGVs, identifying a gradual but positive change in sentiment as operators gained hands-on experience. While willingness to adopt remains at an early and small-scale stage, this emerging change in

mindset was echoed in Wave 3 interviews, where beneficiaries noted continued movement in a favourable direction.

> *"I think for those that those operators that are involved in ZEHID in particular, there is definitely a shift in mindset more to like a test and learn."* – Wave 3 ZEHID beneficiary

FOAK case study vignette showcasing the role of active engagement with industry users in driving commercial progress

The Cross Freight project (see Appendix B.II) developed a modern software platform to automate freight access right management and enable service planning, replacing fragmented, out-of-date spreadsheet-based systems. The platform was designed to support a modal shift from road to rail, improve efficiency, reduce operational errors, and unlock underutilised rail freight capacity.

The primary barrier to broader commercialisation is changing entrenched behaviours within legacy processes, including resistance from staff accustomed to existing manual practices. Key enablers include active engagement with end users, iterative development, and FOAK-facilitated access to commercial stakeholders, which helped to build trust, develop a strong use-case for the technology and accelerate adoption.

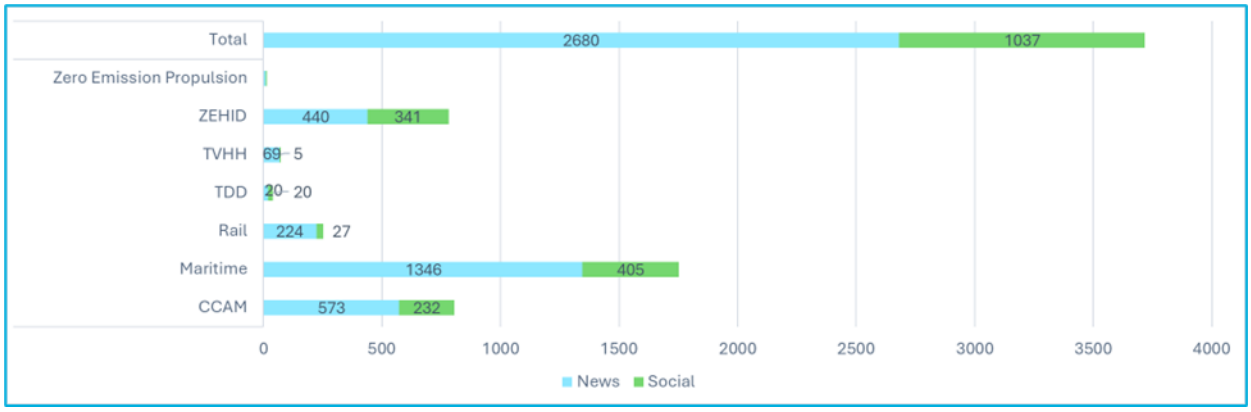
Through the project, Hack Partners established close partnerships with seven of the eight Freight Operating Companies, safeguarded three jobs, and created a pipeline of several follow-on, revenue-generating opportunities.

The project successfully delivered a baseline product that has been commercialised with Network Rail and is now in national use. Building on this foundation, the technology continues to evolve through ongoing development and further investment by Hack Partners.

6.7 Beneficiaries also highlighted local ownership and co-design as important drivers of adoption, particularly in programmes focused on place-based innovation. Engagement was strongest when technologies were visibly applied to real-world local challenges. For example, TDD projects incorporated on-street designs, flight demonstrations, and decision-support tools using local data, enabling residents and partners to observe tangible benefits. This emphasis on locally tailored solutions was viewed as critical for securing buy-in and ensuring technologies gained meaningful traction.

6.8 As explored in Chapter 4, media and communications were identified as further enablers of adoption and engagement. **An assessment of the Wave 2 LMT portfolio's media output (see Figure 6-1) recorded 3,717 media items produced over the past year, showcasing projects and their outcomes**. Beneficiaries noted that additional social media activity is planned for project closures and demonstrations, with sequencing often influenced by intellectual property considerations.

Figure 6-1: Number of individual media references to projects across different programmes



Source: Meltwater, Technopolis analysis, data collected August 2024 to August 2025, (Wave 2)

The role of projects in shaping the regulatory environment

6.9 Beyond demonstrating the technologies in question, another key role of the portfolio is to influence the regulatory framework itself, identifying areas where regulations need updating or where additional regulatory intervention may be required to facilitate technological progress.

6.10 To assess the extent of regulatory engagement, survey respondents were asked whether their projects had interacted with regulatory stakeholders. Engagement levels remained high and consistent across Waves, **with 61% of Wave 1 respondents reported contact with policymakers or other regulatory stakeholders ; this increased slightly to 63% in Wave 2** and remained consistent at 61% in Wave 3.

6.11 Wave 2 respondents were also asked whether **their project had led to or contributed to regulatory updates. 37% reported that it had, representing an increase from 29% of Wave 1 respondents.** This proportion fell slightly to 32% in Wave 3. These figures should be interpreted carefully, as the survey respondents across Waves were not necessarily the same individuals. Therefore, an increase does not necessarily mean that the same projects experienced more regulatory engagement over time. Respondents who answered positively were invited to provide further detail through free-text responses, which highlighted three main mechanisms through which projects are influencing regulation:

- **Direct engagement with regulatory bodies** such as the Driver and Vehicle Standards Agency, the British Standards Institution and the Civil Aviation Authority (CAA).

6.12 Several beneficiaries developing net zero propulsion highlighted the value of early engagement with regulators, standards bodies and test houses, and called for a clearer pathway from collaborative R&D to first commercial pilots so that learning and certification can be completed before market entry.

6.13 Aviation-focused beneficiaries reported particularly constructive engagement with the CAA, including participation in its hydrogen sandbox, which has supported both

regulatory advancement and the development of technologies aligned with emerging compliance requirements.

"The project has positively impacted the regulatory environment by directly engaging with the Civil Aviation Authority to explore certification pathways for integrating an electrically powered full-span rotor jump take-off system into gyrocopter and compound gyrocopter platforms." – Wave 2 NZP beneficiary survey

6.14 Several beneficiaries also cited contributions to emerging regulatory debates. For example, FOAK beneficiaries reported that learning on drone transponders, electronic conspicuity and frequency usage has informed CAA policy development and is expected to continue shaping future regulatory work under SORA frameworks. ZEHID beneficiaries similarly highlighted the importance of data collection through their projects to inform regulatory discussions in enabling HGV decarbonisation, Wave 3 CCAM beneficiaries also reported ongoing engagement with the Vehicle Certification Agency and Driver and Vehicle Standards Agency, supporting shared learning on the role of simulation in type approval of Advanced Driver Assistance Systems and future autonomous vehicles.

"*The use of 'transponders' on drones and the frequency used has been a part of policy work developed by the Civil Aviation Authority. The need for electronic conspicuity and how this forms part of risk mitigation has also featured and will likely do as part of future regulatory work"* – Wave 3 FOAK beneficiary survey

"Much of the learnings within ZEHID have found that the regulatory environment is key to the decarbonisation of HGVs, whether that be policy encouraging purchase, or perhaps more greatly allowing these vehicles to operate to their potential – weighs and dimensions is a key point, and ZEHID is giving us an evidence and data base to support these ongoing conversations" – Wave 3 ZEHID beneficiary survey

- **Collaboration with Government departments,** most notably DfT, took place mainly during project delivery; for example, at dissemination and demonstrator events. This engagement, which was largely advisory, helped guide projects by providing feedback on progress, shaping project direction, and enabling alignment with policy objectives. Beneficiaries noted that these interactions were typically not formal partnerships, but DfT's interest in the projects provided valuable knowledge sharing opportunities, regarding the regulatory environment.

"We are working closely with the DfT to update HGV weights and length regulations, impacting on electric and autonomous vehicles. To achieve this, we have created a cross-industry panel to create a single ask from the whole of industry: SMMT, RHA, Logistics UK and CILT; plus input from National Highways and West Midlands Combined Authority." – Wave 2 ZEHID beneficiary

"We have provided insights into how regulation can develop to support the roll out of CAV logistics. This has included providing evidence and slides to DfT so they could present them at a relevant UN meeting which was considering remote and tele operation regulations." – Wave 3 CCAM beneficiary survey

- **Close collaboration with project partners and potential customers** to demonstrate technological value and real-world application, particularly in areas such as automation and artificial intelligence assurance for maintenance and inspection.

"Network Rail are now changing their standards in light of the data/lessons learned from our train-borne monitoring systems. For example, moving from contact force to acceleration measurements, dynamic height and stagger measurements using intelligent camera and reducing manual inspections based on reliable train-borne monitoring alternatives." – Wave 2 FOAK beneficiary

6.15 These responses illustrate tangible ways in which projects are influencing regulation. However, it should be noted that some beneficiaries among the 37% who reported that their project had contributed to the regulatory environment appear to have based their claims on hypothetical or forward-looking expectations rather than confirmed regulatory changes. For example, several respondents noted that their projects have produced evidence or demonstrations expected to inform future regulatory developments. While mechanisms cited are real, the extent of actual regulatory impact to date may be limited.

"Our research has produced insights on potential users of autonomous buses, which can support decision-making at regulatory level." – Wave 2 CCAM beneficiary

6.16 Although most projects are now complete or nearing completion, it is still difficult to confirm whether the anticipated benefits will be realised. This is because these benefits are expected to emerge only after completion, once the technologies have been further developed and applied beyond the immediate project environment.

6.17 However, one valuable source of information is monitoring officer scores. As in Wave 1, most projects scored highly for scope and exploitation. In Wave 2, **84% were judged to be 'on course to deliver all planned objectives' or 'the consortium has identified opportunities, beyond those specified in its proposal, and plans to explore these within this project'**. Additionally, **84% scored 'good' or 'exceeding expectations' for their exploitation approach**, meaning that monitoring officers were satisfied with the approach to developing commercial, economic or societal value beyond the project's life. In Wave 3, 79% of projects scored positively for scope and 80% for exploitation, indicating continued confidence in projects' ability to deliver value beyond the funding period.

6.18 In-depth interviews supported these findings. For some technologies, regulatory factors were not yet an issue, particularly for lower TRL projects. For others, beneficiaries described concrete interactions with regulatory and certification bodies, especially where

these were embedded within project teams. This was especially evident among NZP and ZEHID beneficiaries, particularly where regulatory bodies were embedded within project teams. Several NZP beneficiaries reported that their projects have informed regulators and standards bodies with new safety and performance evidence, especially in areas such as hydrogen fuel propulsion for aviation, rail battery systems and maritime certification pathways. Similarly, one of the key outcomes and successes related to the application of the lessons from ZEHID has been the three British Standards Institution (BSI) standards (see below), which have been developed with the support of learning from ZEHID.

ZEHID case study vignette showcasing how a project has helped to contribute to changes in the national standards

Electric Freightway reported collaborating with BSI, which published three new, freely accessible standards related to zero emission HGVs and the associated infrastructure in April/May 2025. These standards are expected to support wider adoption by giving operators and logistics companies confidence that their bay designs and associated systems are compliant and optimal, representing a step towards formalising the technology.

During the deployment phase Gridserve gained significant knowledge of: HGV bay design, signage, and safe movements around charging infrastructure. They were able to share the lessons learnt along with other materials (such as site layouts and designs) with the BSI.

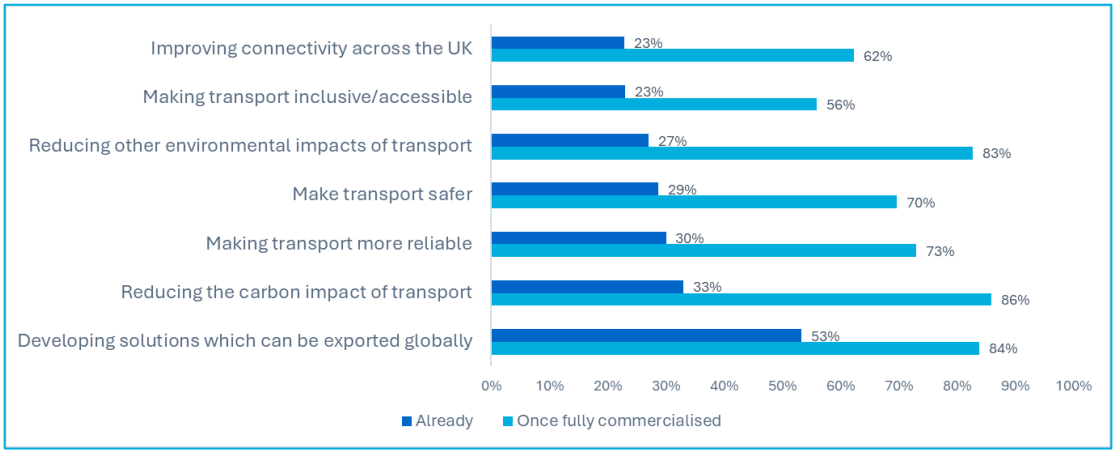
"ZEHID has been the catalyst, without the programme there wouldn't have been such an awareness and willingness in the industry to do this. Not just the ones that got the funding but everyone, contributing to various initiatives like the standards programme." – Wave 2 ZEHID wider stakeholder

Potential long-term outcomes anticipated from projects

6.19 The beneficiary survey asked respondents whether the technologies being developed had already contributed to a range of societal impacts and whether they were expected to do so once fully commercialised (Figure 6-2).

- In Wave 1 and Wave 2, the most commonly reported impact already achieved was the development of solutions with export potential, cited by 53% of beneficiaries as contributing 'a fair amount' or 'a great deal'. The next most frequently reported impact was reducing the carbon impact of transport, noted by 33% of respondents.
- Wave 3 findings show a similar pattern, with 47% reporting export potential and 36% reporting carbon reduction impacts.

Figure 6-2: Beneficiary views on the societal impacts of their technologies (sample size varies between n=113 and n=137, depending on survey question)



Source: Analysis of beneficiary survey, 2025 (Wave 2). Questions: "To what extent has the project already contributed to the following societal impacts…?" / "Based on your expectations for the technology being developed, to what extent could the technology contribute to the following societal impacts once fully commercialised…?" Graphs reports those answering, 'a fair amount' or 'a great deal'.

6.20 Looking ahead, beneficiaries anticipate greater societal benefits once technologies reach full commercialisation:

- In Wave 2, 86% of survey respondents expected their technology to reduce the carbon impact of transport, 84% expected to deliver solutions that can be exported globally and 83% anticipated reducing other environmental impacts of transport.
- Wave 3 findings were similar, with 83%, 80% and 74% of respondents selecting these options respectively.

6.21 These high proportions are unsurprising given that projects were selected partly for their potential to deliver societal benefits, and none would have been included in the portfolio without meeting at least one of these criteria.

6.22 Interview findings support these expectations, with respondents highlighting secondary benefits beyond environmental objectives. Examples include potential for improved safety through the elimination of hazardous working practices and efficiency gains from process improvements.

6.23 Another notable outcome, identified through interviews, relates to market signalling and supply chain resilience, particularly within the ZEHID programme. ZEHID beneficiaries reported that partnerships formed through the programme have begun to strengthen UK resilience and reduce SMEs' reliance on international suppliers. SME participants noted that these collaborations have enhanced industry credibility, enabling access to major fleet operators. This micro-level change, switching to UK suppliers or SMEs gaining credibility, signals momentum towards a broader strengthening of domestic supply chains driven by ZEHID.

"Our first clients were the biggest fleets in the world." – Wave 2 ZEHID beneficiary

ZEHID case study vignette showcasing partnership development and the benefits to the project or organisation

eFreight 2030 (see Appendix F.II) is led by Voltempo, a chargepoint developer, manufacturer and installer.

Through the ZEHID programme, Voltempo has been able to identify and move to using UK-based manufacturers within its supply chain. Examples include:

- The switching system, previously sourced from Germany, new provider located in Wales
- The cooling system was Chinese and is now from Glasgow – a more efficient product with no moving parts.

The quantities of these products ordered by the ZEHID project help their businesses to advance enhancing domestic supply chains and regional economic development.

Barriers to achieving long-term outcomes

6.24 Beneficiaries and wider stakeholders identified several persistent barriers to achieving long-term outcomes, many of which were reported across all Waves. These include:

- **Political and policy uncertainty:** Wave 3 Maritime beneficiaries frequently raised concerns about long-term government commitment to net zero. Without sustained legislative backing and funding certainty, operators and developers reported limited incentives to invest in clean technologies, constraining long-term environmental outcomes.
- **Insufficient enabling infrastructure and supply-side challenges:** Linked to the above, in some cases, the technology itself is not the limiting factor; rather, adoption is hindered by the absence or limitations (in terms of scale) of supporting national infrastructure. This issue spans multiple programmes, including the lack of refuelling or charging networks, the need for electricity grid upgrades, and the absence of nationwide hydrogen infrastructure.
- **Coordinated approach/need for aligned action:** Delivering these technologies at scale requires alignment across stakeholders and sectors. For example, within ZEHID, beneficiaries attributed delays in deploying charging infrastructure to limited grid capacity, complications with distribution network operators and challenges related to land availability and landlord permissions.
- **Regulatory hurdles:** Across programmes, beneficiaries and stakeholders reported several regulatory barriers and challenges:
  - TVH beneficiaries and stakeholders reported that current requirements for large safety distances, which are far greater than those for diesel vehicles, combined with bureaucratic planning and permitting processes, have created barriers to deployment.
  - NZP beneficiaries reported persistent regulatory and certification delays, alongside limited infrastructure, high operating costs, restricted access to assets and test facilities, and difficulties securing growth finance once grant funding ends.
  - TDD beneficiaries also reported immature regulation as a key barrier to impact.
  - FOAK beneficiaries noted structural constraints within the rail sector, where TOCs may be interested in new technologies but decision-making authority often

sits with Great British Railways and must align with its strategic priorities. Others highlighted that regulatory frameworks for emerging technologies, particularly artificial intelligence and drone applications, remain underdeveloped, increasing uncertainty for innovators. They noted that clearer policy support and successful use cases will make the application and approvals process easier.

"One of the first questions is if it's mandated by DfT. […] Some TOCs are hesitant to take on any new products because it might just change […]. It's been quite tricky, especially because no one knows what's happening and its quite hard for us to navigate without that guidance" - Wave 3 FOAK beneficiary

Conclusion

6.25 Influencing wider framework conditions - such as the regulatory environment and factors influencing public trust and adoption – remains challenging. As noted in Wave 1 and 2, it is still too early to draw firm conclusions about long-term outcomes. Since Waves 1 and 2, there are signs of enduring positive outcomes. Beneficiaries continue to report growing awareness, trust, and openness toward new technologies, with real-world demonstrations and local co-design again highlighted as key enablers, consistent with Wave 1 and 2 findings. However, evidence of adoption at scale remains limited, given projects have only finished in recent years or are still ongoing.

6.26 Regulatory engagement shows continuity and some evolution since Wave 1. Overall **levels of contact with policymakers remain similar across all Waves**, **while the proportion of beneficiaries self-reporting contributions to regulatory updates increased.** While many claims remain forward-looking, examples such as ZEHID's role in supporting three new BSI standards and NZP projects informing certification pathways suggest that the portfolio is beginning to move beyond dialogue towards early regulatory influence.

6.27 Expectations of societal benefits remain high and broadly consistent across Waves, with **over 80% of Wave 2 beneficiaries anticipating exportable solutions, carbon reduction, and wider environmental improvements once technologies are commercialised.** Interviews reinforce these expectations and highlight emerging themes such as improvements in supply chain resilience, particularly within ZEHID. Several ZEHID beneficiaries reported that their projects are helping to build a more local UK supply chain, with organisations partnering with domestic subcontractors and supporting SMEs to gain credibility.

6.28 **While these signals are encouraging, they remain at an early stage and do not yet constitute firm evidence of impact**. Persistent barriers identified in Wave 1, such as infrastructure gaps, regulatory hurdles, and the need for coordinated action, continue to constrain progress.

7 Conclusions and next steps

Introduction

7.1 This portfolio report summarises the evidence collected to date to assess the implementation and effectiveness of IUK's LMT portfolio and outlines intentions to support long-term evaluation of its impact. It brings together findings from three Waves of research across the seven constituent programmes and competitions, drawing on the corresponding programme-level reports.

Comparison and learning looking across the portfolio

Overarching conclusion

7.2 Overall, the LMT portfolio has made strong progress in advancing the UK's transport innovation landscape. It has delivered tangible technological, commercial, organisational and societal impacts while generating valuable insights into the conditions required for successful delivery. Continued focus on regulatory alignment, stronger incentives to support market transition, and wider industry and public acceptance will be essential to sustaining momentum and unlocking the full long-term potential of these innovations.

Portfolio overview and progress

7.3 This report covers seven of the programmes that comprise the LMT portfolio, representing £444.7 million of invested across 203 projects. The majority of these projects are complete, though some remain active due to their later competition date (e.g. FOAK25) or complexity, or project extensions being issued as a result of delays. Funding and project scale vary widely, with Maritime receiving the largest share and FOAK supporting the largest number of projects.

7.4 The LMT portfolio represents a significant commitment to driving innovation and decarbonisation in UK transport. By bringing together a diverse range of programmes with distinct objectives and approaches, it has enabled progress across multiple technologies and transport modes. This breadth has supported solutions from zero-emission freight to early-stage propulsion and local decarbonisation, while fostering collaboration between industry, government and businesses.

7.5 While most projects met or exceeded objectives, delivery has faced challenges, with timelines affected by infrastructure complexity, planning, and supply chain issues (a key challenge identified, particularly for the ZEHID programme). These hurdles highlight the realities of ambitious projects, but teams have shown resilience, adapting to circumstances and maintaining focus. Continued progress reflects the commitment of delivery teams and the support from IUK and monitoring partners throughout the process.

7.6 Beneficiaries consistently valued the clarity of the application process and the quality of IUK support. Monitoring was generally regarded as proportionate and evidence-based, with quarterly reviews praised for ensuring alignment with project objectives and effective risk management. However, smaller organisations faced disproportionate administrative and resource burdens. Key challenges comprised portal issues, duplicate reporting, and cash flow pressures for SMEs. These findings highlight the need for flexible funding mechanisms, timelines, standardised reporting, and streamlined processes calibrated to project scale and complexity.

Partnership development

7.7 Partnership development was central to most programmes. **The majority of beneficiaries formed new or stronger collaborations**, often formalised through funding and intermediary support. These partnerships have enabled access to specialist expertise, testing facilities, and commercial pathways, and many are expected to endure beyond project completion. Such sustained collaboration is already contributing to more mature technologies and better defined product requirements, demonstrating a strategic and lasting impact.

Development, commercialisation and deployment of new technologies

7.8 **The LMT portfolio has driven strong technological advancement**, evidenced by an average TRL increase of 1.7 amongst survey respondents, the generation of new intellectual property, and the progression of many projects to advanced market readiness. The majority of projects have achieved advanced stages of market readiness, with numerous organisations successfully launching new products and making substantial progress toward commercial viability. In certain programmes, LMT support was further amplified through private investment leverage, with over £1.11 billion in private funding secured (data only available for some projects within the CCAM and Maritime programmes). Dissemination activities have been highly effective, with strong visibility in both trade and mainstream media, enhancing market confidence, accelerating adoption, and amplifying the portfolio's overall impact.

7.9 Despite this progress, key barriers remain. Beneficiaries report a need for greater regulatory clarity, stronger incentives to support market transition, follow-on funding to bridge commercialisation gaps, and wider industry and public acceptance of emerging technologies. Addressing these challenges would likely support the portfolio's impact and realisation of full commercial and technological potential.

Organisational skills and job creation

7.10 The LMT portfolio has had a significant positive impact on organisational skills development. The **majority of beneficiaries reported enhanced technical and regulatory understanding, improved market knowledge, and access to new equipment and testing facilities.** These projects have enabled organisations to upskill their workforce, embed new operational and project management practices, and strengthen their ability to respond to future challenges.

7.11 While organisational benefits are evident, skills shortages continue to be a challenge. These are particularly acute in commercialisation pathways and routes to market, but are also felt in operational roles, where an ageing workforce, limited new entrants, and low

skills levels remain structural barriers. Evidence indicates that LMT support is strengthening individual and organisational capability by developing such critical skills, underscoring the strategic importance of sustained innovation programmes. Stakeholders also highlighted the need for enhanced IUK advisory support to amplify impact further, particularly by facilitating closer, more effective collaboration between innovators and end users, to help accelerate pathways to commercialisation.

7.12 The LMT portfolio has **supported both job creation and the safeguarding of existing roles.** Looking ahead, **nearly half of CCAM, FOAK, TDD, NZP and Maritime beneficiaries** (IMS data was only available for the listed programmes) **expect further increases in full-time equivalent employees within five years**, underscoring the portfolio's role in fostering both immediate and sustainable organisational growth.

Long-term outcomes

7.13 Although long-term impacts will take time to materialise fully, early evidence demonstrates that **the LMT programmes are already delivering tangible benefits.** Projects are already contributing to regulatory engagement, shaping future standards, and building trust and awareness of new technologies. Many beneficiaries anticipate that their technologies will deliver long-term benefits, including reducing the carbon impact of transport, achieving global export potential, and generating broader environmental gains. These outcomes signal that the portfolio is on track to achieve lasting technological, commercial, and environmental impact.

Future activity anticipated for the portfolio

7.14 It is intended that the following activities will continue as part of the LMT portfolio moving forward, to build upon its success to date:

- Real-world demonstrations and trials to build trust and adoption.
- Active engagement and dissemination with industry users, customers and the public.
- Local ownership and co-design in place-based innovation.
- Media and communications activity, with more social media planned for project closures and demonstrations.

7.15 Projects are expected to continue to engage with regulatory stakeholders and government departments to shape future regulations. There is an ongoing effort to contribute to standards and regulatory updates, as seen with the ZEHID programme's role in supporting new BSI standard.

7.16 Alongside this study by Steer, Innovate UK is working with separate contractors over the next three to five years to gather technical data from the real-world demonstration projects related to the Zero Emission Vessels and Infrastructure competition within UKSHORE and ZEHID. These programmes will deliver multi-year demonstrations of vessels and port infrastructure and HGVs by operators in real world environments around the UK. These studies involve projects supplying usage data from vehicles and vessels and their corresponding infrastructure so that the real world performance with operators can be assessed and shared with the wider industry. These two studies will publish reports out to 2030 to update industry on a range of performance metrics to help inform the sectors about these technologies and support the whole industry to benefit from the findings.

Next steps

7.17 This report concludes the current monitoring and evaluation commission. To carry forwards the learning and momentum generated across the three Waves of fieldwork, dissemination of findings and continued monitoring of programme implementation and emerging impacts could include:

- Dissemination activities including publication of programme and portfolio level reports alongside a series of stakeholder workshops targeting relevant IUK and DfT policy and research teams.
- Continue monitoring progress and emerging impacts across the portfolio through beneficiary surveys in order to supplement and augment management data collected via QMS and IMS.
- Case study 'success stories' could also be identified and developed to help ensure effective engagement with beneficiaries whilst the relationship with IUK is live/recent.
- Review established evaluation plan and update in light of insights from this commission and any shifts in the timing, scope and operating context of programmes and/or the wider portfolio.
- Following on from this review, develop detailed scope and requirements for undertaking comprehensive impact evaluation(s).

Appendices

Appendix A – CCAM Case Studies

A.I The EvolvAD project

A.II Project Harlander

A.III DriveSafe AI Project

Appendix B – FOAK Case Studies

B.I PROLECT -Protection and Resilience for Overhead Line Equipment using Computer Vision Techniques

B.II Cross Freight

B.III Trains with Brain(s)

Appendix C – NZP Case Studies

C.I Compact battery propulsion for inclusive regional trains

C.II Case Study: Higher performance modular dual motor propulsion system

C.III Case Study: Paradigm Shift

Appendix D – TDD Case Studies

D.I The IONA Drone Delivery Initiative

D.II Private Infrastructure Network Solution

D.III HomeRun School Travel Evaluation Platform

Appendix E – TVH Case Studies

E.I Zero Emission Hydrogen Demonstration in Airport Applications (ZEHyDA-2)

E.II Teesside International Airport Hydrogen Refuelling Hub

Appendix F – ZEHID Case Studies

F.I Case study: Electric Freightway

F.II Case study: Electric Freightway - Amazon

F.III Case study: eFREIGHT2030

F.IV Case study: eFREIGHT2030 – Menzies

Appendix G – Maritime Case Studies

G.I Case Study: Service Operation Vessel Offshore Charging System

G.II Case Study: Hydrogen Innovation - Future Infrastructure & Vessel Evaluation and Demonstration (HI-FIVED)

G.III Case Study: Retrofit 20m Mercurio CTV - 100% Electric)

Appendix H – Sources of evidence utilised

Appendix I – Description of Projects

A.I. Case study: The EvolvAD project

Introduction	
Value	Project cost is £4.2m, Offer Grant is £2.2m
Duration	33 months
Start date	07/01/2023
End date	03/31/2026
Context & Objectives	
Project summary	Building upon previous Nissan research, evolvAD[1] is a £4.2 million initiative funded (£2.2m) via the CCAM programme, which aims to develop an automated vehicle AV capable of safely driving in residential, urban, and rural environments. The five project partners focus on high definition map generation and validation, alignment with multiple complex operational design domains and improving interactions in complex urban environments with vulnerable road users. The project was supposed to run for 21 months, between July 2023 and March 2025, but was granted a 12-month extension until March 2026 to deliver a few additional work packages to conduct a final demonstration during the Cenex Expo week, as well as to begin the study towards the commercialisation of the technology. As a lead partner, Nissan's role is to lead the development of the connected and autonomous vehicles (CAV) trialled for the project. Other project partners include: • Connected Places Catapult: Applying advanced machine learning techniques to generate high-definition maps of aerial imagery. • Humanising Autonomy: UK supplier with advanced vulnerable road users (pedestrians, cyclists and motorcyclists). • SBD Automotive: Providing onboard cybersecurity and advanced safety case for taking the driver out of the vehicle. • TRL: Developing vehicle system validation processes utilising infrastructure on the Smart Mobility Living lab testbed. As of September 2025, the project has resulted in successfully running 2,000 autonomous test miles[2] and 45 people working on project delivery.
Context	evolvAD is the third consecutive autonomous driving project completed by the Nissan research team since 2017. The first project, HumanDrive, ran from 2017 to 2020, and aimed to develop an AV capable of safely driving on **highways and motorways.** The project culminated in sending a Nissan LEAF on a self-navigated drive for 230 miles, with the system making decisions about how to navigate roads

[1] https://www.evolvad.co.uk

[2] https://www.evolvad.co.uk/outcome

	and obstacles encountered on a journey, directing the car to change lanes, merge with traffic and stop and start, when necessary, at roundabouts and traffic signals. Between 2020 and 2023, Nissan also ran their ServCity project which aimed to help cities harness the latest autonomous vehicle technologies and successfully incorporate them into a **complex urban environment.** ServCity tested vehicle technologies on board a Nissan LEAF in the lab, before public road testing in London at TRL's Smart Mobility Living Lab. For the first time the research team accessed direct communication from the infrastructure (e.g., CCTV) to inform their work. After successfully completing testing in both highway / motorway and complex urban environment, Nissan applied for the CCAM programme in 2023, and secured funding for evolvAD – a project aiming to take the technology further and lead testing in **residential and rural roads.** Residential and rural roads present their own unique set of challenges for autonomous driving (AD) technology. For example, in residential areas, drivers often face narrow roads, single lanes with parked vehicles on either side and slow driving speeds. Rural roads can include similar conditions but with higher driving speeds and winding roads with little to no road markings. Testing AD in these environments is of strategic importance for the UK. The technology was previously tested in the US and Japan – countries with very different driving culture and road infrastructure – leaving knowledge and technological gaps to be further explored by Nissan's UK team. For instance, the team considered pedestrian and cycling behaviour and patterns, and built on their ServCity findings, by focusing on how to navigate mini roundabouts, speed humps, and Pelican crossings in residential and rural areas in the UK.
Objectives	• Nissan is conducting 'Autonomous mobility service' research globally in Japan (Nissan Research Centre), the UK (Nissan Technical Centre Europe), and the US (Nissan Advanced Technology Centre, Silicon Valley). This includes the latest 'Easy Ride' Serena AD vehicle testing in Yokohoma, Japan, where the company is aiming to launch autonomous mobility services. • evolvAD contributes to Nissan's ongoing global development of autonomous mobility efforts, sharing insights and data to understand how the technology can be tailored to perform safely across different driving conditions worldwide. The project has four key objectives: • Bring together a UK Government-funded consortium of experts to further enhance autonomous drive capability and technically support supply chain readiness • Nissan will contribute to the project aim by further establishing autonomous drive (AD) technology capability in the UK in collaboration with consortium partners • Enable 100% electric Nissan LEAFs equipped with cutting-edge AD technology to be put through their paces on urban residential and rural roads • evolvAD builds on successful Nissan-backed AD research projects, HumanDrive and ServCity, and contributes to the advancement of AD

	technologies at Nissan as the brand accelerates towards its Nissan Ambition 2030 long-term vision for empowering mobility[3].
Project Activities	
	Since July 2023, the five evolvAD partners – Nissan, Connected Places Catapult, Humanising Autonomy, SBD Automotive and TRL – have worked to technically support UK supply chain readiness for future mass deployment of AD technologies in the UK. The focus area of process activities is trialling advanced AD technology in built-up residential and rural areas. During evolvAD, Connected and Autonomous Vehicles (CAVs), were tested by **Nissan** in various simulators and on private test-tracks before being introduced onto urban residential and rural roads. For higher speed routes on winding roads with no markings in rural areas, Nissan has introduced a chassis control system for the AD vehicle to enhance the braking and steering performance, allowing the system to behave with a level of competence comparable to an Advanced Driver. In the urban environment, using infrastructure such as CCTV on residential streets, the evolvAD CAVs received information to improve situational awareness, creating a unique case study on how vehicle to infrastructure (V2I) can be used to enhance the performance of CAVs, as well as developing all-new V2I technologies. Project partners also led on a series of evolvAD activities. **SBD Automotive** focused on ensuring the safety and security of the AD technology. First, a safety case study was developed for taking the test driver out of the vehicle. Whilst the safety driver remained in the vehicle during the evolvAD trials, the research is important for future technological applications. The team also explored the cybersecurity threats the technology can be vulnerable to, especially if used as a mobility service. **TRL's** activities focused on supporting the Smart Mobility Living Lab and worked to design test specification standards for suppliers delivering AD components and testing systems in the UK. **Connected Places Catapult** developed a low-cost, high-definition map using aerial images that, whilst not utilised by evolvAD (as was ready upon trial completion), may be used in future projects. **Humanising Autonomy's** role in the project was to use facial recognition technology and help decipher pedestrian intensions (e.g., what is the probability of a pedestrian crossing the road). However, the organisation went into administration at the end of March, just as the project was close to completion. In addition to the core activities mentioned above, Nissan secured a project extension until March 2026. This comprises the delivery of an additional package of work focused on efforts to commercialise the technology in the UK. Nissan is already planning to launch AD mobility services in Yokohama, Japan, in 2027. The additional evolvAD work package aims to build a business case demonstrating that the UK could be the entry point for expansion of these efforts in Europe. The document will consider potential factors for expansion, including variations in the built-up infrastructure, policymaking and regulatory framework. In

3

	August 2025, the team is conducting consultations with local authorities in the UK to inform the document and create a methodology for replicating these efforts to different geographies in the future. The final draft will contain criteria for assessing the potential for launching CAVs in different geographies and explore what social value can be delivered and then maximised as part of the commercialisation efforts. Key project success factors included being able to draw learnings from the safety cases developed for the HumanDrive and ServCity projects. The team could utilise six years of previous project experience and adapt pre-existing safety cases to residential and rural areas instead of building those from scratch, saving valuable time and resource. A key project challenge that remains is securing public acceptance for commercialising AD technology in the UK and globally. Whilst a media event, led by Nissan in March 2025, showcased that the public is mostly positive towards the prospect of launching autonomous vehicles, the research team still needs to identify and secure the support of a local council to pursue next steps for commercialisation in the UK. The project extension aims to take these challenges into consideration and explore topics such as how to prevent acts of vandalism or ensure autonomous vehicles successfully interact with the whole local transport ecosystem, including public transport. Another challenge for commercialisation is the cost associated with launching the technology more widely. That is why Nissan is aiming at launching a mobility service for public use, as opposed to a vehicle equipped with AD technology that can be purchased for personal ownership. A challenge for the whole CAM ecosystem is the lack of wider coordinated activities and knowledge exchange. Whilst some activities were organised by the CCAM programme leads, more nation-wide efforts are required to stimulate CAM technology acceptance with trials across the UK. As a lead organisation, the team at Nissan reported having positive experience with applying for the CCAM programme and delivering the programme of work after being successful. Having applied for similar programmes in the past, the team felt well prepared for the application process, which was in line with their expectations. One suggestion was made around shortening some of the timelines. This included being able to apply soon after the programme is announced instead of waiting for months and being able to find out the application outcome sooner. Another suggestion was tailoring the criteria depending on whether the application covers a new / existing project or based on project size / length, as currently the requirements and amount of preparation needed are the same for all projects.
Outcomes & Impacts	
Outcomes	Overall, 12,000 autonomous miles were driven with 0 accidents across all three projects (HumanDrive, ServCity and evolvAD). evolvAD alone includes £4.2 million in investment, 2,000 autonomous test miles ran and 45 people working on project delivery. According to Nissan, one of the key project outcomes was building stronger rapport with project partners, universities and other experts from the wider CAM community.

	For instance, the team held conversations and shared experience with Zenzic and the Advanced Propulsion Centre UK – two organisations who worked together to launch a new future mobility accelerator. Nissan also worked closely with government and trade bodies, including with IUK, Auto Council, the Society of Motor Manufacturers and Traders, DfT and DBT. The Nissan research team built better understanding of the work and expertise of their project partners, which helped them gain wider insight on which organisations they might potentially want to include in future projects. This was considered particularly important takeaway as Nissan approaches their planned commercialisation stage, and the choice of project partners is more important than ever. They also worked with Leeds University, Cranfield University and Nottingham University and will continue to preserve the relationships built as a result of evolvAD in future. The project extension will look into building on these relationships further and attempt to identify local partnerships that can support the commercialisation activity. Another valuable outcome was building a stronger understanding of how to tailor the AD technology for the UK market. The project findings helped tailor the AD technology developed in Japan for European and UK road infrastructure and driving style. A new supplier was also chosen based on these findings, which was considered an important legacy for next generation projects led in the UK. Finally, an important outcome was engaging in activities to promote the programme progress. In 2025, evolvAD demonstrations were completed for both the media and UK government. This included an event in London with government ministers, automotive groups and potential host councils which took place in February 2025, as well as an event in the Nissan Technical Centre Europe in March 2025 with media and influencers. The technology was presented at the Cenex Expo – a conference bringing together the UK innovation community working on net zero and connected automated mobility research.[4] The event took place at the beginning of September 2025 in Millbrook, where 20 guests were invited by Cenex to Nissan Cranfield to experience the technology first-hand. It is also expected that the project's technological learnings and data collected will be an important outcome for the wider research community and will be used to support the development and launch of CAM technologies in future.
Impacts	Nissan's team felt that it is too early to report on impacts achieved as a result of the project. However, it is anticipated for multiple long-term impacts to be realised in future both for Nissan and for the wider economy, society and the environment. The team felt that the research project was successful in driving Nissan's knowledge and understanding of how AD technology performs across challenging driving environments. The technology has made driving safer by reducing human error, and cleaner by improving efficiency. It is anticipated that this technology can enable

[4] https://cenex-expo.com/

	access to mobility to many more people who may not have it today due to location, age or disability. Bringing mobility to underserved locations is in turn expected to improve equity and access to opportunities. From the point of view of local and central government, the technology can help decarbonise and reduce congestion, as well as stimulate the local economy and provide services to underserved communities. However, challenges remain in the future around how these potential impacts can be measured, including data availability and building impact assessment methodologies. From Original Equipment Manufacturer (OEM) point of view, a potential long-term benefit could be pivoting into mobility services as a new business model. This could bring a new revenue stream for Nissan but also transform the entire supply chain and introduce new employment opportunities in the CAM sector. If Nissan's commercialisation plan in the UK is successful and the technology is introduced in selected local geographies, it can also be anticipated for the UK to become a smart cities specialist on a global level, attracting investment, skills and expertise for future AD technology development. To help enable that, greater CAM ecosystem-building activities are required in the UK, to support sharing of learnings and data, and could be promoted via future IUK programmes and the Catapult Network activities.
Additionality	Globally, Nissan has a dedicated AD team in both Japan and the US, leading AD trials before the evolvAD project was launched in the UK. The team located at the headquarters in Yokohama are a step ahead in their commercialisation journey, actively working to launch an AD mobility service in 2027. They work closely with the UK team, by sharing emerging learnings and offering secondment / upskilling opportunities for one of the UK engineers. However, despite this ongoing support, the UK team felt that Nissan could have decided against launching AD trials in Europe, without the dedicated CCAM funding secured for evolvAD, as well as the funding secured for previous projects, such as HumanDrive and ServCity. In fact, the first Nissan AD engineering team in the UK was set up because of the funding provided for the HumanDrive project. Securing funding for evolvAD prevented this team from being disbanded and further contributed to its expansion to five AD engineers, one test engineer, one technician, and one test technician working on the project.
Successes and Lessons Learnt	
Key lessons	As a lead delivery organisation of evolvAD, Nissan learnt important lessons regarding the adoption and application of project management processes. One of the project partners, Humanising Autonomy, went into administration in March 2025 just as their key project outputs were due to be submitted. As a result, that component of the research could not be delivered. It was suggested that in future deliverables are scheduled to be submitted in stages throughout the project lifetime instead of at the end to avoid delays. Another delivery challenge mentioned was around the high staff turnover, which led to skill loss across the team. For instance, project Monitoring Service Providers were particularly hard to retain. The team responsible for co-leading and project managing evolvAD at the Connected Places Catapult also experienced staff turnover. However,

	the consortium showed agility in these challenging situations and still managed to deliver the project on time and meet wider project objectives. Finally, Nissan's research team in the UK was responsible for submitting multiple financial forecast predictions to the headquarters in Japan. The lead team in Japan further showed very strong interest in the development of the core AD technology. Overall, these reporting processes and ongoing conversations highlighted that a lot of research is still required to identify best customer practices for the UK market, and social value requirements, including accessibility criteria, and how to accommodate wider inclusion needs. The aim for Nissan UK is to use these research efforts and become a global role model on how to maximise social value via AD technology.
Next Steps	Following the successful delivery of evolvAD and previous projects, Nissan are now shifting towards studying the readiness of the UK to introduce AD systems. The intention is to continue working in this space beyond project completion in March 2026 and effectively start making the necessary adjustments to take the technology to the selected geography for commercialisation with an appropriate service design to suit the local area. The team is working to identify gaps, address operational design domains (ODDs) or adjustments needed to take this work forward, compiling the necessary data to select a suitable city for launching a mobility service in the UK around 2030. Working with partners, the team in Cranfield will continue their research to develop a 360-degree understanding of infrastructure and regulatory needs across the country and provide critical insights to policymakers and urban planners to ensure a successful introduction of AD mobility service around 2030.

A.II Case study: Project Harlander

Introduction	
Value	Project cost is £10,196,420, Offer grant is £5,487,017
Duration	32 months
Start date	March 2023
End date	October 2025
Context & Objectives	
Project summary	The Harlander project has been awarded funding through the Commercialising Connected and Automated Mobility: Deployment programme, which sought to support new automated transport service projects. The Harlander project aims to establish Northern Ireland's first self-driving passenger service on mixed-use public roads in a 2,000-acre Belfast Harbour Estate. The project seeks to solve the transportation challenges in the Belfast Harbour area by delivering four electric shuttle buses (called Harlander) integrated with Level 4 autonomy software that would trial last-mile connectivity between Titanic Halt train station and key destinations across Belfast's Titanic Quarter. The project is part of Belfast Harbour's strategic plans and investment, underscoring its commitment to enhancing local infrastructure utilising cutting-edge technology. The Harlander project is led by Belfast Harbour, working with ANGOKA (providers of cybersecurity infrastructure), British Telecommunications (providers of 5G mobile network and security expertise), eVersum (providers of the shuttle buses), Oxa (providers of the self-driving software stack-Oxa Driver), and HORIBA MIRA (providers of the driving safety assurance and validation for real world autonomy). Despite initial delays to the start of the project, due to a partner leaving the consortium and the rescoping of the project, the eight-seater Harlander buses have been launched to the public in Belfast Harbour after the successful completion of a 3-month closed door testing. The vehicle provides low-carbon transport from public transport hubs to destinations across the Titanic Quarter and Queen's Island with a safety operator on board and is currently carrying passengers for free. The successful delivery of the Harlander project has led to the development of new products and services such as an electric autonomous passenger shuttle (eVersum) and a new safety assurance test for level 4 autonomous vehicles (HORIBA MIRA) which are available for purchase. Other partners such as Oxa have now discovered new use cases for their technology, formed new partnerships and are exploring different routes to commercialise the outputs from the project. For Belfast Harbour, the success of the project has established them as a hub for innovation and a testbed for autonomous vehicles. They are now in talks with councils, governments and the private sector regarding deploying new AVs and are seeking other funding opportunities to expand the routes in the public realm. In

	future, the Harlander shuttle buses are expected to contribute to the reduction of transport-related carbon emissions within the wider Belfast Harbour Estate.
Context	The Belfast Harbour Estate is a 2000-acre area on Belfast's waterfront that serves as Northern Ireland's primary maritime gateway and economic hub. It hosts about 760 businesses and handles significant trade and passenger traffic. Belfast Harbour is currently facing rising demand for public transport in its wider estate, particularly the Queen's Island and Titanic Quarter area and suffers from significant congestion due to limited access points. The Harlander project, supported through the Commercialising Connected and Automated Mobility: Deployment programme is addressing this problem. It seeks to deploy four autonomous electric shuttle buses that would trial last-mile connectivity between the Titanic Halt train station and key destinations across Belfast's Titanic Quarter such as the Innovation District, the Northern Ireland Science Park and Belfast Metropolitan College and the Titanic Belfast exhibition. Electric autonomous vehicles offer a route to provide clean, efficient, and affordable public transport that aligns with net zero targets and connectivity to other modes of transport. This makes them suitable for Belfast Harbour. The project is expected to benefit commuters travelling to Catalyst as well as students attending Belfast MET, together with visitors to the estate, providing intra-port connectivity. The Harlander project is part of Belfast Harbour's broader "Smart Port" strategy, which aims to integrate cutting edge technology to improve infrastructure and sustainability. The Harlander project is led by Belfast Harbour who are the project lead, overseeing the deployment of the shuttle buses. Other partners in the project are: ANGOKA (a software company based in Belfast) responsible for the cyber security of the remote operation of the vehicles in the Harlander project, and for system-wide Vehicle-SOC, preventing unauthorised access and ensuring passenger safety. British Telecommunications (a British multinational telecommunications holding company headquartered in London) provides advanced connectivity powered by its extensive 5G mobile network, along with their security expertise and innovative solutions. eVersum (a high-tech original equipment manufacturing company headquartered in Austria, specializing in the design, development, and production of electric commercial vehicles and platforms, primarily focused on passenger transport solutions) provides the eShuttle buses. The eShuttle is a mid-sized complete low-floor accessible shuttle bus that is low noise and designed utilising the latest zero-emission technology. The eShuttle is also designed for inner-city and last-mile transport. Oxa (an autonomous vehicle software company headquartered in Oxfordshire, England) provides the self-driving software stack called Oxa Driver which powers the eShuttle buses. Oxa Driver enables safe and efficient self-driving. The system is highly modular and customizable and can be retrofitted as a complete solution or integrated into co-developed autonomy solutions in full or at a component level.

	HORIBA MIRA (an automative engineering and development company headquartered in Warwickshire, UK) provides safety assurance and conducts validation activities, helping to establish confidence in the shuttles' performance. The Harlander project is a vital component in the Belfast's sustainable transport plan as current visitor numbers of over 3.6 million people a year are predicted to rise to more than 5.6 million by 2035 as a result of a major investment program. The project is therefore helping to support Belfast Harbour's delivery of its Strategic Transport Masterplan for Queen's Island and is an initial step towards wider implementation of autonomous vehicles in the UK.
Objectives	The main aim of the project is to solve the transportation challenges in the Belfast Harbour Estate area with the deployment of four autonomous passenger shuttles running between local transportation links, through Belfast's Innovation District and major tourist attractions including the Titanic Belfast. The project also aims to deliver the most advanced autonomous service in the UK, inspire and inform sustainable future travel solutions and bring cutting-edge technology to the market through the deployment of the four shuttle buses. Alongside this, the project aims to investigate public acceptance of autonomous shuttles within existing public transportation and help people understand how autonomous transport options can complement public transport in the Belfast Harbour Estate area. In the long term, it is expected that the project will expand the use of autonomous vehicles in public transportation, with fleets of vehicles remotely monitored from control centres.
Project Activities	
	The project is structured into seven main work strands. The first work strand involves the vehicle delivery, certification and integration. During the delivery of this work strand, the project team ran into some technological challenges. The initial scope of the project was to deliver a level four unattended passenger service with four autonomous shuttles in Belfast Harbour Estate. A level four autonomous vehicle can drive itself without human intervention in specific conditions and environments. Early in the project, it became clear that the technology itself was still immature and not yet capable of supporting high automation. The project had to be rescoped to reflect the maturity level of the technology (by having a safety operator onboard rather than the shuttles buses being fully unmanned) and the number of autonomous shuttles buses to be delivered was reduced from four to two. Another key challenge during this stage, was the early withdrawal of the project partner REE from the consortium, who were supposed to provide the shuttles buses, but decided the project was not sufficiently aligned with their current strategic direction. This led to project delays, as the project lead had to find new autonomous vehicle and software stack providers, resulting in a three-month schedule slip. However, the project lead (Belfast Harbour) in collaboration with Innovate UK were able to identify and secure new partners Oxa and eVersum to deliver the two shuttle buses that would work with a safety operator onboard.

	The second and third work strands focus on safety and infrastructure respectively and involve conducting safety assurance tests and setting up the infrastructure needed such as bus stops and signage. The fourth work strand focuses on cyber security installations and trials on the shuttle buses. The fifth work strand focuses on managed services and involved installing the platforms and ingesting data from vehicle and security logs from the Vehicle Systems Management System (VSMS) into the Vehicle Operations Control System (VOCS) to enable better monitoring, control and decision making in the eShuttles, while the sixth work strand involves route mapping and setting up the internet connection for vehicle data upload. The seventh work strand of the project involves exploitation activities such as events and press engagements. All the infrastructure and operator related work strands have been completed and were followed by a closed testing of the shuttles buses to allow Harlander's systems to map the route. The project is now close to complete, and Belfast Harbour have taken delivery of an eight-seater driverless electric shuttle buses with a safety operator on board. The second shuttle bus is on track to be launched into the public service in the coming months.
Outcomes & Impacts	
Outcomes	In July 2025, Northern Ireland's first self-driving bus service was launched heralding the start of a 3-month pilot in Belfast's Titanic Quarter. The driverless electric shuttle bus will run every 20 minutes along a one-mile route between Titanic Halt Train Station and Catalyst, serving both commuters and tourists for free. The pilot will run for eight weeks ending in late September 2025 and mark the start of a multi-year initiative aiming to have Level 4 services operating in the Belfast Harbour Estate by 2029. Participating in the Harlander project had positive effects for all the partners involved. Overall, the activities embarked on as part of the project led to the development of numerous outputs including new IPs and products that have potential for commercialisation in the future. Specifically, the project enabled HORIBA MIRA, to develop a detailed sample safety assurance case which demonstrated their capability to lead full end-to-end safety assurance programmes for future automated vehicle deployments. As a result, they have now developed a new level 4 testing for autonomous vehicles that is now on the market. As a result of the Harlander project, OXA and eVersum have increased their technical capabilities. For OXA, the integration of their self-driving software with the eVersum eShuttles has progressed their capabilities in offering a safe, secure and efficient way of deploying new shuttle fleets at scale. This successful integration has now been added to Oxa's portfolio to showcase their use case on passenger vehicles. Similarly, because of the project eVersum has now developed a new Level 2 autonomous vehicle platform with high capacity of passengers and disabled access that could be used in the UK fully integrated with the Oxa Driver and AV stack. The project team reports that there are now potential buyers for eVersum's new vehicle.

	For Belfast Harbour, the project has greatly increased their knowledge of autonomous vehicles which will be helpful with planning for the future in Belfast Harbour and Northern Ireland. In addition, the project team comments that by launching the UK's first fully autonomous passenger shuttle on public roads, Belfast Harbour has established itself as a key testbed for connected and automated mobility technologies. As a trust port that reinvests in innovation, it is now positioned to serve as a forward-thinking hub bridging the needs of port logistics with urban mobility and advanced technology trials. Belfast Harbour says that they are already having conversations with UK and overseas stakeholders, service providers and non-traditional operators regarding the deployment of autonomous vehicles. In addition, other government departments are now interacting with them to learn about challenges, benefits and changes required to deploy autonomous vehicles in public roads.

Impacts	The impacts of the Highlander project is yet to emerge. However, the project has the potential to show that the UK is competing with passengers with countries such as the US, China and Singapore in the global race towards the deployment of autonomous vehicles on public roads. Potentially, the project will benefit the Northen Ireland region and Belfast economically. The Harlander project plays a key role in Belfast Harbour's wider "Advance Regional Prosperity" strategy, which includes major investment in port infrastructure and estate regeneration. By strengthening Belfast's position as a Smart Port and innovation hub, the Harlander project will potentially help attract further investment in future and support the city's ambition to lead in next-generation mobility. In addition, some of the outputs of the projects have the potential for commercialisation in the future. For Oxa, the project is expected to assist with commercialisation of the product in future. They are actively building on the success of Harlander by pursuing other projects with, eVersum, focusing on near-term passenger transportation deployments in off-road environments e.g. airport and ports. This integration and collaboration is critical to their strategy of expanding into different operational domains. They report that there is a possibility to continue beyond the trial period to fully commercialise the outputs of the project. In terms of the environment, the project will potentially enable the reduction of transport-related carbon emissions within the wider Belfast Harbour Estate. The shuttle buses are electric, producing no tail pipe emissions, and directly contributing to the reduction of transport-related carbon emissions. Also, the shuttle buses are designed for last mile connectivity- from the Titanic Quarter railway station to key destination and will significantly contribute to cutting the reliance on private vehicles, easing traffic flow and lowering congestion related emissions. Furthermore, the project is a key part of Belfast Harbour's wider Environmental, Social and Governance and Smart Port strategy, supporting its goal of becoming a net-zero regional port. Insights and data gathered from the initiative will guide future sustainable transport planning, including the development of digital twin models and smart infrastructure solutions.
Additionality	The funding provided under Commercialising Connected and Automated Mobility: Deployment programme was essential to the initiating of the project. Belfast Harbour state that the project would not have happened without the funding as it helped to derisk the investment for the consortium. Consultations with project partners highlighted that the programme enabled the building of a large consortium from the different parts of the autonomous vehicle supply chain to develop a component-themed project. They also comment that the Innovate UK team had the expertise to enable the understanding of the project and provided guidance and advice.
Successes and Lessons Learnt	
Key lessons	Project Harlander provides important lessons into the technical, operational and collaborative aspects of the deployment of autonomous vehicles in the real world and identify success factors for similar future projects.

	First, a commercial agreement should be in place for partners who rely on close collaboration to achieve specific project milestones within a consortium. Not having an agreement for the partners involved in the vehicle and technology stack made collaboration difficult initially. But this was eventually resolved by the project lead. Second, the project highlighted the need to evaluate the maturity of both technology and the suppliers involved in the deployment of autonomous vehicles. The project team discovered that not all technology solutions are deployment-ready and assumptions about capabilities can lead to delays. Also, it is important to address any critical interdependence between partners in advance, ensuring that if one company changes its strategy, the other is not left unsupported. Third, to succeed, the deployment of autonomous vehicle projects requires the establishment of clear responsibilities and clarification of partner roles, expertise and contributions. One of the key successes of the project was finding new partners for the delivery of the shuttle buses. Belfast Harbour working with the CCAV and Innovate UK team were able to find new partners and took proactive steps to bring the new partners on board, finalise legal agreements and ensured their alignment and support for the project's direction. Also, the early recognition that neither a vehicle nor an autonomy stack was in place allowed Belfast Harbour to quickly realign its efforts, prioritising the development and integration of both from the outset. Also, finding new partners for the delivery of the shuttle buses. Another success was working with stakeholders to design the interior of the shuttle buses to be accessible. The Harlander shuttle bus is mid-sized with low-floor accessible shuttle bus. The low-floor design particularly beneficial for passengers with mobility impairments or those using wheelchairs. The shuttle bus also has interior elements such as handrails and accessible stop buttons - key features that support passengers with limited mobility or visual impairments. Another key enabler was having a strong project management team on the side of Belfast Harbour that was able to keep the partners working together especially when their internal strategic direction changed. This ensured that the project kept progressing to meet its objectives and stayed aligned with its intended outcomes. Also, the size of the consortium required a concerted effort to establish a strong, collaborative working relationship among all partners and navigating the diverse expectations and operational styles of each organisation was a challenge These issues were successfully addressed through open communication, shared problem-solving, and a mutual commitment to the project's success.
Next Steps	The Harlander project is close to complete and the partners in the consortium have embarked on various activities related to the further development of the technologies produced in the Harlander project. Belfast Harbour is looking to see if they can extend the project through to 2026 and they are seeking other funding opportunities to expand the routes in the public realm. They are also looking at opportunities in the port side for Belfast's industrial autonomy.

A.III Case study: DriveSafe AI Project

Introduction	
Value	Project cost is £2,791,758
Duration	22 months
Start date	9/1/2023
End date	6/30/2025
Context & Objectives	
Project summary	In 2023, Waye and Warwick Manufacturing Group (WMG), University of Warwick received funding from the Commercialising Connected and Automated Mobility competition (CCAM) under the Supply Chain theme to embark on the DriveSafe AI project. The DriveSafeAI project was a collaborative research partnership that aimed to develop a safety assurance framework for Artificial Intelligence (AI) systems in assisted and automated vehicles (AVs). The project was led by Wayve a leading developer of Embodied AI technology for automated driving and the WMG, a multi-disciplinary department at the University of Warwick renowned for tackling industrial, environmental and societal challenges through collaborative research with companies. WMG is globally recognised, undertaking a programme of research and engineering across the verification and validation spectrum and members of its research and engineering team sit on global standards committees. The project is now complete and progressed as expected. The project team launched a microsite through which Wayve and WMG will share their research on AI safety assurance in assisted and automated driving technology. In the long term, the outputs developed as part of the project is expected to potentially generate the evidence to underpin industry-wide standards and international regulations for the safe deployment of AI in automated vehicles, build confidence in the AV ecosystem and pave the way for the commercial deployment of AV technology globally.
Context	AI is important in enabling self-driving cars understand their environment, make decisions and drive safely. Despite the potential benefits of self-driving cars safety remains a big challenge and is related to the development of trust and acceptance in the technology. While safety is an important issue in the deployment of AVs, ensuring it is challenging due to the absence of a universal safety standard and the numerous versions of AI software. The complex and rapidly evolving nature of automated

	vehicle technology has led to various approaches to standardisation by different organisations. Demonstrating the safety of AI in AVs is crucial to the successful deployment of self-driving vehicles and realising the accompanying benefits. There needs to be safety validation based on well-defined standards within which self-driving vehicles would operate. This will confirm that algorithms developed and used in AVs are able to meet specified safety standard and function as intended. The industry expert interviewed highlighted that algorithms developed for AVs must be able to perform and adhere to safety standards hence the need for validation. So far, there has been little guidance regarding the specification, design, and verification of functionally safe AI systems, or how to apply AI technology for functions that are safety related. The DriveSafeAI project aimed to address the need for independent safety validation required by policy makers to build confidence in the safe use of AI in AVs. The project was led by UK AI company Wayve and WMG, University of Warwick. Wayve is a leading developer of Embodied AI technology for automated driving. The company develops advanced AI software and foundation models for autonomy that enable vehicles to perceive, understand, and navigate any environment, enhancing the usability and safety of autonomous driving systems. Wayve contributed its expertise in building AI systems and developing end-to-end machine learning for self-driving to the project. WMG is an internationally renowned research organisation. The organisation contributed its expertise in safety assurance and safety processes to the DriveSafe AI project.
Objectives	The DriveSafe AI project had four objectives: • To build safe assurance methods for the development of AI systems • To add datasets on Safety Pool for testing and training • To develop a methodology for simulation tools • To develop a rationale for AI safety architecture
Project Activities	
	The DriveSafeAI project had four work packages: Work package one: The development of evidence for a generalisable AI safety framework for self-driving, aligned with internationally recognized ODD-based safety assurance methods. This included evidence of the completeness of data for scenario training and testing. Work package two: This involved testing various approaches to scenario generation and publishing selected scenarios on Safety Pool™. The aim was to support industry efforts to build a shared scenario library for training and testing. Work package three: The development of evidence to inform simulation validation guidelines by comparing model performance in real-world and simulated environments.

	Work package four: The development of a design rationale for a redundant safety architecture in AI-based systems and share safety recommendations for the industry. In terms of challenges, the WMG identified no challenges. However, they commented that the accelerated development of AI required the project team to develop a safety assurance approach that is agonistic and applicable to all technologies. A key success factors in the project has been the collaboration between Wayve and WMG. Both teams have been able to work collaboratively on the research, deliver panel discussions at events and highlight the need for domain specific standards regulations to the AV ecosystem. In terms of their experience with LMT, Wavye and WMG had different responses. The experience of LMT has been positive for WMG as they were familiar with the application process and the requirements were clear. However, for Wavye, the bidding for the project required enormous resources and was challenging to navigate.
Outcomes & Impacts	
Outcomes	The DriveSafeAI project was recently completed (September 2025), therefore it is too early to report on the outcomes achieved. So far, the project has produced a taxonomy of the dataset that will be made into a standard and shared with the public in future. As part of the project, WMG and Wayve launched the DriveSafeAI microsite. The microsite is a dedicated platform through which Wayve and WMG can share insights, research, and tools focused on AI safety assurance in assisted and automated driving technology with industry professionals, researchers and policymakers. The resources provided will potentially help regulators build confidence in the use of AI in assisted and automated vehicles. Wayve and WMG have presented the concept and framework used in the DriveSafeAI project at various events and conferences such as the ADAS and Autonomous Vehicle Technology Expo which held in Stuttgart in 2024 and the MOVE mobility conference in which was held in London in 2024. At both events, the project team discussed the importance of safe AI for self-driving technology, highlighting the DriveSafeAI project as a prime example of how industry and academia can work together to develop safety methods and tools that inform future regulation. The DriveSafeAI has led to the creation of new roles within the WMG and Wayve team, thereby building skills and capacities in AI. For example, WMG has funded three positions within its research team including research fellows and postdocs that work on the DriveSafeAI project. Similarly, Wayve has created a new data set team of comprising of 5 people working full time on the machine learning engineering and simulation aspects of the DriveSafeAI project. The project has led to new collaborations. For example, Wayve was involved in the development of the BSI behavioural competency, helping to shape early drafts and created an independent advisory committee. As a result of the project, WMG is also

	engaging with groups, networks and policy makers working on regulation in the AV sector as an independent expert.
Impacts	A potential impact of the DriveSafeAI project is the development of an AI safety framework that will potentially build regulator and stakeholder confidence in the use of AI in AVs. This AI safety framework will drive innovation while ensuring the highest safety standards. Thereby creating a safety approach to AI while enabling scalability and innovation. The outputs from the project will potentially generate the evidence to underpin industry-wide standards and international regulations for the safety of AI, thereby contributing to building confidence in the AV ecosystem and public trust in self-driving vehicles. Furthermore, if successful, the DriveSafeAI project will potentially contribute to establishing the UK's leadership in AI safety by impacting global standards and regulation. Both partners intend to leverage their roles in standards and regulation development to translate DriveSafeAI's evidence-based outputs to shape and inform national standards (BSI), international standards (ISO), and regulations such as the United Nations Economic Commission for Europe (UNECE). This will contribute to demonstrating UK leadership at a global level. Members of WMG's research and engineering team sit on global standards committees and have contributed to standards. In terms of potential economic impact, by addressing AI safety, the project could help unlock the economic benefits that self-driving vehicles could bring to the UK. For instance, addressing AI safety in AVs will contribute to accelerating Wayve's path to commercialisation through the deployment of their software stack with an OEM. The expert interviewed for the case study also pointed out that the development of safety standards had the potential to advance the uptake of AVs and could lead to commercialisation in the area of developing testing algorithms and safety assessment for car manufacturers. The expert further noted that, competition could affect commercialisation as there are numerous players developing AVs.
Additionality	CCAM enabled the collaboration between industry and academia required to solve the challenge of AI in safety-critical applications like automated driving. Wayve notes that the funding enabled them to work on AI safety and collaborate with an independent academic partner with expertise in verifying and validating the safety of self-driving technologies. The funding provided by CCAM enabled WMG to provide an independent assessment to the project, which is crucial for ensuring AI systems in AVs are reliable and trustworthy. WMG provided expertise in AI safety, test scenario identification and use of simulation and real-world testing for evidence generation that Wayve did not have in-house. Wayve further added that it would have been challenging to carry out a project on AI Safety without an independent partner.

	"WMG provided an independent view of how AI safety in AVs should be conducted and crucial expertise on AI safety that we did not have inhouse" The funding also enabled WMG to embark on a new line of research in the area of AI safety and contributed to establishing University of Warwick as a hub for AI safety. The funding provided by CCAM led to the creation of jobs with the WMG team and attracted new collaborations. For example, the WMG team is working on new proposals at the European level. Also, the DriveSafeAI project has established University of Warwick as a hub for AI safety. Additionally, CCAM provided a platform for Wayve to continue moving forward with their work on AI safety and build their leadership in the AI and AV sector.
Successes and Lessons Learnt	
Key lessons	The success achieved so far in the DriveSafe AI project is driven by the strong expertise of the teams involved. A representative from Wavye stated that the expertise of WMG has been instrumental to the project's progression, highlighting that WMG provided an independent view of how AI safety in AVs should be conducted. The expert partner interviewed pointed out that the successful acceptance of the safety assurance frameworks AI systems in AVs and standards would require co-creation with manufactures ad policy makers. Therefore, the DriveSafe AI project is fundamental first step to addressing issues of safety in AVs and a catalyst for the deployment of AVs.
Next Steps	In terms of next steps, insights and findings from the research will be disseminated widely and published on the DriveSafe AI microsite.

B.I Case study: PROLECT - Protection and Resilience for Overhead Line Equipment using Computer Vision Techniques

Introduction	
Project Value	£247,115
Project Duration	6 months
Start date	October 2022
End date	March 2023
Context & Objectives	
Project summary	The "Protection and Resilience for OLE using Computer Vision Techniques" (PROLECT) project was funded through the FOAK 2022 competition, under the theme of cost efficiency and performance prioritisation for a reliable railway. The PROLECT project aimed to target maintenance and monitoring of overhead line equipment (OLE) on electrified trains and received FOAK funding for two use cases. For the first use case, the project aimed to mitigate the impact of high temperatures on OLE wires, which expand and droop in hot weather, disrupting electrified train routes. By using machine learning algorithms, the project optimised means of measuring the placement of balance weights captured in train borne video imagery, in efforts to assist engineers to keep the wires taut based on temperature. This solution - now supported by Network Rail R&D - has been deployed across hundreds of miles train track. For the second use case, PROLECT sought to address structural risks caused by electrical discharge on damaged or dirty OLE; the project installed a Corona monitoring camera, which detects discharge using UV light. Despite some delays to implementation the technology is receiving further funding from Network Rail's OLE Engineering team and will be installed on in-service trains within six months, with full commercialisation expected in a year.
Context	PROLECT addresses two key maintenance challenges OLE: • Rising external temperatures cause OLE wires to expand and droop, leading to service restrictions, delays to customers, and financial losses. As global

temperatures increase, ensuring the reliability of OLE infrastructure becomes more critical for the railway network.

- High-voltage OLEs can suffer from corona discharge—dangerous electrical discharges from damaged or dirty components, which can lead to fires. Early detection with the corona camera allows problem areas to be quickly identified and isolated, minimising service disruption and improving safety for engineers.

An industry expert highlighted the need for increased resilience, especially with increased pressure on operational budgets and climate challenges. Automated maintenance technologies like PROLECT's machine learning-based balance weight placement and automated detection technologies like corona cameras can help address these concerns by preventing disruptions and reducing manual interventions. PROLECT's approach offers more targeted, condition-based maintenance, potentially improving reliability, reducing downtime, and enhancing passenger safety.

Objectives

The key aims of the project were:

- Reduce downtime of OLE lines, by improving maintenance processes and assisting engineers to prevent issues like drooping OLE wires or corona discharge. The project aimed to create a more reliable service with fewer disruptions, benefitting passenger experience, freight and generating overall industry cost savings.
- Reduce the need for engineers to work on live high-voltage infrastructure, improving their safety by replacing manual maintenance with machine systems.
- By automating the inspection and maintenance process, the project aimed to reduce the need for engineers to travel to sites, cutting down on vehicle emissions.
- Increase the resilience of the electrical transport infrastructure to rising temperatures.

Project Activities	
	FOAK funding supported live demonstrations of the PROLECT technology on trains and fixed infrastructure, which were delivered through six work packages over six months: • Work package 1 setup and stakeholder engagement: project initiation, stakeholder engagement, and preparing documentation. • Work package 2 requirement analysis, interface design, and procurement: designing the computer vision systems, mitigating design risks, submitting designs to train operators via engineering change requests, and procuring corona camera equipment. • Work package 3 detection and positioning: footage from the system was reviewed and interpreted for both use cases, and the machine learning model was programmed. • Work package 4 camera installation: The camera was installed, ensuring the train ran smoothly and the footage collected was valuable. • Work package 5 demonstration: event at Westminster with Rail Industry Association, followed by the production of an evaluation report. • Work package 6 business case and exploitation plan: included analysis of the technologies' commercial viability and establishing a future exploitation plan. In terms of key challenges, the time to acquire the camera was originally quoted at three months which would have caused delays to implementation, but this was negotiated with the supplier and brought forward. Once delivered the camera was faulty, however the supplier personally flew the camera to and from their headquarters to ensure it was fixed. The train in which the Corona camera was installed unexpectedly had to undergo maintenance shortly after installation and led to project delays. For the balance weights as well, the initial input data into the model was not 100% accurate, whilst this was not initially realised by the engineers, however it was later diagnosed and rectified. Despite challenges, the balance weights element has been very successful, and the corona cameras has plenty of potential, the team also successfully met critical timing milestones, including the installation and testing dates. Strong partnerships were developed with Network Rail engineers (from Northwest and Central Region), Angel Trains (the rolling stock company), and OFIL Systems (camera manufacturer). The collaborative working amongst stakeholders was an important factor in the project's success. The involvement of industry experts was essential for the technology's development and commercialisation. The involvement of these industry experts also supported the technology's commercialisation after FOAK by providing further R&D funding for both products. The FOAK experience was highly positive. Having access to technical rail experts through the IUK team enabled One Big Circle to engage with a broader range of stakeholders and ask challenging questions.
Outcomes & Impacts	
Outcomes	The project has resulted in significant technological advancements. The balance weights model developed during the project represents one of the first One Big Circle technologies to utilise frame-by-frame analysis, allowing for greater detail to be captured

	in high-speed environments. This innovative technology has since been applied to other projects. One Big Circle has also significantly boosted its internal research and development spending. The company is now able to fund its own R&D projects, allowing for the development of new software and hardware solutions while taking on more innovative risks. The PROLECT project was also reported to have significantly enhanced One Big Circle's market position and technological capabilities. It provided opportunities for the company to connect with new suppliers and expand into EU markets, broadening its business reach. Additionally, the project's success contributed to organisational growth, with an increase from 25 to 58 employees.
Impacts	PROLECT is reported to have impacted the safety, efficiency and sustainability of railway operations, through the roll out of balance weight modelling technology. This technology will create a more reliable service with fewer disruptions, delivering direct benefits to passengers and freight and generating cost savings. It will also enhance the climate resilience of rail networks and reduce carbon emissions, as a result of the automation of maintenance processes. The external expert emphasised the significance of the technological advances made by PROLECT, particularly the balance weight system, which automates a key maintenance survey process. In the broader context of OLE maintenance, this innovation could reduce service disruptions due to temperature-induced wire expansion, a major cause of train delays. Additionally, by integrating the corona camera for detecting dangerous discharges, the technology has potential to enhance the safety of rail operations, potentially reducing both the frequency and severity of failures in electrified systems. From an operational standpoint, PROLECT has the potential to greatly improve efficiency. As noted by the expert, targeted maintenance can minimise unnecessary interventions, reduce delays and improve train punctuality. Furthermore, automating these processes reduces the need for engineers to work in dangerous, high-voltage environments, directly enhancing worker safety. However, any changes may take time to embed as there is necessarily a need to ensure that changes to activity are providing long-term benefits, and that the accompanying processes, and competency management are fully updated and aligned. Environmentally, the project aligns with the industry's push toward decarbonisation. The biggest impact is likely to arise from greater train service reliability acting to support mode transfer to rail from modes with higher per passenger emissions. Also, by cutting down on manual maintenance trips and optimising the condition of OLEs, the technology reduces carbon emissions related to maintenance processes. Furthermore, the expert pointed out that climate resilience—ensuring infrastructure can handle rising temperatures—is increasingly important as the railway sector seeks to adapt to the effects of climate change.

Additionality	Without the PROLECT project, the balance weight technology would likely still have been developed, as it relied on existing footage and incurred relatively low costs. The CFI funding and project however were critical for advancing the corona camera technology. The upfront procurement cost for the corona camera was substantial, at ~£50,000, and there was no existing data from on board vehicles available prior to its development. This lack of data increased the project's risk for One Big Circle, making the support from the CFI funding essential for developing the technology.
Successes and Lessons Learnt	
Key lessons	The success of PROLECT was driven by strong collaboration with key stakeholders like Network Rail engineers, Angel Trains, and OFIL Systems. These partnerships combined diverse expertise to ensure the technology met rail industry needs and bridged knowledge gaps, aiding the development and commercialisation of the technology. However, the expert partner that was interviewed in relation to the case study project, pointed out that even when new technology, like PROLECT's corona camera, functions as intended, operational processes often lag. Ensuring these technologies lead to tangible changes in maintenance practices will be key to their long-term success. Understanding the broader industry context, especially balancing efficiency with cost constraints, will be vital for scaling PROLECT. Continued financial support from Network Rail post-FOAK is essential to overcoming commercial challenges. Potential barriers to widespread deployment include high implementation costs. OLE failures, while infrequent, are very costly, making justifying the expense difficult without clear immediate benefits. User trust and adoption also pose a challenge, therefore, gaining user confidence and demonstrating reliable performance will be critical for PROLECT's success.
Next Steps	The balance weight model has been fully commercialised and is now deployed on Network Rail systems. The corona camera is receiving additional funding for commercialisation from Network Rail. Over the next six months (by January 2026), this technology will be installed on in-service trains, with plans for full commercialisation expected within a year.

B.II Case study: Cross Freight

Introduction	
Name of case study project	Cross Freight: Automating freight access right management and spot bidding using novel and modern software to drive modal shift from road to rail
Project Value	£322,420 (inc VAT)
Project Duration	9 months
Start date	October 2022
End date	June 2023
Context & Objectives	
Project summary	The "Automating freight access right management and spot bidding using novel and modern software to drive modal shift from road to rail" project was funded through the FOAK 2022 competition, under the theme of rail freight. The FOAK-funded project delivered Cross Freight, a modern software system that consolidates multiple data sources into a single, robust platform. Cross Freight enables freight operators and Network Rail Freight Account teams to manage access rights efficiently and quickly identify unused capacity. By replacing manual processes, which were essentially an array of varied excel spreadsheets across organisations, with a scalable, robust, digital system, the project also has the potential to deliver multi-million-pound efficiency savings, grow the freight industry, improve data integrity and streamline decision-making. Ultimately, the project led by CrossTech (Hack Partners Limited), aimed to build a user-focused software system that could handle complex and messy legacy data, automate key processes, and enable more efficient freight operations.
Context	The project addressed a national strategic priority to grow freight on the rail network, as set out in the National Freight Strategy. An industry expert emphasised the need to encourage a shift from road to rail transport. For this to succeed, rail freight must continually demonstrate that it can offer a reliable and flexible option that can move goods at short notice. Engagement with Freight Operating Companies (FOCs) and Network Rail revealed that freight access rights were managed using multiple spreadsheets in different formats, an outdated method, creating inefficiencies and limiting scalability. There was a clear need for a digital, automated system to manage capacity, identify underutilised access rights and facilitate the growth of rail freight. The project addressed this by taking on multiple, different data feeds, amalgamating them in a scalable, robust way and then delivering software to the different user groups across the industry to streamline how access rights are managed.

Objectives	The key aim of the project was to: • Build a modern freight access right management system, integrating user needs to generate efficiency savings for the industry.
Project Activities	
	FOAK funding supported a live demonstration of the technology, which were delivered through several work packages: • Software development and data engineering: Building the core system architecture and data models, incorporating multiple industry data feeds. • User engagement: Running workshops to understand user needs and iteratively refining the system. • Data science: Designing algorithms to handle messy, disparate legacy data, ensuring robustness and scalability. • Pilot testing: Conducting 6–8-week trials with freight teams, collecting feedback to refine functionality. • Integration: Connecting the system with open data platforms and marketplace feeds to ensure accurate, real-time information. • Demonstration and evaluation: Showcasing the tool to the industry, gathering insights, and formalising findings in reports. Challenges during development included poor-quality and inconsistent data and overcoming cultural resistance from stakeholders accustomed to legacy processes. Despite these obstacles, Cross Freight was successfully developed, trialled, and commercialised, with adoption by Network Rail and ongoing development to expand its capabilities. The FOAK experience was highly positive, providing access to commercial stakeholders, live trial opportunities and early user feedback which allowed for iterative development.
Outcomes & Impacts	
Outcomes	The project successfully delivered a baseline product that has been commercialised with Network Rail and is now in national use. Building on this foundation, the technology continues to evolve through ongoing development and further investment. At its core, the system provides a digital platform to manage freight access rights, offering a single source of truth that allows users to quickly identify conflicts and uncover new service opportunities. By leveraging advanced data science and machine learning techniques, the platform transforms disparate and legacy datasets into a modern, robust digital system, improving operational efficiency and knowledge management across the industry. The project has delivered tangible commercial and operational benefits. For Network Rail, it has generated efficiency savings, created revenue opportunities by enabling additional freight services and contributed to the broader objective of increasing rail freight capacity and promoting a modal shift from road to rail. A key

	challenge, however, lies in driving the behavioural change needed to encourage this modal shift, particularly by ensuring that rail can demonstrate its credentials as reliable option. Cross Freight plays a role in supporting this transition, which could take many years and depends on several external factors, including fixed timetabling, fuel prices and broader costs associated with powering units. An industry expert emphasised that although the technology could be seen as being a very pragmatic means to provide the features, and benefits to offers the deliver significant operational and efficiency gains for the end user. They noted that it seemed that the product was focused on end-user benefits. For Hack Partners, the project has safeguarded three jobs, supported partnership development (they now have partnerships with 7/8 FOCs), and established a foundation for expansion into other areas of railway operations and potential international markets. New partnerships have also led to subsequent revenue-generating projects. FOAK's exhibitions and networking events have been instrumental in showcasing the technology and building industry connections.
Impacts	The project establishes a foundation to support long-term transformation in freight operations, creating opportunities to drive lasting efficiency improvements across the industry. The product enhances revenue generation and efficiency for freight operations, with the potential to expand into other core railway functions, improving industry-wide efficiency and delivering better services to end users. For Network Rail, it enables increased freight capacity, generating ongoing revenue while streamlining operational processes. An industry expert supported the applicability to scale this technology across Network Rail. CrossTech have invested £300,000 in further product development, positioning the platform as a core growth engine in a new product domain, providing market diversification and significant future growth potential.
Additionality	FOAK funding was critical to the success of the project. Without it, the risk of development would have been too high, and access to key, commercial stakeholders would not have been possible. The support of commercial stakeholders was key to maintaining momentum.
Successes and Lessons Learnt	
Key lessons	Key lessons from the project include the importance of iterative development and close user engagement for software success. Legacy data quality and organisational resistance can create barriers that must be managed through technical solutions and relationship management. Additionally, software requires continuous development, testing, and refinement to remain effective. Aligning software development cycles with traditional procurement models is a challenge, but necessary to deliver value in the rail industry. The project has strongly welcomed the DfT and IUK's focus on system interfaces, recognising it as highly valuable problem to solve. A key future area of focus will be engaging both the FOCs and firms that contract FOCs to deliver their product. This will require strong relationship management and

	clear demonstration of the benefits of new processes and technologies to encourage adoption as well as an awareness of the external factors that may support or create barriers to this modal transition. An industry expert highlighted that CrossTech will need to work closely with Network Rail and FOCs to gather feedback and develop the technology iteratively. They noted it is encouraging that CrossTech has committed to further investment to explore new functionalities and improvements.
Next Steps	As an initial product, Cross Freight has been commercialised with Network Rail, and future work will focus on expanding its capabilities to new market segments and additional railway operations. There is also potential for overseas adoption. Continued iteration and user engagement will ensure the platform remains robust, scalable, and aligned with industry needs.

B.III Case study: Trains with Brain(s)

Introduction	
Name of case study project	Trains with Brain(s)
Project Value	£248,046
Project Duration	6 months
Start date	October 2022
End date	March 2023
Context & Objectives	
Project summary	The Trains with Brains project was funded through the FOAK 2022 competition, under the theme "More efficient use of access for infrastructure maintenance". The project demonstrated how a suite of rail infrastructure monitoring technologies, collectively branded as Trains with Brains, provides critical intelligence to improve the efficiency and safety of rail operations. The project, led by Transmission Dynamics, combines roof-mounted cameras with pantograph and bogie mounted accelerometers which deliver continuous, real-time insights into the dynamic interactions between trains and OLE, as well as other critical components. The project successfully integrated these technologies onto passenger rail services, showcasing bi-directional data flows between on-train monitoring devices and Network Rail's digital systems. The demonstration highlighted how improved data integration could help Network Rail to plan maintenance work more effectively, through smarter decision making informed by AI machine learning. The project was delivered by Transmission Dynamics, an independent SME Industrial Internet of Things solutions provider. Key project partners included Network Rail (infrastructure owners and operators), Angel Trains (rolling stock leasing company) and West Midlands Trains (a Train Operating Company).
Context	Trains with Brain(s) solutions address several key maintenance challenges facing overhead line equipment and rail maintenance. • De-wirements and pantograph/OLE faults: Failures in these systems can cause severe service disruption, safety risks and costly infrastructure repairs (c.£1.5m per incident). • Undetected faults: Without continuous monitoring, small anomalies may go unnoticed, deteriorate over time and eventually result in failures.

	• High reliance on manual inspection: Traditional approaches require manual patrols or infrequent monitoring fleet runs, which are costly, less accurate and potentially hazardous for engineers. As the rail industry navigates CP7[5], with increasing pressures on budgets, and climate resilience, there is growing demand for insightful and frequent monitoring of overhead line assets, capable of detecting anomalies including arcing, broken/missing wires, dropper faults, wheel flats, wheel pits and more. By providing early alerts, PANDAS-V® (pantograph and overhead line monitoring solution) from Trains with Brain(s)) enables targeted maintenance, reducing both operational disruption and risk to safety. Similarly, there is growing demand for intelligent, real-time monitoring of critical mechanical systems such as gearboxes, axles and bogies. SmartBugs® and Smart Oil Plugs® provide continuous insight into equipment health, capable of detecting anomalies such as temperature spikes, vibration irregularities, lubrication degradation, and early signs of mechanical wear. By delivering timely alerts, these solutions enable targeted maintenance, helping operators reduce downtime, extend asset life, and safeguard both performance and safety. Without holistic monitoring it is difficult to ensure the right parameters are being monitored to avoid failures. Combining solutions on the roof and undercarriage of the trains through Trains with Brains® enables visibility of the dynamic interactions between rail and overhead line for the first time. This increases intelligence, optimises predictive maintenance and reduces the likelihood of critical faults occurring. An industry expert emphasised that, given the economic pressures on the rail sector and the key challenges related to maintenance, including the impacts of climate change, greater automation of maintenance processes, particularly those which have potential to reduce on-site in person requirements, is likely to represent a robust investment in productivity.
Objectives	The key aims of the project were: • Demonstrate the benefits of integrating multiple condition-monitoring technologies onto a passenger train. • Provide visibility of interactions between OLE and track components in real-time, supported by AI and machine learning.
Project Activities	
	FOAK funding supported live demonstrations of the Trains with Brains technology on trains, which were delivered through five work packages over six months: • Project management & stakeholder engagement – planning, contracting, and stakeholder alignment.

[5] CP7 is the seventh five-year planning and funding cycle for Network Rail. It spans from 1 April 2024 to 31 March 2029. These periods are used to plan, fund, and regulate the operation, maintenance and renewal of the rail network infrastructure in Great Britain.

	• Algorithm development – developing machine learning algorithms to classify faults and combine datasets from multiple monitoring devices for a full operational picture. • Bi-directional integration – ensuring seamless communication between Transmission Dynamics' cloud platform and Network Rail's systems via APIs. • Live demonstration – installation of devices on passenger services and demonstration of data flows • Evaluation & exploitation – reporting against KPIs, producing evaluation outputs and disseminating findings to commercial stakeholders. In terms of key challenges, the project was delivered under tight timelines (6 months), which placed pressure on all partners to prioritise and deliver at pace. Obtaining engineering approvals, installing the technologies and demonstrating tangible benefits within such a short duration was particularly difficult. Despite this, the structured contract and defined work packages with committed partners enabled the team to stay on track. The project successfully delivered all objectives on time and in full. The exploitation work package was completed with full demonstrations, and the team is now actively rolling out deployment of all products across the UK and globally. Direct engagement with stakeholders proved crucial. Having stakeholders signed up to support the evaluation enabled the collection of meaningful KPIs and demonstrated benefits, strengthening the business case and supporting commercialisation. This structured stakeholder collaboration was a key enabler of success, providing clarity and momentum. The FOAK experience was highly positive. The project leader emphasised the relevant competition theme, developed through listening to the rail sector, which reinforced relevance, practical value of the project and therefore credible potential for commercialisation post project.
Outcomes & Impacts	
Outcomes	The project achieved significant commercial, technical, and strategic outcomes. After project completion, the technology developed were launched under the product line Trains with Brains. The tangible and positive evaluation evidence gained through FOAK was key for developing the project business case. The project has already self-reportedly generated millions of pounds of revenue from UK and global orders of Trains with Brains solutions, representing a strong return on investment for both the SME and IUK. Commercially, the project is now in contract with all of the project partners and more, including Mainland UK Network Rail, Network Rail Scotland, Network Rail High Speed and various train operating companies, and Rolling stock leasing companies (ROSCOs), in the UK and their equivalents globally (including in the EU, US, Australia, Brazil and India. Stakeholder engagement fostered strong word-of-mouth referrals and long-term relationships. The project has resulted in back-to-back procurement framework with Network Rail, which accounts for around 80% of the UK revenue achieved.

	From a market perspective, the initiative strengthened the company's position, increasing LinkedIn and website engagement by 20% since January 2024. The commercialisation of the products has also safeguarded 20 existing jobs and created five new ones, with rail now accounting for over half of the company's income (previously 25%). Technically, the project delivered lasting knowledge outputs that are influencing industry standards. Network Rail is adopting lessons from the trainbourne monitoring systems, shifting from manual inspections to more reliable trainbourne monitoring alternatives, and the company is increasingly recognised as a sector leader, with publications including the White Paper on Mentor Train Force Measurements influencing standards and working practices. An industry expert highlighted that a key innovative aspect of Trains with Brains lies in its ability to make sense of the vast amounts of data across different asset components and infrastructure , cross-reference these datasets and use the insights to identify the causes and effects of maintenance needs more quickly.
Impacts	Trains with Brain(s) has demonstrably improved the safety, efficiency and operational reliability of rail infrastructure through the deployment of a combination of train-borne monitoring technologies. Network Rail has self-reported the following benefits to date: • 30% reduction in high impact incidents (2018/2019 – 2023/2024). • 18% work bank reduction between 2021–2025. • Efficiency forecasted at £5.1m by end of CP7. • 17,000 delay minutes saved in last 18 months. • At least six dewirements saved in last 18 months. • MENTOR being retired for OLE monitoring. • Drive to reduce manual patrolling, targeting £2.5m per annum saving. • Driving standards change to dynamic monitoring. The technology is also reshaping how standards are applied across the network. Previously, data collection relied on manual or infrequent monitoring fleet runs, which were limited in accuracy and frequency. With Trains with Brains, measurements including pantograph height, overhead line wire stagger, arcing, dropper wire failures and foliage and rail component baseline temperature and acceleration exceedances are now captured in real-time under actual operating conditions. Image-based analytics allow for more precise and representative data collection, enabling standards to evolve towards dynamic, condition-based monitoring and reducing reliance on expensive and less frequent traditional surveys and reducing 'boots on ballast' as per Network Rail's critical safety campaign aims. We understand that safety improvements have been significant. Manual patrols, which previously exposed engineers to potentially hazardous environments, have been reduced and in some cases eliminated in regions where the system has been deployed. Maintenance teams are now able to prioritise interventions based on automated alerts, preventing incidents before they escalate. This targeted

	approach has also decreased operational costs, as staff can be redeployed from routine inspections to critical fault resolution. The project also contributes to potential to support asset longevity. Continuous, accurate monitoring allows mechanical components and overhead line infrastructure to operate more smoothly, extending service life. This proactive management generates further cost savings and efficiency improvements, including service reliability and safety for passengers. Indirectly, this improved reliability also supports environmental benefits as more consistent rail services encourage modal shift from higher-emission transport, while reductions in manual inspections and emergency repairs lower the carbon footprint associated with rail maintenance and repairs.
Additionality	The FOAK grant played a critical role in accelerating the development and integration of Trains with Brains. While Transmission Dynamics already had individual products in operation, the project enabled them to be combined and demonstrated together on a single train, something unlikely to have been achieved under a modular, incremental approach within the same timeframes. Without FOAK, it is likely that the technologies would still have been commercialised, but the process would have been significantly slower and less coordinated. The project also provided the structure and stakeholder engagement needed to secure widespread buy-in. The formal demonstration and evaluation framework, requiring Network Rail and other partners to provide feedback, was essential in proving the business case and ensuring the solutions were adopted into long-term commercial frameworks.
Successes and Lessons Learnt	
Key lessons	The success of Trains with Brains was underpinned by strong collaboration with partners, the clear alignment of FOAK themes with industry needs and the structured approach to evaluation and reporting. Transmission Dynamics highlighted that having commercial KPIs embedded into the project design was crucial, as it ensured that technical demonstrations translated into tangible business benefits. Another key lesson was the importance of timing. The project succeeded partly because the products were already at a high technology readiness level and ready to be deployed innovatively. FOAK provided the opportunity to integrate and evaluate them collectively, which demonstrated strategic value and directly supported commercialisation. Looking ahead, Transmission Dynamics suggested that longer project durations (still with well-defined themes that meet sector demand) and earlier announcement of imminent funding competitions would help SMEs maximise value from FOAK programmes. Nevertheless, the company emphasised that the programme structure, with its defined themes, contract structure, proportional reporting and stakeholder involvement, has been invaluable in de-risking innovation and enabling rapid commercialisation.
Next Steps	Transmission Dynamics is now actively commercialising the Trains with Brains product globally. Contracts are already in place with Network Rail, Angel Trains,

	and TOCs, both in the UK and overseas and they have a healthy pipeline of new contracts to build on. The company continues to develop additional software capabilities for the existing future-proof hardware platform. An industry expert highlighted that several additional asset types could be integrated into the Trains with Brains software. They noted that as the technology develops to incorporate more inputs, this expansion will occur naturally should it become more widely used and embedded.

C.I Case Study: Compact battery propulsion for inclusive regional trains

Introduction	
Project Value	£202,703
Project Duration	23 months
Start date	8/01/2023
End date	31/01/2025
Context & Objectives	
Project summary	This project advanced the development of next-generation zero-emission battery trains for the UK, targeting commuter and suburban services. It built on Hitachi Rail's earlier hybrid train trial and focused on making battery systems more compact, modular, and safe. Specifically, key aims were to: • Develop a modular battery enclosure and cooling system to increase energy density while reducing size, enabling lower floors and improved accessibility. • Validate fire safety and mitigation measures through large-scale testing of lithium iron phosphate (LFP) cells. • Produce verified designs and manufacturing drawings to support near-term commercial deployment.
Context	Hitachi is a multinational rolling stock manufacturer. The challenge was twofold. Around 2,000 ageing diesel units still in UK service and decarbonisation requires rapid shift to zero-emission alternatives. However, the UK's railway has unique constraints: tighter loading gauges and limited underfloor space for batteries compared with much of Europe. Meeting the required range and power levels within that space had not yet been solved. Second, the industry lacked knowledge on how lithium iron phosphate (LFP) batteries behave in railway-scale applications, particularly in fire or failure conditions.
Objectives	The project's key objectives included: • Reducing the volumetric size of the battery enclosures to support low-floor accessible train designs; • Increasing modularity and maintainability; and • Validating fire safety through large-scale testing. At its core, the project was focused on turning conceptual ideas into a practical, commercial design that could be deployed on real UK routes.

Project Activities	
Outline of process activities	Hitachi Rail worked in partnership with DB ESG and the University of Birmingham, supported by suppliers such as Turntide Technologies. Together they developed a modular battery enclosure design and undertook extensive safety validation. One of the most significant activities was a programme of large-scale fire testing at Sphere, a specialist facility in Germany. No equivalent UK facility was available, which created delays and highlighted a gap in domestic testing infrastructure. The tests forced LFP cells into thermal runaway conditions and measured both fire behaviour and the gases emitted. Results showed that Hitachi's proposed fire mitigations - including water-cooled plates and inter-cell insulation blocks - performed exceptionally well, often preventing runaway entirely. The tests also provided data on hydrogen fluoride emissions, giving the team a much clearer understanding of how to design exhaust systems and inform safety standards. Alongside this, the University of Birmingham contributed academic modelling and simulation to validate the designs, while Ricardo supported hazard assessments and safety cases. DB ESG led on mechanical design of the enclosures. Together, the consortium produced a complete set of manufacturing drawings and a modular design concept that could be easily adapted for future contracts.
Outcomes & Impacts	
Outcomes	The project achieved its main objectives and, in some areas, exceeded expectations. The design is unique in the UK market, able to pack sufficient energy into the constrained loading gauge while enabling lower floors for improved passenger accessibility. While the project's core objectives focused on compact design, modularity, and maintainability, one of the most valuable outcomes turned out to be the fire testing programme and knowledge of LFP stability. Hitachi Rail and its partners discovered that their fire mitigation systems, particularly the water-cooled plates and inter-cell insulation blocks, were far more effective than expected. In some tests, the cooling systems were so robust that the team could not induce thermal runaway, even under extreme conditions. The fire testing generated new insights not previously available to the rail sector, raising the overall level of industry knowledge and directly feeding into regulatory work by the RSSB. Although the project activities stopped short of producing a physical demonstrator, by the end of the project in February 2025, Hitachi secured a contract with Grand Central to supply tri-mode trains using the new battery design. Further bids are also leveraging the design, and Hitachi anticipate that all future rolling stock tenders in the UK will require some form of battery capability.

	"I don't think we're going to sell another train in the UK without a battery on it." Case study beneficiary
Impacts	Beyond the UK, the compact, modular design has attracted international interest through Hitachi's global rail network. While no contracts have yet been signed, the technology has already been put forward in proposals overseas, showing export potential. The impacts are both immediate and longer term: • In the short term, the project has strengthened Hitachi's market position, improved technical knowledge, and delivered a design now being commercialised, as demonstrated by the contract secured with Grand Central. • Over time, widespread adoption could remove thousands of diesel engines from the UK network, cutting CO_2, NOx and particulates, lowering maintenance costs, and enabling quieter, more accessible trains.
Additionality	The project contributed to addressing the challenge of the UK railway industry's reliance on diesel traction for its rolling stock, accelerating the development of battery technology and adding to the level of overall industry knowledge. Hitachi Rail would probably have developed a product eventually, because customer demand is strong and it aligns with their rolling stock strategy. But without IUK support, progress would have been: • **Slower** – they would have waited until a commercial contract forced the investment. • **Less collaborative** – they would not have had the same level of engagement with DB ESG, the University of Birmingham, or Ricardo, meaning they'd have missed out on academic insights and rigorous hazard assessments from a wider range of industry experts. • **Less comprehensive** – they would not have been able to carry out the dedicated fire testing programme with the same efficiency, which became one of the project's most important contributions.
	"I think we probably would have got there, but it just wouldn't have been done with the same efficiency or with the type of insight we got from having a collaborative project like this."- NZP beneficiary
Successes and lessons learnt	
Key lessons	Three major successes were identified • The technical insights from fire testing • The positive industry reception (including press coverage and dissemination through RSSB)

	• Hitachi's ability to seamlessly move from design concept to live commercial contract The latter was particularly valuable; by having the Innovate-funded design ready, Hitachi could present customers with a mature solution rather than starting from scratch. There were, however, important lessons. The lack of UK fire testing capacity was a significant barrier, forcing the project to rely on facilities abroad and delaying design validation. Administrative burdens, particularly securing independent accountants' reports, were disproportionately time-consuming compared with the technical work. On the technical side, the project reinforced the importance of modularity and fire safety as differentiators in the market and showed how academic–industry collaboration can accelerate innovation.
Next Steps	Hitachi Rail is now integrating the battery design into trains for Grand Central, due to enter service in 2028. It is pursuing further contracts in the UK and abroad and expects the design to become a core part of its rolling stock offering. The company is also continuing to contribute to RSSB working groups, ensuring its fire safety findings shape emerging industry standards. Future opportunities include retrofitting existing diesel fleets with battery units, exporting the modular design overseas, and developing complementary products such as a Battery Driver Advisory System (B-DAS) to optimise energy use. *"[The project has] raised the bar for the industry in terms of understanding of how this type of battery technology can be utilised in the railway context."*- NZP beneficiary

C.II Case Study: Higher performance modular dual motor propulsion system

Introduction	
Project Value	£1,092,321
Project Duration	21 months
Start date	1/6/2023
End date	28/2/2025
Context & Objectives	
Project summary	Talos was founded in 2018 by two co-founders, both experienced engineers with long careers in the automotive industry. The IUK-funded HIPERMod project gave the company the opportunity to transition from consultancy into a product-based business. The project centred on the development of a dual flux electric motor design, integrating permanent magnets and electromagnets in a single rotor. This technology offers higher efficiency across a broader speed range, reduced reliance on costly permanent magnets, and lower overall operating costs.
Context	Electrification is critical to decarbonisation of transport, but motor innovation has lagged compared to battery advances. Talos's dual flux technology fills an important gap by addressing both efficiency and supply chain resilience. Talos' tech aims to: • Improve the efficiency and performance of electric motors. • Reduce reliance on permanent magnets, which are expensive, environmentally damaging to produce, and subject to supply chain risk (China dominates production). • Enable smaller, cheaper batteries while extending range, reducing cost, and lowering emissions.
Objectives	The key aims of the project were to: • Develop and test a novel dual flux electric motor. • Integrate the motor into a demonstrator motorcycle. • Generate new IP and patents. • Position the company to attract investors and commercial partners.
Project Activities	

Outline of process activities	The grant enabled Talos to expand its capabilities rapidly. The company hired new engineers, invested in specialist modelling and simulation tools, and built and tested prototype components. Collaboration was central. Talos initially worked with ARC Ltd, an electric motorcycle manufacturer, before partnering with Lyra Electronics to support inverter development. Both partners subsequently went into administration, forcing Talos to restructure its project plan and assume a larger share of the work. Despite these disruptions, the company successfully built and tested a demonstrator motorcycle equipped with the dual flux motor. There were technical challenges too, notably, deciding when to stop iterating designs and commit to physical builds. Reliance on external suppliers also drove up costs, with logistics and transport accounting for around 10% of the budget. Nevertheless, the combination of simulation and real-world validation proved powerful, accelerating progress from low-level concepts (TRL 2–3) to working demonstrators (TRL 4–5). The project's biggest success was demonstrating the dual-flux motor in a working motorcycle, moving the concept from theory into a tangible prototype that could prove its efficiency and reliability. This demonstrator was critical in building credibility with investors and OEMs, helping Talos to attract follow-on funding and industry interest. Alongside this, the company secured patents for its technology, transitioned from consultancy to product-led start-up, and expanded its technical team. The ability to adapt when delivery partners went into administration was itself a success, showing resilience and ensuring the project still delivered meaningful outcomes. Talos found the LMT programme supportive and enabling. IUK's flexibility, particularly when partners failed, was seen as pivotal in keeping the project on track, and MSPs provided constructive oversight without creating undue burden. The application process was workable, though securing partner commitments was challenging, and the requirement for additional accountant reports during delivery was an administrative frustration.
Outcomes & Impacts	
Outcomes	By the end of the project, Talos had: • Produced a working demonstrator motorcycle showcasing the dual flux motor. • Filed patents and secured valuable intellectual property (submitted patents have not yet been granted but IP protections are in place).

	• Transitioned from consultancy to a high-growth start-up, attracting strong investor interest. • Increased technical capacity through new hires and specialist skills • Technically, Talos proved its concept in hardware, moving the technology from TRL 2-3 to TRL 4-5, with plans to reach TRL 7-8 in the next phase.
Impacts	Efficiency improvements of 10–20% could reduce vehicle emissions significantly, while reduced reliance on permanent magnets lowers costs and mitigates environmental damage from mining. The design also offers a safer failure mode: rather than sudden heavy regenerative braking, the motor freewheels, improving safety in real-world use. The project raised Talos's profile with OEMs and investors, securing £1.8 million in follow-on funding through the Drive to 35 programme. For a small start-up, this credibility was significant *"Where we were three years ago, external investors would not really be interested in the company because it was nothing proven. It was just some ideas. IUK has taken that risk with us and now we're in a much better position."* – NZP beneficiary
Additionality	The grant was essential. Without it, Talos would have not been able to fund the resource costs to develop the technology and would have had to continued focussing on consultancy work to maintain company cash flow. This would have resulted in the technology progressing much more slowly, if at all. The funding enabled demonstrator builds, IP generation, and investor engagement.
Successes and lessons learnt	
Key lessons	A number of factors underpinned the project's success. Strong founder expertise and a long-term vision provided resilience when partners failed. The decision to focus on motorcycles as a manageable first application proved strategic, allowing Talos to refine the technology at a realistic scale before moving into larger markets. Key lessons included the importance of balancing simulation with physical validation, the need for demonstrators to build credibility, and the value of flexibility, both from IUK, who adapted requirements when partners collapsed, and from Talos, who absorbed additional work. Barriers included partner insolvencies, reliance on suppliers, and wider sector downturns, while enablers were IUK's flexibility, Talos's internal expertise, and strong investor appetite once the demonstrator was in place.

C.III Case Study: Paradigm Shift

Introduction	
Project Value	£515,391
Project Duration	20 months
Start date	01/09/2023
End date	31/03/2025
Context & Objectives	
Project summary	The Paradigm Shift project aims to develop and test a prototype two-speed gearbox for an electric motorcycle. The project is a beneficiary of the Zero Emission Propulsion CR&D competition run by IUK. The project was awarded a grant offer of £515,391 by IUK. Although electric vehicles can launch and reach top speeds with a single gear ratio, adding a light and cheap gearbox could improve the performance of electric vehicles while reducing the cost of the overall build of the vehicle. In addition, this technology may be applicable to a range of vehicle types and engines. The project is a partnership between BSA Company Ltd (a subsidiary of Mahinda Group, which resurrected the BSA brand upon their introduction of the Gold Star petrol-powered motorcycle in 2016), Zeroshift Transmissions, a subsidiary of the Jardines Group, and the University of Bath. BSA Motorcycles and Zeroshift Transmissions are developing the gearbox, while testing of the prototype occurs at the Institute of Advanced Automotive Propulsion Systems (IAAPS) facility at the University of Bath.
Context	Currently, most electric vehicles rely on a single gear ratio and while they do not require a two-speed gearbox, this can help an electric vehicle improve its range, acceleration and speed. The Paradigm Shift project looked to address three key issues which increase the feasibility of installing two-speed gearboxes in electric vehicles: • The cost - which is considered to be too expensive; • The weight – they are too heavy; and • The electric system – which replaces the gearbox hydraulics. The concept of developing a lighter, more energy efficient and smaller gearbox was not necessarily a new idea. Indeed, Zeroshift Transmissions Ltd was originally working on the idea in the mid-2000s; however, during the

	2007/08 global financial crisis, the financial backing for the project was withdrawn and the project concluded early. BSA Company Ltd. is currently in a consortium sponsored by the Advanced Propulsion Centre UK to develop an electric "retro-roadster" motorcycle targeted at the mid-performance segment. In 2022, BSA Company Ltd approached Zeroshift Transmissions Ltd about a potential collaboration and to restart the project for their electric motorcycle. Once the partnership was agreed, the team decided to approach IUK for project funding.
Objectives	The Paradigm Shift project aims to develop a two-speed gearbox which satisfies the following criteria for the partner BSA motorcycle: • The gear shift must be smooth; • The gear shift must be quiet; • The gearbox must be packaged within the motorcycle; • The gearbox must be durable; • The gearbox must improve the motorcycle acceleration compared to its single speed equivalent; • The gearbox must help improve the city cycle range of the battery; and • The gearbox aims to lower the cost of building the motorcycle compared to the current configuration (the battery and motor can be downsized). In addition, the project has wider objectives, including: • To derisk the process of adding two-speed gearboxes to electric vehicles of all types by proving the viability and performance benefits of this two-speed gearbox. • To provide a more-efficient gearbox which can be applied to combustion engine vehicles as well as electric vehicles. By replacing conventional hydraulics with electrical actuation, the gearbox will be more energy efficient, and less energy will be lost in the power transmission from the engine (in a combustion engine vehicle) or motor (in an electric vehicle) to the wheels.
Project Activities	
Outline of process activities	The Paradigm Shift project has developed the technology for a two-speed gearbox which can be applied to electric motorcycles – with potentially wider application to other electric vehicle types as well as combustion engines. To test the technology, the project has utilised a rig at the IAAPS facility at the University of Bath to test the performance of the gearbox and make changes in response to the observations from the tests. The project will also carry out final back-to-back testing. The project originally intended to trial the technology with an existing motorcycle clutch; however, due to the level of expertise and knowledge within the team, the project was able to develop a new type of clutch to test the technology. The new clutch was smaller and lighter. While this had some implications in terms of cost and delivery timeframes, this was considered to

	be key to the success of the project. Another success highlighted by the project manager was the collaboration with IAAPs and access to the IAAPS facility. This added value to the project by enabling robust testing of the technology and access to the team and their expertise. The feedback from the IAAPs team gave the partners confidence in the project technology regarding novelty and wider applicability.
Outcomes & Impacts	
Outcomes	The project has developed a prototype two-speed gearbox for an electric motorcycle, which is lighter and cheaper than current alternatives for electric vehicles and contains an effective electrical system to power the gear shifts. In the process of developing the two-speed gearbox, the project has also developed a novel and innovative clutch design. The project will test the prototype gearbox on a rig to test the performance of the gearbox compared to a single speed BSA EV motorcycle. The project will use the testing of the gearbox on the rig to ascertain the rideability of the motorcycle with the new gearbox packaged into the vehicle The final back-to-back testing will aim to prove the performance superiority over the conventional configuration of the BSA Motorcycle without a two-speed gearbox. The results of the test will help contribute to the patent applications Zeroshift Transmissions have made to secure the IP from their novel work. Once IP is secured, the project will use the IAAPS facility to demonstrate the project to other members of the automotive industry to gain further funding to develop the gearbox further and eventually commercialise the technology. Other outcomes noted by the project manager including the relationships formed with partners, many of which were new, including IAAPs. This relationship is expected to continue post-project completion.
Impacts	The project has the possibility of providing wide-ranging impacts which could greatly affect and disrupt the automotive industry. The project aims to first prove the feasibility of adding a two-speed gearbox to electric vehicles. If cheap, light and well-packaged, the gearbox will be commercially attractive to add to electric vehicles. The application of this technology also offers the possibility of reducing the size and weight of electric vehicle batteries and motors, the two most expensive components of the majority of electric vehicles. The addition of a two-speed gearbox to electric vehicles could also improve the range and acceleration of electric vehicles. By reducing the cost and weight of electric vehicles and improving their performance, the improved gearbox developed in this project could increase the attractiveness of electric vehicles in comparison to combustion engine vehicles to customers and thus increase the uptake of electric vehicles amongst end users. However, a rise in uptake would be heavily dependent on whether the project can deliver both initial capital and operating cost savings for end users. Any increase in electric vehicle uptake caused by this project

	would contribute to a reduction in carbon emissions and help decarbonise the automotive industry. The project's objective of developing electrical actuation to replace gearbox hydraulics and its development of a novel clutch concept could have wide impacts on the automotive industry beyond the electric vehicles sector. These technologies could be applied to vehicles including combustion engine cars and motorcycles (including excavators, diggers, tractors and tanks). By applying these novel technologies to combustion engine vehicles, they could reduce energy loss during transmission from engine to wheels. This could improve the efficiency of these vehicles and reduce their cost.
Additionality	The IUK funding for the project has been essential for the continuation of the Paradigm Shift project. The funding has enabled Zeroshift Transmissions to take risks and invest their workforce's time in innovation R&D that they may have otherwise been unwilling to do. Without the additional funding for the project from IUK, Zeroshift Transmissions would have been nervous about starting the Paradigm Shift project.
Successes and lessons learnt	
Key lessons	The Paradigm Shift project has led to many lessons being learnt. During the course of the project, technical changes were made which delayed the progress of the gearbox development and testing. The original application for funding had a couple of mistakes which needed addressing. Moreover, the project initially used a conventional motorcycle clutch which was too big and heavy to be viable for the prototype. These hiccups have led to the project being delayed. To accommodate this, a couple of change request were made to IUK to overcome these hurdles and keep the project on track to achieve its outputs. The process of working through the change requests and dealing with project timeline issues with IUK has been smooth. IUK have been reportedly relatively hands off with the project, but their desire for frequent updates on project delivery and bi-weekly meetings has enabled them to stay on top of any issues or delays and the team have been able to access their support to keep the project moving forward. A key enabler of the project has been the seamless collaboration of the partners in the project. Zeroshift and BSA Motorcycles have worked incredibly well together. This effective collaboration allowed the company to spend an extra £20k to help cover the additional costs associated with the new clutch design. However, if the Paradigm Shift project had been able to make more drastic changes to the project brief, secure additional finance and deliver the project over a longer timeframe they may have been able to develop and test the new clutch more comprehensively. By developing more variables on the new clutch design and being able to test the variants (by conducting back-to-back

	comparison tests), the project could further de-risk the gearbox for industry when they seek to commercialise the new design.

D.I Case Study: The IONA Drone Delivery Initiative

Introduction	
Grant Value	£248,460 (grant value)
Project Duration	10 months
Start date	01/06/2024
End date	21/03/2025
Context & Objectives	
Project summary	The IONA Drone Delivery Initiative project is being funded through the TDD competition. The project involves the trialling of an unmanned, fixed wing, tilt motor, electric propulsion aircraft drone in the rural setting of Argyll and Bute in west Scotland. In technological and mechanical terms, the drone had already been demonstrated but this project seeks to gain operational learnings in how a drone would work in a commercial logistics business model. This involves integrating the drone into a logistics environment with delivery network systems. The project aims to test trial run flights with partners to show how a rural drop off and pick up would work and will allow for follow-on analysis and optimisation.
Context *Business/org. type* *What challenges was the project trying to address?* *Any relevant contextual information about the industry and technology*	The IONA Drone Delivery Initiative seeks to address three key logistics challenges: • **High last-mile delivery costs**: In rural settings, logistics costs are high. This is primarily due to fuel costs and the cost of the labour-intensive operations (i.e. certain conditions require a drive of multiple hours for one delivery which can be done in minutes using a drone: and delivery services in Scotland are subsidised by the Scottish government) • **Disparity in quality of service:** Inefficiencies in last-mile logistics do create disparities in service quality depending on where you live. This especially impacts rural residents and their access to essential goods and healthcare services. This could to a lesser effect also impact drones which may also not be permitted to fly over certain rural areas. • **Environmental impact:** The logistics sector faces mounting pressure to reduce its carbon footprint and adopt sustainable practices, particularly in rural areas where reliance on fossil fuel vehicles is still currently prevalent. **Conclusion:** The last-mile logistics sector in rural environments is underserved, with limited innovation tailored to non-urban settings. Autonomous drone solutions combine innovations: electric, unmanned,

	and flight to address issues in an environmentally sustainable and more cost-effective manner. The project's proprietary drone technology, featuring a unique tilt-rotor model with a fixed-wing design, provides for vertical take-off and landing, and long-distance capability. This makes it a more flexible solution for logistical needs than other innovations. Additionally, IONA seeks to specialise in generic parcel delivery where many competitors target specialisations such as the movement of medical supplies.
Objectives What were the key aims of the project?	**Key Aims:** • **Reduce operational costs:** Deliver a flight demonstration that proves the cost effectiveness, in terms of cost-per-delivery, of using a drone to deliver parcels in certain rural settings over fossil-fuel powered van deliveries. • **Decarbonisation:** Cut emissions through utilising electric and autonomous technology, contributing to environmental goals and sustainable rural development. • **Prototype validation and commercialisation:** Achieve technical validation (TRL 5 to 6) and establish a pathway to commercialisation for autonomous rural logistics solutions.
Project Activities	
Outline of process activities *Key challenges* *Key successes* *Experience of the LMT programme*	There are several ongoing activities being delivered as part of the project. These include conducting: • Developing and testing payload management design for operational requirements. This includes conducting infrastructure assessments through tests and developing an interface for the drone to work with. • Test flights to validate the drone's economic feasibility and update the airframe for new regulations. This may result in refining the tilt-rotor drone model. • Regulatory compliance procedures. The project has initiated an airspace application under the Open A3 category to allow for a controlled, limited test of operations in rural airspace. • Interface tests with logistics providers to examine interactions between drones and couriers. A major challenge has been regulatory delays. While the EU has implemented the SORA framework under European Union Aviation Safety Agency (EASA), the UK's adoption has been delayed—originally scheduled for Q3 2024, now postponed to April 2025 (Q2 2025). This delay prevents operations at high TRL levels and impedes data gathering needed for certification (SAIL III and beyond). Additionally, Temporary Restricted Areas (TRAs)—part of the UK's Airspace Change Programme to enable unmanned aerial vehicle (UAV) operations—have not yet been approved. Some companies have had applications pending for over 18 months. Without TRAs, operations are limited to ~1.5km line-of-sight or require observers every 3km,

	undermining cost-efficiency. TRAs are also time-limited and cannot be renewed in the same area for the same purpose, making them unsuitable for long-term logistics services. Whilst still in delivery phase the project still hopes to achieve the outlined objectives in testing drone flights in rural logistics settings. Additionally, the project has already garnered considerable interest and engagement from stakeholders, including other local councils, some logistics providers, and community businesses. This stakeholder support is reflective of a collective interest in addressing the pressing need for improved rural logistics infrastructure. One of the reasons IONA applied for this grant was to increase their market visibility and reputation by receiving a UK government grant, which has already been partially achieved. Feedback on the grant process was that it was reflective of most grant funding programmes. The project's UKRI representative, has provided invaluable guidance. The programme manager has been highly effective in assisting the project throughout. Some constructive criticism was that the funding and submission portal could benefit from some refinement to streamline the process further. This could include some feedback or interactive features, although there have been noticeable improvements to this system throughout the project delivery period.
Outcomes & Impacts	
Outcomes *What outcomes where achieved?*	The project aims to validate IONA's tilt-rotor fixed-wing design by demonstrating its efficiency in time, cost, and emissions. The results will feed into demonstrating a viable business model for logistics partners, with proven capability to carry 10kg cargo over a 70km round trip. The work has also enhanced IONA's R&D capacity, enabling further refinement of its logistics model and technology infrastructure. Broader third-party benefits are being realised which were not explicitly planned at project start. Several of IONA's suppliers are providing technical guidance, leveraging their expertise to support as consultants rather than purely as direct manufacturers. This collaborative approach has yielded significant benefits and created a network that includes UAV technology organisations, ground station personnel, and an organisation with an integrated transport management system. which has generated insights and practical learnings that have proven critical for the project's development. Internal processes have been refined by creating detailed checklists, addressing previously unknown operational issues, and running iterative "internal loops" to continually improve processes. These process optimisations, are reflective of the procedural advancements already achieved.

Impacts *What impacts have been achieved or are anticipated?*	The impacts of the project are multifaceted. A key objective is to further evidence the decarbonisation impacts of using drones over traditional methods. Therefore, the corresponding environmental impacts are clear. The drone technology is estimated to emit less than 2 grams of CO_2 equivalent per kilogram of cargo per kilometre, a substantial reduction compared to traditional fossil-fuel powered delivery vans. Carbon savings are also delivered at the vehicle manufacture step on a drone versus van basis; although noting differences in overall vehicle lifespans and the lifetime payloads delivered per vehicle. Drone parts production and assembly is estimated to use significantly lower carbon emissions than van manufacture and assembly process. To assess the overall environmental impact of the technology, comprehensive lifecycle analysis would have to be conducted but the technology is likely to provide decarbonisation benefits. Economically, autonomous delivery services in rural areas could improve access to wider supply chains for local businesses, lower logistics costs, and support the growth of smaller businesses, such as hotels, bakeries, and pharmacies, that rely on timely deliveries. It also opens the possibility for examining direct supplier-to-user delivery rather than requiring parcels to be transferred to a central logistics hub first. In terms of social equity, enhancing service reliability in rural communities would address longstanding service disparities, improving quality of life and potentially contributing to better health outcomes for residents.
Additionality *To what extent did the project play a role in the outcomes and impacts that have been achieved?*	The funding received through this project has been important for advancing the drone technology and maintaining development momentum. The support of IUK provides some credibility to the project, particularly when seeking regulatory approvals for testing innovations, and as a potential investment opportunity. The LMT funding has been important to bolster investor confidence, which is key for research and development projects.
Successes and lessons learnt	
Key lessons *What has been learnt?* *Are there any key factors for why the case study was successful/unsuccessful?* *What are the barriers and enablers to delivery and impact?*	Through this project, several important lessons have been learned. Regulatory alignment has proven critical, with delays in UK regulatory frameworks representing a major barrier to progress. The experience has underscored the need for streamlined regulatory pathways or additional government support in order to expedite the development and deployment of autonomous drone solutions. Furthermore, the supplier network and stakeholder collaboration has been invaluable. Working closely with end-users and logistics partners has been essential for refining the service model and for addressing technical and operational challenges in adverse Scottish weather conditions. These have led to the realisation of unexpected benefits,

Are there any suggested improvements for future?	such as the use and refinement of checklists and “internal loops” which will continue to be used by IONA in the future. The project’s primary barriers remain regulatory delays combined with high development costs, which present ongoing obstacles to scaling the technology. However, these are offset by some enabling factors, including the partnerships with logistics businesses and drone suppliers that recognise the potential for improved logistics and service quality in rural areas.
Next Steps *What are the next steps for the project*	IONA plans to test operations in jurisdictions with more advanced regulatory environments to continue validation and demonstrate scalability. The goal is to establish a commercially viable rural delivery service, complementing existing infrastructure with sustainable drone logistics.

D. II Case Study: Private Infrastructure Network Solution

Introduction	
Grant Value	£318,171
Project Duration	10 months
Start date	01/06/2024
End date	31/03/2025

Context & Objectives	
Project summary	Paua PINS aimed to tackle the challenges surrounding EV (electric vehicle) fleet charging by enabling the sharing of private depot infrastructure. By developing a secure, scalable digital matchmaking platform and running live demonstrations, Paua tested and proved that shared private charging infrastructure can be viable and impactful for accelerating fleet electrification. Paua Share allows fleets to find and agree sharing terms for depot charging access. The platform includes health and safety vetting, in-app navigation, billing through Paua's existing tools, and revenue options for host depots. Bus depots are often empty during the day but fill up overnight, council depots show similar patterns, while HGV depots vary but typically operate more intensively at night. By aligning these usage profiles with fleet demand, Paua Share helps unlock underused capacity and lower charging costs.
Context *Business/org. type* *What challenges was the project trying to address?* *Any relevant contextual information about the industry and technology*	Paua is a business formed in 2020. The organisation has been involved in several grant-funded initiatives focused on EV infrastructure. Paua PINS is strategically significant as a foundation for its commercial growth into shared depot charging. EV fleet infrastructure is growing, but commercial vehicles—particularly heavy good vehicles (HGVs) and vans—face infrastructure barriers and while there is growing interest in sharing depot-based chargers, no scalable or digital solution has existed. *"It is really, really compelling... a way of getting more electric vehicles, particularly larger ones, on the road."* – project beneficiary The project seeks to provide solutions for: • Limited public charging for heavy and commercial vehicles;

	• Underutilised private charging infrastructure; • Security and safety concerns for certain fleets (e.g. emergency services); • Inefficiencies in depot access and charging for fleet operators; • Lack of scalable models for infrastructure sharing; and • Complexity of liability, insurance, and operational risks in depot sharing
Objectives What were the key aims of the project?	**The objectives of the project were to:** • Develop and launch a product that enables private charging depot sharing; • Build a smart matchmaking engine to optimise sharing opportunities; • Publish a white paper to establish industry best practice; • Demonstrate viability through active depot hosts and live charging activity; and • Support wider EV adoption through lower-cost charging solutions.
Project Activities	
Outline of process activities *Key challenges* *Key successes* *Experience of the LMT programme*	**Key project activities included:** • Development of a new software module for depot sharing, integrated into Paua's core platform; • Establishment of ~12 depot locations and 80 connectors in the private network; • Demonstrations with fleet operators; • Publication of a white paper in collaboration with Cenex; and • Partnership building and an advisory panel with stakeholders including LAs and fleet managers. **Key challenges included:** • Slow onboarding of large depots due to concerns about insurance, liability, and operational complexity. When host organisations had dedicated decarbonisation teams, this has often less of a challenge. *"Getting people comfortable with sharing… bigger organisations have been more difficult… anxieties more about commercial or operational - e.g. what if a vehicle sets on fire at my depot."* – project beneficiary • "Cold start" challenge of launching a two-sided marketplace (getting both users and hosts onboard); • Industrial disputes or local disruptions could reduce availability of depots to third parties. However, if the shared asset market becomes sufficiently large, pooling could actually enhance resilience by giving fleets more alternatives; and • Nervousness among some potential hosts about competitive sensitivities. Sharing depots with other fleets could lead to unintended knowledge transfer about the host's operations or business model. **Key successes included:**

	• Commercial product launched and now live; • Multiple depot hosts onboarded including a mix of public- and private-sector operators; • Created thought leadership via best practice guide; • Paua recognised as a market leader in shared charging infrastructure; and • Realised significant interest from OEMs and HGV dealerships. **Experience of the LMT Programme** Assessor feedback was consistently recognised as highly valuable throughout the application process, regardless of whether the outcome was successful. During the programme, Paua Pins participated in a cross-programme meeting where they met other TDD grant awardees. While Paua found this engagement useful, the breadth of the programme meant that discussions were not specific to the EV sector, limiting the relevance of lessons learned from other actors in the industry. During the programme, Paua also interacted with the DfT HGV-electrification strategy team. Given the change of UK Government during the project, there was uncertainty regarding the team's direction, which limited the support they could offer. This engagement was largely coincidental and not directly linked to the programme. Paua further engaged with various parts of the ZEHID team, recognising potential shared benefits, though these opportunities have yet to be fully leveraged to support other projects in the sector. Unlike other projects Paua has been involved in, there was no showcasing event available to attend. Such an event could have been a beneficial addition, as it has proven successful in previous initiatives. At the conclusion of the project, Paua engaged with the Department for Transport (DfT) to share details of their work during the project; however, it remained unclear how this information was utilised by DfT. Overall, Paua reported that most DfT and IUK activities appeared somewhat ad hoc and did not seem to be well integrated into the programme. Throughout the project. However, Paua worked closely with their MSP , who provided clear and consistent support for the administrative aspects of project delivery.
Outcomes & Impacts	
Outcomes *What outcomes where achieved?*	• Successful launch of a new commercial product (depot sharing module); • Live use by fleets and operators, including van fleets, regional haulage operators, and public service vehicles such as emergency or council service depots; • Increased engagement from commercial vehicle market stakeholders; and • Collaboration with LAs and Cenex on best practice.

Impacts *What impacts have been achieved or are anticipated?*	The project delivered significant benefits across cost, efficiency, safety, and decarbonisation. One of the most notable impacts was the reduction in EV charging costs for certain fleets by more than 50%. This was achieved through a shared charging model, where visiting operators accessed depot chargers at lower rates, while hosts generated additional revenue from underutilised assets. The savings were therefore mutual: external users reduced operating costs, and depot owners monetised infrastructure that would otherwise remain idle. Beyond cost savings, the project improved infrastructure efficiency and utilisation, ensuring that existing charging assets were used to their full potential. It also enhanced safety by relocating heavy vehicle charging away from public areas, reducing risks associated with mixed-use environments. Crucially, the initiative encouraged the electrification of heavier vehicles by making depot charging more accessible and flexible. Sharing arrangements gave operators confidence that charging would be available when needed, alleviating range anxiety and the risk of stranded assets. For depot hosts, the ability to schedule and monetise underused chargers strengthened the business case for investing in higher-capacity infrastructure, further accelerating the transition of heavy vehicles to electric power. The project also delivered broader public value by maximising the use of Department for Transport's Zero Emission Bus Regional Areas (ZEBRA)-funded charging infrastructure, ensuring taxpayer-funded assets were fully leveraged. Finally, it helped de-risk depot electrification for users by removing infrastructure friction, creating a more seamless and reliable charging experience.
Additionality *To what extent did the project play a role in the outcomes and impacts that have been achieved?*	The funding played a critical part of the development of the technology. The support enabled faster development, better quality output, and the demonstration phase that underpinned industry buy-in and commercialisation.
Successes and lessons learnt	
Key lessons *What has been learnt?* *Are there any key factors for why the case study was successful/unsuccessful?*	**Key lessons included:** • There is significant demand for sharing infrastructure for large vehicles; • Cultural and operational readiness in organisations is key to infrastructure sharing; • Dedicated decarbonisation teams within host organisations are major enablers; • Commercial and liability concerns need early engagement to prevent delays; and • A product can succeed technically but requires active engagement to overcome behavioural and organisational barriers. **Suggested improvements included:**

What are the barriers and enablers to delivery and impact? *Are there any suggested improvements for future?*	• More targeted support for large depot operators around insurance and legal frameworks. Paua argued that this that this would come from a combination of market leaders and also "learning by doing" rather than any specific intervention. The development of "good practice" guides for sharing depot infrastructure that is funded from the public purse could help provide this guidance; and • Policy-level support to incentivise depot sharing; Paua stated that the recently announced depot grants do not mandate sharing but should possibly consider how maximum taxpayer value is created from this funding i.e. what about best practice being the sharing of depot infrastructure.
Next Steps *What are the next steps for the project*	The next steps for the project will concentrate on scaling the two-sided network by onboarding additional hosts and fleet users, ensuring broader adoption and impact. In parallel, the matchmaking engine will be refined to deliver more efficient and seamless connections between charging providers and operators. The team will also explore strategic partnerships with OEMs, LAs, and HGV dealerships to strengthen market integration and accelerate uptake. Finally, development will continue on HGV-specific public charging solutions, building on the principles established through PINS to create infrastructure tailored to heavy vehicle needs.

D. III Case Study: HomeRun School Travel Evaluation Platform

Introduction	
Grant Value	£150,007
Project Duration	10 months
Start date	01/06/2024
End date	31/03/2025
Context & Objectives	
Project summary	This project was delivered by HomeRun and analysed school run journey data across Essex (72% rural) to develop the HomeRun School Travel Evaluation Platform (STEP). The platform predicts and aggregates pupil journeys to generate actionable insights, identify congestion tipping points, and estimate the region's school run carbon footprint. The analysis informed evidence-based recommendations enabling Essex County Council (ECC) to target resources for maximum impact on reducing emissions and congestion, supporting transport strategy and funding decisions.
Context	Addressing school-run-caused traffic is key to the UK's Transport Decarbonisation Plan, spanning traffic reduction, improved air quality and net-zero by 2050, alongside Local Transport Plans (LTPs). School travel is particularly challenging in rural settings, where longer distances and lack of active travel and public transport infrastructure make private car use dominant. Currently, Zero Emission Vehicle (ZEV) ownership rates tend to be lower in rural regions. School travel in rural areas is particularly carbon-intensive; trips in these settings can generate up to five times more CO_2 emissions than urban school journeys, largely due to longer distances and limited active travel or public transport options.
Objectives	**The objectives of the project are to:** • Create a scalable data platform; • Provide LAs with visual and analytic intelligence to inform travel policy and better support schools; and • Enable scenario forecasting and impact quantification for intervention. Ultimately encouraging modal shift to more active travel modes.
Project Activities	

Project activities included:

- Platform development and data modelling;
- Collaborated with Essex County Council, Solace Digital (UX/design), Talink (AI modelling); and
- Initial plans to collect bespoke survey data were set aside when this proved impractical at scale. Instead, the team drew on existing datasets provided by the LA. This approach improved accuracy, scalability, and timeliness, since the datasets were already detailed, regularly updated, and capable of supporting ongoing monitoring.
- Key challenges to delivery included:
- Limited internal resource managing multiple tools;
- Legal agreements caused early delays. This was because the project involved sensitive data on children's travel patterns, robust safeguards were essential. Data governance had to be carefully framed to meet ethical and legal standards, with multiple stakeholders involved in reviewing and approving arrangements;
- Tight six-week application window spanning the Christmas break, with a 5 January 2024 deadline, made it very difficult to finalise the LA partnership in time; and
- Lack of opportunity to present the project directly to DfT at the end of the programme - an in-person demo would have been far more engaging and effective than a mid-project virtual meeting when the product was not yet ready.

Key successes of the project included:

- Met all project goals and extended coverage from dozens to hundreds of schools;
- Secured positive visibility at a regional conference (York), endorsed by ECC; and
- Raised profile significantly through early commercial traction and national exposure.

Experience of the LMT programme:

The application process presented some challenges, particularly due to the tight deadline and the need to secure LA commitment during the Christmas period. These timing constraints added complexity and required significant coordination to meet submission requirements.

Once the project commenced, early legal and administrative processes could have been more streamlined to avoid delays. Additionally, the absence of a final showcase for funders, such as DfT and potential consumers, was seen as a missed opportunity to highlight achievements and demonstrate impact.

Outcomes & Impacts

Outcomes	The project successfully delivered a fully operational STEP platform, which is now being used by ECC across approximately 550 schools. This marks a significant milestone in terms of adoption and demonstrates the platform's scalability and impact within the education sector. In addition, early commercial traction has been achieved, with a contract currently in progress with WCC. The project also strengthened in-house technical capability. Finally, the company's profile has been raised significantly, positioning it more prominently within the market and providing the potential to work with a wider range of LAs.
Impacts	The project enabled data-driven identification of schools with the greatest potential for emission reductions, ensuring that efforts were targeted where they could deliver the most significant benefits. This insight also informed the strategic allocation of active travel spending, helping to maximise the impact of available resources. The project is expected to deliver significant benefits, including reduced congestion and carbon emissions, alongside improved safety and increased uptake of active travel. Fewer cars on the road will contribute to cleaner air and safer environments, while a modal shift towards more active forms of travel is anticipated to generate substantial health benefits.
Additionality	The grant played a critical role in enabling these outcomes. It accelerated product development, allowing for rapid delivery, and boosted confidence among potential collaborators and customers in both the provider and the solution. Additionally, the funding facilitated meaningful engagement with LAs, strengthening partnerships essential for long-term success.
Successes and lessons learnt	
Key lessons	**Key lessons:** A critical lesson from the project was the importance of close coordination with LA teams to ensure the solution remained relevant and achieved strong adoption. Another major factor in the project's success was that STEP was not treated as a side initiative but formed part of a strategic pivot for the company. This meant additional time and resources were invested beyond what was covered by the grant, ensuring delivery quality and long-term impact. **Barriers and enablers:** The project faced some early challenges, particularly around bureaucratic processes and the time required to finalise legal agreements, which slowed initial progress. These delays were compounded by limited resources, which stretched the team's capacity during critical phases. Conversely, early endorsement from ECC proved to be a key enabler. This support provided credibility and helped drive adoption, reinforcing confidence in the project and its outcomes.

Next Steps	The next phase will focus on expanding the rollout of STEP to additional LAs, including WCC. Alongside this, the team will explore opportunities to integrate complementary tools, such as a journey-sharing app, to enhance functionality and user experience. Finally, efforts will be directed towards positioning STEP as a strategic planning tool for developers, transport planners, and active travel projects, ensuring its value extends beyond immediate use cases.

E.I Case Study: Zero Emission Hydrogen Demonstration in Airport Applications (ZEHyDA-2)

Introduction	
Project	Zero Emission Hydrogen Demonstration in Airport Applications (ZEHyDA-2)
Value	£2.7m
Duration	30 months
Start date	September 2023
End date	March 2026 (extended)
Context & Objectives	
Project summary	The Zero Emission Hydrogen Demonstration in Airport Applications (ZEHyDA-2) project was awarded funding through the Tees Valley Hydrogen Transport Hub Demonstration phase 2 programme, which sought demonstrations of hydrogen powered vehicles across transport modes in real world operational settings. The project aimed to demonstrate a range of hydrogen-fuelled electric support vehicles at Teesside International Airport and RAF Leeming, delivering capability and learning for the application of hydrogen to decarbonising airport operations. The project is led by ULEMCo Ltd (pioneers of technology that enables commercial vehicles to convert the fuel they run on to include hydrogen), working with Motive Fuels (provider of hydrogen refuelling infrastructure) and Newcastle University (for data capture and analysis), plus Teesside International Airport Ltd (TIA) and the Ministry of Defence (MoD) who are providing demonstration sites and vehicles. Despite initial delays with the start of the project and being able to release vehicles from their usual operations (plus a key supplier going into liquidation), the conversions of four vehicles (from diesel to hydrogen combustion and electric) are now underway, including the upcycling of two Ambulifts (for the boarding of disabled or reduced-mobility passengers), a fuel bowser (for aircraft refuelling) and a field energy power system (hydrogen power unit). Delivery of these converted vehicles is now anticipated in February or March 2026, with deployment at TIA and RAF Leeming then providing an opportunity to demonstrate (and capture data on) real-world operations. A hydrogen powered Medium Aircraft Towing Tractor (MATT) (a tow tug used for pulling aircraft) that was converted for a prior project (ZEHyDA) has also been returned to the RAF site and will be demonstrated alongside the other vehicles, taking the total to five. Demonstrations are expected to continue beyond the project end-date (with e.g. three-months of fuel available at the RAF site).

	Afterwards, it is anticipated that TIA will continue to use the vehicles, and consider investing in the conversion of other vehicles (with the infrastructure to support them still in place from the current project). Other airports, as well as local authorities and businesses in other sectors, that are looking to decarbonise their vehicle fleets, have also shown interest in the possibility of converting (rather than replacing) existing assets, and the project will undertake various dissemination and demonstration activities in the coming months to build on this initial interest and generate further leads, both in the UK and internationally.
Context	For the transport sector to develop in line with the Government's ambitious climate targets, new thinking and approaches to decarbonising transport and off-highway vehicles are needed. While cars increasingly transition to electric, other sectors, such as haulage, construction and agriculture, are harder to move to batteries. The range and power needs in these sectors (e.g. 24/7 use, thousands of stop-start miles, fast refuelling requirements), means a hydrogen-based solution is more practical. The ZEHyDA-2 project, supported through the Tees Valley Hydrogen Transport Hub Demonstration programme (phase 2), is addressing this need. It seeks to develop and demonstrate a range of hydrogen-fuelled support vehicles in airports, helping to decarbonise these operations and show the potential of these solutions for application elsewhere – initially for localised (i.e. single site / back-to-base) operations, where the lack of national refuelling infrastructure is not an impediment. The project is led by the Ultra Low Emission Mileage Company (ULEMCo) Ltd, a Liverpool-based company that specialises in integrating hydrogen into commercial vehicles. Its primary product is a hydrogen dual-fuel approach, H2ICED®, that allows hydrogen to be mixed with diesel directly in a conventional engine, supplied via onboard gas tanks, in volumes that displace between 30-70% of the energy from diesel. However, it also develops a range of other solutions for zero-emission hydrogen combustion and fuel cell technology integration. This includes the HyICE™ 100% hydrogen combustion hybrid powertrain, which is being demonstrated through the ZEHyDA-2 project. This solution converts an existing diesel-powered vehicle by replacing the diesel drive train with an electric drive train, and then installs a hydrogen combustion engine to charge the battery. This enables range extension, keeping the battery charged by burning hydrogen directly in the engine, efficiently and with immeasurable nitrogen oxides. Other partners in the project include: Motive Fuels (who build and operate green hydrogen refuelling stations), who are providing hydrogen refuelling for the project at RAF Leeming; and Newcastle University's Future Mobility Group, who are capturing and analysing data and supporting the dissemination of results. Teesside International Airport Ltd and the Ministry of Defence (MoD) are also project partners, providing the demonstration sites and vehicles. The current project builds on a successful phase 1 project (ZEHyDA), which was supported through the previous phase of the Hydrogen Demonstration programme (£389k grant). That project worked with the same partners and looked at the feasibility of zero-emission hydrogen engines in specialist utility vehicles used within ground support operations, and resulted in the development of a hydrogen powered Medium Aircraft Towing Tractor (MATT) (a tow tug used for pulling aircraft). The project worked well, and provided good data. The converted tow tug is still being actively publicised, e.g. demonstrating the pulling of F16 fighter jets at the Royal International Air Tattoo (RIAT) in

	July 2024, and at the CENEX next-zero expo hydrogen technology showcase in September 2024. They are also in discussion with other airports, and have conducted a demonstration of the Tug at Exeter airport in April 2025[6]. ZEHyDA-2 uses the same approach and technology as the initial project (i.e. the conversion from diesel to hydrogen combustion and electric), but is applying it to a wider fleet of different vehicles, and demonstrating them in real world environments.
Objectives	The project initially aimed to upcycle up to 10 airside specialist-vehicles and handling-equipment to zero-emission (from diesel to hydrogen combustion) [although the target number has since been reduced to 4] and then demonstrate and capture evidence on these in real life operating conditions across two airport site (TIA and RAF Leeming). Alongside this, the project aimed to instal hydrogen refuelling capability at RAF-Leeming, with hydrogen being provided at TIA by another Tees Valley Hydrogen Transport Hub project led by Element-2, to build understanding of the future role of hydrogen within the Airport-Hub model.
Project Activities	
	The start of the project was delayed, which reduced the funded phase of the project from 22 to 16 months. There were then further delays caused by a lack of availability of vehicles for conversion. The airport and RAF needed to release vehicles in order for them to be converted and then put back into use. This proved difficult for both operators. For TIA it was difficult to free up vehicles from their operations. For the MoD, it emerged that due to internal rules it could not 'lend' its vehicles for the conversion – and that it would need to gift the vehicles permanently to the project. To make good use of the unexpected delay the project team developed a test rig to test and calibrate the drivetrains before they are placed in vehicles. This helped to reduce the amount of testing and calibration needed once inside the vehicle. Despite the delays, the project team remained committed to completing their objectives and agreed a 12-month unfunded extension (to March 26). ULEMCo also secured a £1.8m innovation loan from Innovate UK in October 2025, which has then been used to help cover costs for the extended project. In total, four vehicles have now been provided to the project team for conversion. Their delivery back into operations is expected in February or March 2026. These are: • Two Ambulifts (for the boarding of disabled or reduced-mobility passengers), one of which is planned for delivery at the airport in February 2026, and another planned for March • One fuel bowser (the Hydrogen Utility Truck, 'HUT') (for aircraft refuelling), which is partially built, and was on display at Cenex in September 2025. It will shortly be finished and the plan is to deliver it to RAF Leeming in February 2026. • A Field Energy Power System (FEPS, a mobile hydrogen power unit), planned to be delivered at RAF Leeming in February 2026.

[6] https://ulemco.com/ulemco-achievement-in-another-pioneering-project/

	Data analytics are being carried out by University of Newcastle to evaluate engine emissions prior to vehicles delivery. The results will inform subsequent testing and provide insights into performance under real world operations. TIA had also made an additional vehicle available for conversion, an articulated bus, but it was vandalised whilst in storage, and could not be salvaged. As such, the team have brought the MATT Tug from the first ZEHyDA project back to RAF Leeming for further demonstration, which will take the total number of vehicles to 5. After the project extension was agreed, there were further challenges to the project. A complete change of personnel with the RAF team in September 2025, created additional delays in finalising paperwork for the demonstrations. The supplier of battery cells also went into liquidation in late-2025, which has delayed the finalisation of vehicle conversion (demonstrations were due to start at the end of 2025). Another key enabler for achieving the project outcomes is the availability of hydrogen supply. The fuel for the RAF site is controlled by the ZEHyDA-2 project and is due to be available at the same time that the first converted vehicles will now come on site (February 2026). At TIA, however, the hydrogen is being provided through another TVH project (the Refuelling Hub) and so the supply is outside the ZEHyDA-2 project team's direct control. They have still not received a confirmed date for when the hydrogen supply will be available, and until it is, the demonstration of real-world operations at TIA cannot proceed, thus potentially limiting the project's achievements.
Outcomes & Impacts	
Outcomes	The project is still ongoing, with vehicle conversions currently in progress. Initial deliveries are expected in February 2026, with demonstrations then planned to continue for at least three months. It is therefore too early to report fully on outcome achievement. However, the main ambitions and expectations for the future include the following. The project team expects to gain insights from the ongoing vehicle conversions, developing expertise in converting different types of vehicles, and demonstrating the feasibility of these processes. As part of this, it hopes to develop a relatively small set of standardised modules that can then be applied across a whole range of vehicles (reducing time and cost for future conversion). ULEMCo reported that the project has enabled technology development activity that has opened up a whole new product stream which they are keen to continue pursuing. The project team also expects to demonstrate the variety of converted vehicles operating safely and in compliance with requirements across different sites under real world conditions. Ahead of vehicle delivery, the university partner has begun capturing and independently analysing project data to demonstrate net zero emissions, as well as evaluating additional factors, such as efficiency and user experience.[7]

[7] The University has also just published research (in part funded through ZEHyDA-2) into airport stakeholder perceptions towards hydrogen-powered ground support equipment (GSE). The paper (https://doi.org/10.1016/j.jatrs.2025.100097) shows that airport partners were strongly supportive of hydrogen-powered GSE, seeing it as a clean and practical alternative to diesel. However, it also identifies various barriers to adoption, including high costs, lack of refuelling infrastructure and uncertainty around safety regulations.

	This demonstration evidence will hopefully convince the partners currently involved (TIA and the MoD) to continue to pursue the conversion of vehicles and also help convince others elsewhere that this is a good option (de-risking investment). They expect TIA to continue to use the vehicles that have been converted through the project, and consider investing in the conversion of other vehicles (with the infrastructure to support them still in place from the current project). ZEHyDA-2 and its predecessor project will have provided the use case that has convinced the airport to move forwards. For the RAF, Gp Capt Maurice Dixon for RAF Leeming, commented on the phase 1 project: *"The RAF is very pleased to be involved in this ground-breaking investigation into how hydrogen might play a part in supporting the RAF and wider MOD ambitions and targets to reduce our transport emissions. It will be important as we investigate technologies to transition to zero emission vehicles fleets, become more fuel resilient, and understand the potential operational advantages and challenges of hydrogen use. This project is a key element of the wider RAF Net Zero strategy and programme of activities: lessons learned and recommendations will be shared within the MOD."* Beyond immediate partners, there are then other airports, as well as local authorities and businesses in other sectors, that have shown some interest in the project. These organisations are all looking to decarbonise their fleets, and are interested in the possibility of converting (rather than replacing) existing assets to do this. As such, there is a much wider market possible in the longer term, and this project is helping to generate the interest and new leads to start exploring. ULEMCo foresee a growing market for converted vehicles, and are targeting a £5m-£10m income stream within five years. At present, marketing is based on the phase 1 project. However, once the demonstrators are up and running from phase 2, the dissemination will also ramp up, and the results will be demonstrated at e.g. at airshows and conferences in the coming months and years. The project team are hopeful that they will be invited again to showcase their work at the Royal International Air Tattoo in July, with this year's show expected to have a strong focus on sustainability. Localised operations (where local refuelling sites can be used) may continue to be the main focus in the shorter term. This includes other airports, or other uses around a particular location, but also other similar operations that are localised / site based (e.g. a port or local authority services). To move beyond these situations within the UK, a national hydrogen infrastructure would be needed, and this would probably need a big public policy / subsidy push (as has been seen in Germany and other Northern European countries). Currently, the UK has just two or three hydrogen hubs (including the Tees Valley), whereas some other countries have dozens of sites. The ZEHyDA-2 technology means that benefit from decarbonisation can be realised using hydrogen, without the delay of building a full nationwide hydrogen infrastructure.
Impacts	The project itself should be able to show that it has supported the decarbonisation of the airport, helping to fulfil its low carbon obligations (and possibly also supporting it commercially, if airlines take an increasing interest in future in the offer of net zero

	turnaround). It is hoped that the technology can then be applied more widely at the airport and at other sites to further contribute towards decarbonisation of transport.
Additionality	Without the grant funding for ZEHyDA-2 (and its processor ZEHyDA), the projects are unlikely to have gone ahead. As a small business, ULEMCo would likely have been driven by shorter term financial imperatives and focused on their existing (dual fuel) core business, rather than also pushing further at the hydrogen hybrid option alongside. TIA also reports that it would not have pressed ahead, at least as fast, in the decarbonisation of its vehicles without these projects.

E.II Case Study: Teesside International Airport Hydrogen Refuelling Hub

Note that in March 2026 (after the current Wave of research) the Hydrogen Refuelling Hub project was suspended due to delays in delivering the refueller. This will also have consequences for the ZEHyDA-2 project, which was due to demonstrate two of its converted vehicles at the airport. This recent change is not reflected in the current report, which was written prior to the suspension.

Introduction	
Project	Teesside International Airport Hydrogen Refuelling Hub
Value	£2.8m
Duration	31 months
Start date	1 September 2023
End date	31 March 2026
Context & Objectives	
Project summary	Element 2 is developing a pioneering, permanent, hydrogen refuelling station at the Teesside International Airport as part of the Tees Valley Hydrogen Transport Hub. The facility will serve hydrogen-powered trucks, vans and cars, as well as airport vehicles. As part of the project, Innervated Vehicle Engineering (IVe) is also developing and trialling hydrogen fuel cell vans and heavy goods vehicles (HGVs) for zero-emission transport. The project builds on previous trials of hydrogen-fuelled vehicles at the airport.
Context	The project lead, Element 2, has a track record of successfully providing hydrogen refuelling infrastructure and services to enable commercial transport to transition away from diesel. The organisation has completed over 1,500 refuelling operations for a range of blue-chip customers and vehicle types, delivering multi-year refuelling contracts with large customers in industrials, transport and the public sector. It works with a growing number of vehicle OEMs, test centres, key site owners, fleet operators and local authorities to ensure that hydrogen fuel is accessible and available. The team is also expanding the UK's first scaled hydrogen refuelling station network to address the growing demand from commercial fleet owners and operators, including buses, HGVs, refuse trucks and light commercial vehicles. The company is building out a national network of publicly accessible fixed and temporary hydrogen refuelling assets in prime locations along haulage routes. These are needed to give fleet operators confidence that they can switch to zero-emission without changing their business models. Element 2 also has long-term

	supply arrangements with low and zero carbon reliable suppliers of hydrogen across the UK and continental Europe to ensure security of supply. To further build on this growing network, Element 2 teamed up with Teesside International Airport and IVe , to develop a permanent hydrogen refuelling station at the airport. As part of the project, IVe is demonstrating the viability of a hydrogen fuel cell-powered van for a range of commercial uses. With supermarkets and wider retail deliveries to customer homes continuing to expand, the impact of a high number and use of these diesel vehicles is significant in terms of emissions. While solutions are developing for electric vehicles, the potential environmental impact of building new vehicles with battery technology is still an issue. A solution that combines the benefits of retrofit with alternative net zero emission fuel options, such as hydrogen, could change the state of play for the delivery sector. This project builds upon previous successful trials conducted at Teesside Airport. In 2021, the airport hosted a temporary hydrogen refuelling station and operated low-emission hydrogen-fuelled vehicles, including cars, trucks, forklifts, vans, and tugs, as part of the Tees Valley Hydrogen Transport Hub trial. The upcoming permanent station, due to be completed and trialled by March 2026, marks an advancement in the region's commitment to sustainable energy solutions.
Objectives	Element 2 will provide the infrastructure needed for the use of hydrogen as transport fuel in Tees Valley, addressing the strong and fast-growing demand from heavy goods vehicle operators and commercial distribution fleets. Other project objectives include: • Bring together government, industry and academia to conduct hydrogen vehicle trials and help better understand hydrogen's role in meeting UK net zero ambitions. • Service future hydrogen commercial vehicles (trucks, vans, and passenger vehicles) for public highway use plus airport and airside specific vehicles and equipment, including those adopted by tenants at the airport's Business Park. • Support the Tees Valley region in becoming a hydrogen refuelling hub and attract more hydrogen commercial fleet operators by bringing new operators into the area and building on existing relationships with truck manufacturers. The project also helps consortium participants meet their individual aims and objectives. Element 2 are focused on building, owning, and operating a UK network of hydrogen transportation, distribution, storage and refuelling infrastructure for transport, with a business model that is optimised to be profitable with low numbers of vehicles. This scalable, modular strategy enables the company to grow the network slightly ahead of demand. To pursue this ambition, Element 2 have secured millions in UK government funding across different projects, including this one in the Tees Valley. The new station also aims to support the Teesside International Airport's push to become operationally net zero by 2030. The station is aiming for a substantial yearly reduction of 240,000 tonnes of carbon dioxide emissions. Therefore, the project will support the Airport to build on its Round 1 use of hydrogen and fuel cell technology, which in turn will improve its appeal to airlines and other commercial partners, and

	will enable it, with partners, to develop as an innovation centre, one of the first airports in the world to use and demonstrate hydrogen. Other schemes being championed by the airport include development and adoption of sustainable aviation fuel (SAF). Finally, the sustainable vehicle manufacturer IVe aims to demonstrate the opportunity for hydrogen-powered transport in the region, as well as the safety benefits as a new fuel source compared to diesel. The key objective is to de-risk the myths around the hydrogen concept in the eyes of potential customers and partners. It will also focus on the environmental message, not simply in relation to replacing diesel and petrol fuels, but also when it comes to emissions from new vehicle manufacture and the advantage of retrofit technology. Gathering valuable data from the project trials for fine tuning design and capabilities to enhance the efficiency and performance of the vehicles will also be a key output to support IVe's commercial use case after the demonstration phase.
Project Activities	Through previous projects, Element 2 had set up five temporary demonstration refuellers across the UK. These were expensive to build, and opportunities to improve the quality of customer experience were limited due to the use of temporary equipment. The Tees Valley International Airport hydrogen refuelling station project seeks to successfully develop Element 2's first **permanent station**. Planning permission was submitted to Darlington Borough Council in August 2024 and since granted, for work to begin in February 2025. Construction activities took place in spring 2025, followed by a period of installation and commissioning ahead of operations due to begin in early 2026. The construction is completed by S&A and the facility will feature two refuelling bays offering both 350 and 700 bar pressures and three storage tanks, all designed and built by French specialists Hydrogen Refuelling Solutions. A one-year delay to station opening, compared to original plans, created significant additional costs for IVe as they had to still conduct vehicle demonstrations. In the absence of the necessary infrastructure, it designed and constructed its own refuelling rig, and leased capacity from BOC at a cost of approximately £1,500 per month. IVe's activities include developing and trailing IVe's hydrogen fuel cell technology, including the demonstration of **hydrogen-powered vans and airside support vehicles**, at the airport. Whilst demonstrations at the airport have not yet taken place (as the fuelling station is not completed), preliminary testing took place at IVe's production site. Vehicles were deployed in the north of England and operated under normal duty cycles to identify any operational or technical issues. This allowed the organisation to evaluate real-world performance, determine any required remedial actions, and carry out tuning and development on site. This helped test a number of data points around range, power efficiency, emissions and the impact of various weather and other driving conditions. The initial round of testing also focused on examining the functionality of the fuel cell. The findings were crucial in enabling IVe to re-build their first vehicle in order to improve the efficiency of the fuel system, make it more resilient to air and commission it more widely. Findings will also feed into the wider use case and its potential environmental and economic impact for van-based activity centred around the region.

	Beyond the technical outcomes, the programme strengthened IVe's overall resilience. It prompted the team to have a clearer assessment of the uncertainty surrounding the future role of hydrogen within the transport sector, given a slowdown in demand[8]. As a result, the work supported an informed strategic pivot, enabling the company to adapt its core technology toward alternative applications that are potentially faster to market and better aligned with near-term growth objectives.
Outcomes & Impacts	
Outcomes	Until the launch of the new refuelling station at Teesside Airport, the nearest place hydrogen vehicles can refuel is nearly 100 miles away in Rotherham. The location of the airport is also strategic, due to its proximity to key transport links and major freight depots. As hydrogen sites emerge and evolve, it is expected that there will be a growing demand from national fleets who will roll out more hydrogen-powered vehicles in future. Until a national network is developed across the UK to be able to serve those vehicles, pockets of supply are needed to kickstart wider distribution. Therefore, it was considered particularly helpful to build permanent stations across key industrial areas, like Teesside Airport where transport and industrial clusters are lining up. Testing the station and allowing potential customers to experience the refuelling first-hand will also improve public perception of hydrogen transport. While the project is ongoing, a key outcome so far has been a strengthening of the partnership between the lead organisation, Element 2, and the two delivery partners – Teesside International Airport and IVe. Even though the project was delayed, the organisations worked closely together to overcome obstacles and identify strategies to achieve project objectives. The consortium had a risk matrix in place which helped them monitor and address emerging challenges. Team members across the consortium were also regularly in touch with IUK to report on project progress and identify solutions. All key project activities were also developed in close coordination. For instance, Element 2 liaised with the site owners when designing the hydrogen refuelling station and continue to collaborate during the construction work stage. IVe, also worked closely with Element 2, to further develop its vehicle concept and be able to successfully demonstrate the capabilities of hydrogen fuel cells as a power source for delivery vans in the region. The IVe team will aim to use this collaboration and showcase not only the environmental benefits, but also the journey range, sustainability and payload advantages of their vehicle compared to existing diesel and novel electric van options.

[8] One of the key challenges that the project has faced is the decline in the number of original equipment manufacturers (OEMs) who want to develop hydrogen-powered vehicles. For instance, Tevva's hydrogen electric trucks reportedly ended its activity, whilst the German manufacturer Daimler Truck is postponing its series production of liquid-hydrogen trucks to early 2030s. Hydrogen Vauxhall van plans were also cancelled by the OEM Stellantis, due to limited availability of hydrogen refuelling infrastructure, high capital requirements, and the need for stronger consumer purchasing incentives. OEMs have also shown a preference to locate in other European countries where there is clearer HGV legislation (EU hydrogen truck and infrastructure development timelines are five years ahead of the UK).

Working together will have lasting benefits, with partners expecting to continue to expand their activities . Developing a permanent refuelling station at the Teesside International Airport guarantees future collaboration between Element 2 and the site owners, and the station can be expected to expand in future to accommodate a larger number of vehicles as demand grows. Furthermore, both Element 2 and IVe have strong ambitions to continue expanding their activities in the hydrogen space, rolling out more stations and vehicles across the UK, as they work to attract customers and suppliers.

The project has contributed to an increase in Element 2's technical skills and operational knowledge, especially in the areas of site design and refuelling. For instance, the station will be able to provide both 350 and 700 bar refuelling pressures. Hydrogen refuelling is normally standardised to 350 bar for heavy-duty vehicles and 700 bar for light-duty vehicles to achieve different densities and ranges, with the higher pressure allowing for more hydrogen to be stored in the same tank volume. However, while 700 bar offers greater fuel density for light vehicles, it requires more complex and costly tanks made of advanced materials like carbon fiber. The project enabled Element 2 to develop 700 bar refuelling tanks for the first time which helped them strengthen their technical knowledge in the area and expand the refuelling options for different vehicle types (e.g., light-duty vehicles such as cars). Another area of expansion was building in additional buffer storage of high-pressure hydrogen to better accommodate back-to-back demand.

The Element 2 team introduced new software to accommodate the invoicing of hydrogen and is working closely with the University of Teesside to perform monthly product quality testing of the hydrogen itself. This is a particularly innovative area as doing a full test could take weeks, whilst the university has developed tests that allow for quicker assessment of the key components of hydrogen. Getting more regular data on product quality is particularly valuable for ensuring customers have confidence when refuelling their vehicles and no damage is done to the fuel cells in the process.

The IVe team also reported an increase in their technical skills, knowledge and operational capabilities. The vehicles developed were retrofitted with hydrogen fuel cell and powertrain technology to replace existing diesel engines. The van IVe developed has comparable weight and available payload (1,500kg), range (600km) and re-fuelling cycle as its diesel counterparts but with greatly extended life cycle, whilst meeting the zero-tailpipe emissions objective. Preliminary activities were conducted at IVe's production site and helped the team build a better understanding of the technology, which will now be used in a follow-on project to build an 18-ton truck. IVe will also use the vehicle to showcase to potential clients who may want to consider this type of conversion.

Further commercial and technical learnings are expected during the refuelling station demonstration phase in 2026, when data will be collected on the performance of the refuelling equipment and containers, including software, hardware, reliability, product quality and metering. In addition, Element 2 will work with vehicle manufacturers to assess the performance of other hydrogen-powered vehicles, including Light Goods Vehicles (LGVs) and HGVs, with a focus on their range, refuelling speed and payload.

Impacts	HGVs are responsible for almost a third of the UK's transport emissions, and this project will support the shift away from diesel, providing environmental and health benefits. One kilogram of hydrogen is roughly equivalent of 5.6 litres of diesel when used in a fuel-cell electric vehicle. Replacing the diesel with hydrogen abates 12kg of carbon dioxide emissions making the impact on greenhouse gas emissions simple to calculate and audit. Element 2's hydrogen comes from sustainable resources, from renewables such as wind or solar, from waste recycling or as an industrial by-product. The IVe team also highlight the environmental impacts of hydrogen vehicle manufacturing and production. IVe's fuel cells and structural materials are intended to be highly recyclable, reducing end-of-life environmental burden. IVe also aims to use organic/non-metallic materials and low-energy micro-manufacturing techniques in their vehicle development which reduce embedded energy in vehicle production versus conventional all-metal, high-energy manufacturing processes. Beyond the environmental benefits, investment in hydrogen infrastructure will also enable the local hydrogen economy to grow, creating jobs, providing training and stimulating further investment in the Tees Valley. For instance, creating hydrogen refuelling infrastructure will lead to jobs across the ecosystem including manufacturing, production, storage, supply, delivery and vehicles. Element 2 is also preparing to transform hydrogen vehicle trials into tangible, commercial applications, generating valuable performance data that will fuel further breakthroughs in hydrogen-powered transportation. It is anticipated the demonstrators will help encourage more British manufacturers to embrace hydrogen.
Additionality	The project has played a significant role in enabling Element 2 to design and commence constructing a permanent hydrogen refuelling station. The organisation is still an SME and requires both private and public investment to continue expanding its operations in the UK. Securing government support accelerated its growth plans. The team will be in a position to complete a fully operational permanent site by 2026, alongside a series of demonstrations, which would not have been possible without IUK funding. As a result of this experience and the learnings acquired, Element 2 also potentially secured another permanent site to be built in southern Scotland in 2026 and acquired planning permissions for two motorway service station sites. The project also enabled IVe to undertake an additional design iteration of the vehicle, refining and improving the overall concept before finalisation. It further provided the organisation with an extended period for internal development and validation, ensuring the vehicle was more mature and robust before being released to customers.
Successes and Lessons Learnt	
Key lessons	The project helped the consortium draw some lessons for future activities in the hydrogen space. First, the drop in demand for hydrogen across the UK, as well as the reduction in the number of OEMs pursuing the development of hydrogen-powered vehicles, were considered key project challenges. Engaging more vehicle manufacturers and transport fleets from the onset could have provided more

	definite demand for the station at the Teesside International Airport and secured greater project stability. Second, Element 2 conducted fruitful discussions with refuelling and container manufacturers that helped develop the planning, design and construction of the site. Submitting the request for the planning permission also enhanced the organisational understanding of what is required from the planning authorities. These learnings can be applied when Element 2 proceeds with the development of other permanent stations. The duration required to deliver the hydrogen refuelling station, from securing planning permission through design, construction, and commissioning, demonstrated that comparable hydrogen infrastructure projects require extended development timelines to allow all partners to complete the necessary stages. Where such timelines cannot be accommodated, the availability of temporary hydrogen refuelling stations was identified as critical to maintaining hydrogen supply for vehicle manufacturers during testing and demonstration activities, to minimise the risk of project disruption. Finally, valuable lessons learnt are expected to be drawn during the demonstration phase. The trials will showcase that hydrogen refuelling is safe and reliable across different vehicle types (e.g., cars, trucks, vans, forklifts) and applications, including airport operations. They can also demonstrate that hydrogen fuel cell vehicles can be refuelled quickly (in about three minutes) with a significant driving range (around 300 miles), offering a viable alternative to diesel for various uses. The team at IVe also provided some recommendations on how IUK could structure next steps for hydrogen programme planning and delivery. Building a national strategy for hydrogen infrastructure was suggested as a good next step, with the advice and support from industry experts such as ULEMCo and IVe. Working with industry could help IUK map out the areas for concentrating hydrogen projects in order to most effectively develop a nationwide hydrogen rollout plan.
Next Steps	One of the key project requirements was to develop a permanent hydrogen refuelling station, meaning that the site will remain operational beyond project duration. By design the project also provides opportunities for further expansion in the future. For instance, the currently developed station will have an initial capacity of 330 kilograms a day. Next phases of the project could double the capacity to 660 kilograms, and there is also additional space next to the current site to expand further to 1 or 1.5 tonnes a day. Whilst expansion plans will not proceed until partners observe an increase in demand for hydrogen, the site holds potential for growth as it is positioned on the edge of airport land and can serve both airport equipment and the public roads nearby. As an organisation, Element 2 aims to continue to expand the construction of permanent hydrogen refuelling sites in the UK and has potentially secured the construction of another site in southern Scotland for the first half of 2026. Furthermore, the learnings from the project will be applied in the design and development of future sites and Element 2 has secured planning permission for two motorway service station sites.

As part of the project, IVe also built strong relationships with their supply base in the Northeast of England and will aim to expand their operations in the region. The vehicle re-designed as part of the project will be used to showcase the technology to other potential clients, and the team will soon commence working on the development of a larger, 18-ton van.

Similarly, the Teesside Airport will continue to pursue its ambition to become operationally net zero by 2030. According to the Mayor of Tees Valley, Ben Houchen, the area will continue to pioneer offshore, carbon capture, and renewable technologies over at Teesworks, to truly cement Teesside, Darlington and Hartlepool as the place to do business in innovative and clean technologies.

F.I Case study: Electric Freightway

ıtroduction	
Value	£62.2M
Duration	July 2023- July 2030
Start date	01/07/2023
End date	31/07/2030
Context & Objectives	
Project summary	Project Electric Freightway is a £100 million+ initiative led by GRIDSERVE to establish the world's most advanced electric Heavy Goods Vehicle (eHGV) charging network, aiming to replace diesel fleets and address environmental and efficiency challenges in freight transport. Running until 2030, it plans to deploy over 200 high-powered chargers across motorway service areas and commercial depots, support a fleet of around 161 eHGVs, and collect operational data to inform future policy and infrastructure development.
Context	GRIDSERVE is a chargepoint operator. The project is trying to address the wider challenge of decarbonising the heavy goods transport sector. In 2023, the heavy goods sector accounted for 16% of the UK's transport CO2 emissions (18.2 million tonnes) despite doing 16.9 billion vehicle miles. Therefore, if the 500,000 HGVs on UK roads today were switched to electric, the potential saving is 18.2 Mt CO2e – the same as powering roughly two million homes for a year. However, there are key barriers to eHGV adoption: limited availability of vehicles, chargers and higher cost of new vehicle purchase or lease.
Objectives	**1. Installation of eHGV Charging Infrastructure** Over a two-year procurement phase, eHGV charging hubs will be installed at motorway service areas to support long-distance travel and opportunistic charging across major UK trunk roads. • 12 commercial depot charging locations will be established, some offering shared access for multiple fleets. • Approximately 200 chargers (350kW capacity) will be deployed, all powered by 100% net zero carbon energy. **2. Deployment of eHGVs** At least 161 electric HGVs will be integrated into UK-based fleets, with collaboration between multinational corporations and SMEs. **3. Catalyst for change** A five-year data collection programme, led by Ricardo, will generate insights into eHGV operations and electrification to support sector-wide transition.

4. Future-proofing features *(non-mandatory but valuable)*

- Bookability and reservation systems to support commercial operations will be developed.

Project Activities

Key challenges

- Shifts in funding timelines due to government treasury changes.
- Delays across activities; large companies faced pressure to accelerate decisions beyond internal governance allowances.
- Budget constraints due to inflation, extended timelines and complexity of the project (original budgets set two years prior).
- High complexity from the number of consortium partners.
- Grid connection costs: Significant unexpected expenses have emerged during site development—e.g. one location requires an additional £60,000 and a three-month feasibility study due to restrictions on running cables over a bridge.
- Project Change Requests: Multiple change requests have been necessary. The first was particularly time-consuming, taking several months to complete. A fourth request has now completed to increase the project scope to include an additional number of publicly funded sites at no additional cost.
- Infrastructure deployment delays: Progress on public charging sites has been slower than anticipated, with only seven confirmed and efforts ongoing to reach eight or nine.

Key successes

- 161 vehicles ordered, exceeding the original target of 140, demonstrating strong market appetite.
- 12 depots and 7 Motorway Service Area (MSA) sites at various levels of construction.
- £62.2 million in funding secured, the second-largest grant ever awarded by IUK.

Experience of LMT

Delays caused by DfT led to uncertainty around project announcements and timelines. Although the team was allowed to start early, they faced a more challenging funding profile. However, once underway, support from IUK was highly valued. Formal quarterly review meetings were effective, and informal coaching made the team feel supported and able to ask questions freely.

Support for outreach is increasing. Hitachi has led much of the publicity, and Innovate UK Business Connect has provided guidance on suitable events for speaking engagements.

Outcomes & Impacts	
Outcomes	• Strong market demand: Evidenced by high order volumes from hauliers and logistics firms, confirming appetite for eHGV deployment. • Knowledge sharing: Delivered 35 presentations in just over 18 months, helping others navigate the transition to electrified HGVs. • Public visibility: Infrastructure and vehicles are now operational and visible, reinforcing the project's credibility. • Sector transformation: Acted as a catalyst for change in a previously unelectrified segment of transport, enabling more informed decisions by hauliers, OEMs, and standards bodies. • Growing industry engagement: Increasing interest from adjacent sectors such as fuel card providers, payment platforms, and software vendors. • Shared charging potential: the project's identifying opportunities for infrastructure sharing between trucks and buses. • Proof of concept: Large-scale deployment has helped reduce uncertainty around feasibility, backed by substantial knowledge outputs.
Impacts	• **Achieved Impacts** • Exceeded vehicle deployment targets and secured substantial funding. • Raised public and industry awareness of eHGV viability. • Strengthened organisational technical capacity in design methodology, software systems (e.g. bookability), and MW charging readiness. • Positive influence on upstream supply chains by opening markets for infrastructure and hardware suppliers. • Collaboration with **BSI** on three new, freely accessible standards published May/April 2025 on bay design, signage, and movement safety around charging infrastructure; maintenance of zero emission HGVs and design and implementation of hydrogen refuelling sites. • **Anticipated Impacts** • **Environmental**: Significant decarbonisation by replacing diesel HGVs with zero-emission alternatives powered by renewable energy. • **Operational**: While operational benefits are currently limited, commercial advantages exist through CSR and Scope 3 emissions targets. • **Wider sector impacts** • Accelerated electrification in a previously underserved transport segment. • Informed decision-making across hauliers, OEMs, CPOs and standards bodies. • Growing interest and engagement from adjacent sectors. • Demonstrated feasibility through infrastructure and vehicle deployment.

	• Design collaboration: Site layouts, drone footage and other technical information have been shared with OEMs to support product development and infrastructure alignment (e.g. location of charging ports on vehicles). This data sharing has led to technical insights e.g. DAF discovered limitations in their vehicle software's compatibility with chargers, highlighting the need for more universal communication protocols. These learnings are valuable not only for OEMs but also for charger manufacturers, helping improve interoperability and future product design. • There is a noticeable early shift in user and operator willingness to trust new technologies. Hitachi has conducted around 600 interviews to date, tracking user sentiments, attitudes, and perceptions - already revealing a positive change in mindset.
Additionality	• Project funding enabled cost parity for vehicles (based on TCO) and covered infrastructure, labour, and time. Without funding, progress would have been significantly (years) slower, and infrastructure expansion may not have occurred due to lack of demand. Alternative funding sources would likely have been more risk-averse and delayed. • Cross-project collaboration: Engagement with Voltempo from another ZEHID project, with plans to deploy their hardware in additional locations. • Supply chain expansion: Enable Renewables, initially a subcontractor for civil works on the Nissan site, was sourced through ZEHID procurement and is now likely to join the Gridserve's framework for public site development. • Emerging customer relationships: Potential new partnerships are forming, including with Transport Scotland. • While not currently within the project's scope, the infrastructure developed has potential to support other large vehicles such as buses and coaches. However, practical limitations exist e.g. coaches typically park in different areas of motorway service stations compared to trucks, making shared use of facilities challenging. Some shared use may be possible, but in many cases, dedicated infrastructure will be required. Despite these constraints, expanding to include coaches is recognised as a wider priority for decarbonisation.
Successes and Lessons Learnt	
Key lessons	**Lessons learnt:** Our interviewee who was involved from the inception phase of the project said '*I never realised how difficult it would be. Funding was essential because of difficulties and extra resources needed for delivery but the value of grant is much greater than funding because of what we've learnt along the way.*' **Success factors:** • Strong collaboration across stakeholders, including quarterly review meetings and cross-project learning (e.g. ZEHID projects). • Effective engagement with government bodies such as IUK, DfT, BSI, and industry associations.

	Barriers: • Delays and cost escalations due to project complexity and unknowns, extended timelines and inflation. • Decision-making constraints within large organisations. **Improvements:** Greater flexibility in funding timelines and mechanisms would help streamline project delivery and reduce administrative burden.
Next Steps	New MSA sites: Gridserve have seven MSA sites planned, two of which are in construction. Aim to establish more public sites by end of year, then next phase of work is data gathering and analysis.

F.II Case study: Electric Freightway – Amazon

Introduction	
Name of case study project	Project Electric Freightway – Amazon as a project beneficiary
Project Value	£62.7M
Project Duration	July 2023 - July 2030
Start date	01/07/2023
End date	31/07/2030
Context & Objectives	
Project summary	Project Electric Freightway, a £100+ million initiative led by GRIDSERVE, aims to create the world's most advanced eHGV charging network. Running to 2030, it will deploy 200+ high-power chargers, support around 155 electric HGVs, and collect real-world data to guide future infrastructure and policy decisions, helping shift freight transport away from diesel. Amazon is a key partner in the 19-member consortium. Its contribution includes deployment of 30 electric HGVs, sharing learnings from its private charging network and global EV operations, and supporting smaller operators, particularly Amazon Freight Partners, through practical guidance and technical insight.
Context	HGVs produce roughly 20% of the UK's transport emissions, making decarbonisation vital for 2050 net zero targets. With new diesel HGVs banned from 2040 and electric adoption still in its early stages, the UK lacks suitable charging infrastructure. Electric Freightway aims to fast-track this shift by building a national eHGV charging network and providing operators with the tools to transition successfully. Amazon, one of the world's largest and most influential technology and e-commerce companies, plays a critical role in the decarbonisation of freight. With an extensive delivery network and high-volume logistics operations across the UK, transitioning its HGV fleet to electric has a meaningful impact on reducing transport emissions at scale. As part of its commitment to achieving net zero emissions by 2040, Amazon is investing in sustainable technologies and electric freight solutions, helping to demonstrate the feasibility of large-scale eHGV adoption and setting a benchmark for the broader logistics industry.

Objectives	For Amazon, involvement in Electric Freightway centred on four objectives: • **Deploy eHGVs at meaningful scale** within its UK operations. • **Build a consortium-wide community of practice** to exchange knowledge and practical learning. • **Share operational insights**, particularly those beneficial to SMEs that lack access to data, technology, and fleet-transition expertise. • **Send a long-term market signal** about the viability and direction of freight electrification.
Project Activities	
	Amazon's core activity was the procurement and deployment of 30 electric HGVs across London and the Midlands. These vehicles were partially funded through the programme, forming part of Amazon's broader 150-truck national electrification effort. The trucks are operated primarily by Amazon Freight Partners, who trained their drivers specifically in eHGV operation, range management, and charging behaviours. Amazon contributed extensively to knowledge-sharing structures. This included active participation in Quarterly Review Meetings (QRM), where risks, delays, and operational updates were discussed; interviews led by Hitachi and Ricardo with senior managers, operators and drivers; and bi-annual reporting cycles that captured insights on telematics, data compliance, operational risk, and infrastructure requirements. Amazon also provided hands-on feedback on charging-hub design, including requirements for booking systems, accessibility for vehicles with trailers attached, and charger reliability. Amazon did not apply for charging-infrastructure funding owing to requirements for public access that conflicted with operational site security and load-integrity considerations. However, it worked closely with GRIDSERVE, Hitachi, Ricardo, and Daimler on telematics integration, data transmission (including API compatibility), and operational trials. Independently, it plans to install additional fast charging infrastructure across key UK sites to support its wider fleet order. **Key challenges** The consortium's size and diversity made the application process complex, requiring significant coordination to produce a unified proposal. Another challenge was timing: funding was announced in May 2022, proposals finalised later that year, but contracts were not signed until July 2023. This misalignment created difficulties for Amazon, whose financial approvals run on annual cycles, requiring the company to re-secure co-investment authorisations. Sector-wide barriers also affected progress. Many partners experienced delays related to permitting, grid-capacity upgrades, and contractual negotiations for charging-site installation. Although these were outside Amazon's direct scope, Amazon actively shared best practice from its own operations to support smaller partners facing delays. High vehicle costs and the continued need for robust charging infrastructure also remain structural constraints.

	Key Successes The project achieved several important successes. Consortium-wide HGV deployment exceeded initial expectations, with some partners successfully increasing their planned vehicle numbers due to better pricing achieved through collective negotiation. Amazon's 30-truck deployment, combined with Daimler's supportive training and the integration of advanced safety and comfort features in the vehicles, produced a substantial body of operational insight. Collaboration was repeatedly highlighted as a defining strength. Amazon described an open, problem-solving culture in which members supported one another. This ranged from sharing technical knowledge to helping partners resolve administrative issues such as identifying suitable accountants for reporting. Annual in-person consortium events strengthened these connections and helped build a more integrated national network, including opportunities to use private depot chargers as part of a broader charging ecosystem. **Experience of the LMT programme** Amazon's experience of the LMT programme was consistently positive. Although the application phase was complex due to consortium size, Innovate UK's programme team was described as responsive and proactive, offering direct, rapid support that exceeded Amazon's prior experience in working with government agencies. Participation in the project also expanded Amazon's connections with the UK's innovation ecosystem, universities, and start-ups. Innovate UK regularly shared opportunities for technology pilots and academic collaboration, helping Amazon stay informed about emerging decarbonisation technologies. The consortium structures, including in-depth interviews and structured reporting, were viewed as highly effective mechanisms for knowledge exchange.
Outcomes & Impacts	
Outcomes	Amazon deployed all 30 eHGVs, contributing to the consortium's wider roll-out of roughly 161 vehicles. The project created a structured framework for learning, reflected in QRMs, interviews, and biannual reporting. The trucks generated valuable operational data on range, charging behaviour, driver experience, telematics, and cost considerations. The project also strengthened collaboration across operators of varying sizes, offering SMEs access to insights they would otherwise not have.
Impacts	Early impacts include emissions reductions from deployed vehicles, improved driver experience (quieter operation, smoother acceleration, enhanced safety features), and greater organisational capability in managing eHGVs. Longer-term impacts are expected to be more significant. The dataset being collected through 2030 will provide one of the strongest evidence bases yet for eHGV operations in the UK. The project has also influenced infrastructure planning, particularly the importance of booking systems and designs suitable for trucks with trailers. At a sector level, Electric Freightway has demonstrated the feasibility of eHGV deployment at scale and has strengthened public-private collaboration. The

	consortium's work is expected to support broader market adoption, potentially enabling 30-50% electrification of middle-mile fleets as infrastructure matures.
Additionality	While Amazon was already committed to electrifying its fleet, with a 150-truck order in progress, the project accelerated deployment, reduced commercial risk, and provided operational data and shared learning that would not have been available through unilateral action. Participation also amplified Amazon's ability to support SMEs in their supply chain and engage in infrastructure design discussions, ensuring impacts significantly greater than Amazon's independent efforts.
Successes and Lessons Learnt	
Key lessons	**Lessons learnt** Amazon emphasised the importance of close collaboration, strong communication, and structured learning mechanisms. The three learning channels, QRMs, in-depth interviews, and biannual reports, were seen as complementary and highly effective. The project also highlighted the need for better alignment between government funding timelines and corporate investment cycles, and reinforced the importance of early driver training, behavioural adaptation, and operational planning for eHGVs. **Barriers and enablers to delivery and impact** Key enablers included strong project management from GRIDSERVE, responsive Innovate UK support, and the collaborative ethos across the consortium. Structural barriers included the complexity of coordinating a large consortium, misaligned timelines, high vehicle costs, the need for grid upgrades, and the greater operational demands of electric HGV training and route planning.
Next Steps	With all Amazon vehicles now deployed, the wider project's immediate priorities include the activation of motorway charging hubs, supported by a booking system that Amazon has strongly advocated for, and the finalisation of the next bi-annual report. Looking ahead, Amazon and consortium partners will continue sharing operational data until 2030. This multi-year dataset will form a substantial evidence base to identify best-use cases, remaining barriers, and pathways to scaling electrification across 30–50% of UK HGV fleets.

F.III. Case study: eFREIGHT2030

Introduction	
Value	£49.2M
Duration	January 2024- January 2031
Start date	01/01/2024
End date	31/01/2031
Context & Objectives	
Project summary	eFREIGHT 2030 brings together a diverse group of stakeholders, including fleet operators, vehicle and charge point manufacturers, software developers, charging hub owners and operators, and data and research experts, to explore scalable approaches for electrifying heavy goods transport. The initiative is conducting a comprehensive real-world assessment of both the technical and commercial feasibility of electric HGVs. Its goal is to validate the business case for deploying electric trucks and establishing a nationwide network of megawatt capable public charging hubs powered by British innovation.
Context	The UK's freight sector is heavily reliant on trucks and heavy goods vehicles (HGVs), which in 2022 were responsible for transporting around 80% of the country's 200 billion tonne-kilometres of goods. This reliance has come at a significant environmental cost, with HGVs contributing 16% of all domestic transport greenhouse gas emissions in 2023. In response to this challenge, the UK government announced in November 2021 its intention to phase out the sale of new non-zero emission HGVs weighing 26 tonnes or less by 2035, and to ensure that all new HGVs sold from 2040 onwards are fully zero emission at the exhaust. This policy shift has created an urgent need for infrastructure capable of supporting the transition to electric freight. The project is led by Voltempo, developers of the HyperCharger, a British designed, manufactured and patented Megawatt Charging System (MCS) solution for electric HGVs. The HyperCharger MCS, delivers over 1 MW of power and enables multiple vehicles to charge simultaneously at optimal speeds.
Objectives	At its core, the eFREIGHT 2030 project aims to introduce 82 electric HGV 4×2 units, and up to 37 new charging locations, most of which will have megawatt-charging capacity.
Project Activities	
	The eFreight2030 project is being delivered in two phases. The first, a deployment phase running from early 2024 to 2026, focuses on preparing the groundwork: identifying suitable charging locations, securing grid connections, and purchasing electric HGVs (eHGVs). This phase is essential to ensure infrastructure is in place ahead of live operations. The second phase, a demonstration running from January 2026 to January 2031, will see 82 eHGV tractor units} operating in real-world conditions, supported by up to 37

	new megawatt charging hubs and the Berkeley Bulldog e-trailers. The first eHGV hit the road with Welch's Transport in November 2024, while M&S have completed six months of successful operation with five Renault Trucks E-Tech T 4×2 HGVs. **Key challenges** The project has grown significantly in scale, but this expansion has brought new challenges. While the team is no longer focused solely on deploying a few trucks and chargers, the ambition to scale electric HGVs across the industry over the next decade has introduced complex questions around infrastructure, market readiness, and policy. The team is now grappling with how to reach a tipping point where electric HGVs become the default choice over diesel, and this requires a clear understanding of the blockers, risks, and opportunities that lie ahead. These strategic challenges are compounded by the political sensitivity of penalising diesel use, which makes it difficult to push for change through taxation and regulation alone. Instead, the team is exploring alternative approaches that could incentivise adoption without triggering resistance. **Key successes** Despite the challenges, the project has made notable progress. Voltempo's team has expanded with around 50 additional members of staff including assembly line staff. **Experience of LMT programme** The experience of the LMT programme has been marked by strong support from IUK, as well as excellent contributions from the MSP, who has been described as a real asset to both IUK and the project team. Quarterly Review Meetings have also been highlighted as a valuable forum for face-to-face networking and fostering meaningful engagement across consortium partners. However, several challenges have been noted, including significant delays in processing change requests by the Department for Transport, one early instance took five months instead of the expected one month, although more recent requests have been resolved more promptly, well within the one month SLA. Tarmac has faced ongoing issues with submitting a capital claim for £3.5 million, which is now resolved. Additionally, the portal used to manage the programme has been criticised poorly optimised for a project of this scale, and reporting requirements during the early funding stage have been described as ambiguous, leaving partners uncertain about expected deliverables in some areas. More recently, the IT issues have been largely resolved and a better system is being used going forward.
Outcomes & Impacts	
Outcomes	Participation in eFreight2030 has delivered several tangible outcomes for Voltempo. The organisation, for example, has grown from a team of 20 in March 2024 to over 50 employees, across roles including project managers, manufacturing engineers, and assemblers. The majority of these additional staff (48) are permanent members of staff. Through ZEHID, Voltempo has also been able to identify and move to UK-based manufacturers, such as,

	• The switching system, previously sourced from Germany, new provider located in Wales, and, • The cooling system, was Chinese now from Glasgow – a more efficient product with no moving parts. The amount the project is ordering helps their businesses go forward enhancing domestic supply chains. Other consortium members such as Berkeley Coachworks, Dynamon, and various fleet operators have also contributed to employment growth, e.g. Berkeley Coachworks the designer and manufacturer of the innovative lightweight e-trailer Berkeley Bulldog has been able to take on 12 people and expand into a bigger manufacturing facility in South Wales. Through the project, an Associate Membership Programme has been developed. This has facilitated meaningful collaboration enabling companies like Renault to independently run trials with support from the consortium, and engaging retailers such as Tesco, Waitrose, and John Lewis, as well as micro-businesses with operating small fleets of 4-5 trucks, who typically face barriers to participating in IUK projects due to administrative burdens. Additionally, a number of reports have been published via Energy Systems Catapult, reflecting strong engagement across the consortium and contributing to the programme's knowledge-sharing objectives. A Total Cost of Ownership (TCO) toolkit will be completed soon.
Impacts	While many of the broader impacts of eFreight2030 are still to be fully realised, anticipated impacts have significant potential. The data generated through the programme is expected to drive down costs for both trucks and infrastructure by providing greater certainty around the pipeline of demand. This data will also help to identify geographic and operational clusters, which in turn encourages further investment. For Voltempo, the project has already had an organisation level impact: progressing the business from a start-up to a scale-up. Renault Trucks have reportedly said that they are 'winning new business because of eFREIGHT'. Berkeley Coachworks have had interest from DAF and Renault so there may be opportunity to export their products from Wales internationally.
Additionality	The eFreight2030 project has played a pivotal role in enabling the outcomes and impacts outlined above. While some of the achievements, such as organisational growth and sector-wide engagement, may have occurred over time, the structure, funding, and collaborative environment provided by the project have clearly accelerated progress. For Voltempo, participation in the programme has supported its transition from start-up to scale-up. The consortium model has also facilitated partnerships with SMEs and retailers that typically face barriers to entry in government-backed initiatives, demonstrating that the project has added value beyond what individual organisations might have achieved independently. In this way, eFreight2030 has acted as a catalyst by

	bringing together stakeholders, resources, and ideas in a way that has amplified both the pace and scope of impact. Project collaborations facilitate the exploration of innovative ideas, such as monetising carbon savings through blockchain technology. By accurately recording the carbon footprint of EV charging, the team believes it may be possible to generate carbon credits that could be traded or even used to underpin a cryptocurrency. If scaled across 100,000 HGVs, this system could represent over £1.6 billion in value by 2040. This approach not only offers a financial incentive for switching to electric HGVs but also reframes the conversation: moving away from penalising diesel users and towards rewarding carbon savings. If successful, this could deliver up to £10,000 in annual savings per truck, significantly improving the total cost of ownership and strengthening the case for industry-wide adoption.
Successes and Lessons Learnt	
Key lessons	As aforementioned, the project has benefited from strong support from IUK. IUK guidance has been instrumental throughout the programme, as noted in earlier reflections on both positive experiences and outcomes. However, barriers around IT systems and administrative processes persist. As previously mentioned, early delays in change request approvals, such as one instance taking five months instead of the expected month, previously caused significant disruption (though these issues have not persisted into the latter part of the project). For future, it is suggested that in addition to further improvements to the IT systems, tailored training on portal use and project processes would be especially beneficial for smaller businesses, helping them navigate complex systems more effectively and contribute with greater confidence.
Next Steps	The project is committing to 30 sites installed in the next few months, with a total of 180 charging bays. This will rise to a final state of up to 37 sites and 220 bays by summer 2026. Looking ahead, the next steps for eFreight2030, and indeed Voltempo, focus on reaching a point of independence, where the initiative can operate sustainably without reliance on grant funding. A key milestone on the pathway to commercialisation will be identifying the point at which TCO for zero-emission freight reaches parity with diesel. Understanding this tipping point will be critical for scaling adoption and attracting further investment, enabling the programme to provide the evidence base to Government to develop relevant policies and strategies to further support the transition to zero emission HGVs.

F.IV Case study: eFREIGHT2030 – Menzies

Introduction	
Name of case study project	eFREIGHT2030 – Menzies as a project beneficiary
Project Value	£49.2M
Project Duration	January 2024- January 2031
Start date	1/01/2024
End date	31/01/2031
Context & Objectives	
Project summary	eFREIGHT 2030 brings together a broad consortium of stakeholders to develop scalable solutions for electrifying heavy goods transport. Led by Voltempo, the project is undertaking a real-world evaluation of the technical and commercial viability of electric HGVs, with the aim of proving the business case for zero-emission freight. Central to this ambition is the development of a nationwide network of megawatt-capable public charging hubs, underpinned by British innovation. As part of eFREIGHT 2030, Menzies is deploying ten 42-tonne electric tractor units into live operations and installing three 1-megawatt charging platforms, each capable of charging up to six vehicles simultaneously. This operational deployment will generate critical evidence to support the future scaling of electric HGVs across the UK freight sector.
Context	The UK freight sector faces major barriers to adopting zero-emission HGVs. Although HGVs account for a significant share of transport emissions, the infrastructure needed to support large-scale electrification is limited, with a lack of high-power, HGV-specific charging and public networks designed primarily for cars. Alongside uncertainty around vehicle performance, charging times, operational impact, and cost, these constraints have slowed the uptake of electric HGVs across the industry. Currently, less than 1% of HGVs are eHGVs. Menzies is one of the UK's largest supply chain and logistics providers, operating complex, high-volume freight networks that are critical to the movement of goods across the country. As a major HGV operator, Menzies has the potential to have a large-scale environmental impact and help lead the transition to cleaner, more sustainable freight transport.

Objectives	Menzies entered the project with several clear objectives: • **Generate operational data on BEV HGV performance** across different payloads, routes, temperatures and duty cycles. • **Understand where BEV HGVs can integrate into a 44-tonne logistics operation**, including operational windows, back-to-base feasibility, and interaction with customer requirements. • **Develop megawatt charging capability at three core depots**, establishing the technical and commercial foundations for future fleet electrification. • **Build internal capability** across engineering, driver training, planning and estates teams. • **Support customer decarbonisation goals** and offer evidence-based low-carbon logistics propositions.
Project Activities	
	Project activities have combined infrastructure deployment, vehicle readiness and organisational capability development. Menzies has progressed the installation of three 1 MW chargers across its leased depot sites, each requiring separate landlord agreements and extensive coordination with distribution and independent network operators. In parallel, the company has procured ten electric HGVs from three OEMs, timed deliberately to arrive once charging infrastructure is energised. Alongside engineering and estates work, Menzies has undertaken route modelling using Dynamon's tools and engaged with customers to identify appropriate early phase use cases. The driver training team has begun preparing training modules that will be expanded once the vehicles arrive. Menzies has also actively participated in the consortium's operational structures, including Quarterly Review Meetings and operator-only workshops, and has benefited from visiting Kuehne & Nagel's first MW charging site to incorporate commissioning learnings into its own deployment plans. **Key challenges** The most significant challenge has been the timeline for delivering megawatt-scale charging. Menzies experienced longer than anticipated waits for grid connections, legal approvals and landlord agreements, with each of the three private landlords requiring slightly different terms. Coordination across DNOs and IDNOs, combined with software commissioning and hardware manufacturing lead times, contributed to a slower rollout than initially envisaged. The company also had to navigate financial packaging complexities within the consortium, where some partners purchased assets outright while others, like Menzies, leased them. This required flexibility from Innovate UK but was ultimately resolved collaboratively. While vehicles are not yet operational because commissioning is sequenced behind infrastructure energisation, the delays are viewed as an inherent part of deploying first-of-its-kind charging infrastructure rather than the result of programme shortcomings.

	Key successes Despite early stage challenges, the project is progressing effectively. The near completion of the Droitwich site, which will become one of the UK's first megawatt HGV charging locations, represents a significant milestone. Collaboration has been a defining success, with Menzies describing the consortium as open, constructive and noncompetitive. Knowledge sharing has been strong throughout, aided by well-structured QRMs and the establishment of an operator only workshop to deepen alignment on practical and strategic issues. -stage challenges, the project is progressing effectively. The near-completion of the Droitwich site, which will become one of the UK's first megawatt HGV charging locations, represents a significant milestone. Collaboration has been a defining success, with Menzies describing the consortium as open, constructive and non-competitive. Menzies has enhanced its internal capability, with engineering and driver training teams gaining valuable insights through OEM engagement and modelling exercises. The project has also driven innovation in software and back office systems, prompting the adoption of an off the shelf billing and booking solution that will support shared charging access across operators. **Experience of the LMT programme** Menzies reports a highly positive experience with the LMT programme. As this is its first time accessing grant funding at this scale, the organisation found Innovate UK's processes to be clear, structured and well supported. Innovate UK staff have been consistently present at QRMs and responsive to questions, contributing to a sense of shared ownership and momentum. The online claims and reporting systems were described as detailed and logical, and Voltempo's guidance helped the company navigate requirements efficiently. -training teams gaining valuable insights through OEM engagement and modelling exercises. The project has also driven innovation in software and back-office systems, prompting the -the-shelf billing and booking solution that will support shared charging access across operators.
Outcomes & Impacts	
Outcomes	Although vehicles have not yet been deployed, the project has already delivered important outcomes. The Droitwich charging site is close to energisation, demonstrating the feasibility of megawatt-scale depot charging in a leased-estate context. Menzies has significantly deepened its technical understanding of BEV HGV operation, with engineering teams working closely with manufacturers to understand safety, battery management and vehicle capability. Driver-training teams are preparing operational guidance tailored to electric HGV characteristics. Route-modelling capacity has also matured, enabling Menzies to identify realistic early-phase use cases. The project has opened new conversations with customers regarding future low-carbon logistics offerings and has strengthened relationships with operators that Menzies had not previously engaged with. These outcomes provide a solid foundation for the operational phase to follow.

Impacts	Early impacts include the acceleration of knowledge transfer from Kuehne & Nagel's MW site, which allowed Menzies to incorporate software updates and commissioning fixes before its own infrastructure goes live. The consortium's aggregated engagement has improved dialogue with ministers and government bodies, particularly around weight and dimension regulations and the need for HGV-suitable charging infrastructure. The project has already generated industry interest, with customers and peers engaging more actively in discussions about BEV freight. Future impacts are expected to be more substantial, including quantifiable emissions reductions, improved local air quality, lower noise levels around depots and detailed datasets on energy use, range, utilisation and operational windows. The presence of more BEV HGVs on the road over the coming months is also expected to shift industry perceptions and encourage wider adoption.
Additionality	The funding has been essential in enabling Menzies to undertake early-stage BEV HGV trials. Customers remain engaged but reluctant to pay a premium for electric transport, meaning the company would not have deployed vehicles or infrastructure at this scale without public support. The project has created a financially safe environment for Menzies to test vehicles at close parity to diesel, understand operational cost implications and build internal readiness. The collaborative nature of the consortium has accelerated learning and reduced risk, particularly through shared commissioning insights and the rapid dissemination of software updates. These additional benefits would not have materialised through unilateral action.
Successes and Lessons Learnt	
	Lessons learned The project has reinforced that early-stage infrastructure deployment is inherently complex and requires patience, flexibility and iterative problem-solving. Menzies emphasised the value of consistent personnel across participating organisations, noting that stable teams have helped maintain progress and trust. The company has learned that effective electrification requires preparation across multiple functions, including engineering, training, planning and customer engagement. It also found that collaboration accelerates improvement: issues encountered at the Kuehne & Nagel site were quickly communicated and corrected, meaning Menzies will begin operations from a more advanced starting point. **Barriers and enablers to delivery and impact** Enablers of progress included a strong consortium culture, consistent and responsive support from Innovate UK, and Voltempo's adaptability in scaling its project management capacity and integrating lessons into future templates. The operator-only workshop also emerged as a valuable forum for addressing practical challenges and aligning approaches. management capacity and integrating lessons into future templates. Barriers included long grid connection timelines, differing requirements across three private landlords, limited public HGV charging, regulatory weight constraints

	and customer reluctance to pay a green premium. Despite these barriers, none became prohibitive due to collaboration and flexibility within the consortium. **Suggested improvements** Menzies noted that future initiatives could benefit from streamlined landlord and grid coordination processes, clearer national guidance on megawatt charging deployment and continued government engagement on the regulatory reforms needed to support heavy freight electrification.-connection timelines, differing requirements across three private landlords, limited public HGV charging, regulatory weight constraints and customer reluctance to pay a green premium. Despite these barriers, none became prohibitive due to collaboration and flexibility within the consortium.-freight electrification.
Next Steps	The immediate priority for Menzies is to energise the Droitwich site, followed by commissioning the East Kilbride and Wakefield infrastructure. Once charging systems are live, the company will take delivery of its ten BEV HGVs and begin structured data collection to build an evidence base for future fleet transition decisions. Menzies plans to engage customers, share learnings widely, and host site visits once the infrastructure is operational.-transition decisions. In the medium term, the company intends to apply early insights to develop a scalable electrification roadmap, with future uptake shaped by regulatory developments, infrastructure growth and the operational data generated through the project.

G.I Case Study: Service Operation Vessel Offshore Charging System

Introduction	
Value	£834,208 (CMDC) + £478,469 (ZEVI)
Duration	10 months (CMDC), ZEVI ongoing
Start date	January 2023 (CMDC)
End date	October 2023 (CMDC)
Context & Objectives	
Project summary	The Service Operation Vessel (SOV) Offshore Charging System project was funded through the CMDC competition in round 2, under the Collaborative Research and Development (R&D) strand. The lead project partner is MJR Power & Automation, a developer of maritime automation and power solutions. The project involved development of a charging system that can be installed on offshore wind turbines. The charging system can be used to power battery-electric crew transfer boats and maintenance vessels operating in offshore wind farms. The project built on a previous CMDC project which successfully developed a solution for crew transfer vessel (CTV) charging. Related innovation projects are currently ongoing, including the Retrofit 20m Mercurio CTV, which was further funded through the ZEVI competition, under the Battery Electric Vessel and Charging Infrastructure strand.
Context	The SOV project addresses the following challenges: • High fossil fuel consumption in offshore activities, compounded by poor availability of charging infrastructure. • Existing battery technology has range limitations, meaning powered vessels are unable to make the journey to and from offshore wind farms in a single charge. The charging system comprises of several components including a turbine/offshore substation power converter. This converts windfarm power into DC power which works consistently with CTV battery systems. The 'Reeler' deployment system allows a connector to be latched to the substation for charging to take place. When charging is complete, the vessel is detached and can continue with day-to-day activities. The benefit of using this technology is the ability to use battery electric boats, rather than diesel boats, powered by green electricity generated from the wind farm being serviced. The technology also involves a real-time control and safety system, as well as a web portal to access data analytics.

Objectives	The key aims of the project were: • To reduce and eventually remove the use of fossil fuels in offshore activities. • To deliver reduced emissions and contribute towards net zero. • To develop an offshore charging solution, functional in a marine operational environment. • To take a credible and viable idea and create a commercial solution for the UK supply chain to then export into other countries.
Project Activities	
	CMDC funding supported several elements of the SOV project including: • A dedicated project team. • Project management. • Engineering. • Concept design. • Detailed engineering design. • Manufacturing documentation packages. • Manufacturing systems components. • Materials and equipment purchases. In terms of key challenges, supply chain issues were noted as a key barrier to progression. In the peak of the COVID-19 pandemic, there were issues with the availability of specific materials and component parts. In some cases, supplies were unavailable for 12 to 24 months. The interviewee also expressed that the hard deadline for project completion required by IUK was a key challenge to project delivery – due to project delays, the testing of the product had to take place after the project completion deadline, and therefore had to be undertaken at cost to the company (the funds that had not yet been spent had to be returned to IUK). Despite these challenges, building a product from scratch over a compressed period was reported to have been a major success for MJR. Without the funding received from IUK, the interviewee estimates that the project would likely have taken closer to three years to complete. The expert partner interviewed in relation to the case study emphasised that a key success of the project was to have developed a technology which can be used offshore, where there is no stable platform and working conditions are challenging. Additionally, the PR and marketing received from both IUK and the DfT were noted for their role in helping to raise the profile of the product and the organisation. Finally, the opportunity to showcase the British vision and skills in engineering was seen as a success of the programme.
Outcomes & Impacts	

Outcomes	The project has resulted in the delivery of a robust product which, when fully commercialised, will play an important role in the decarbonisation of maritime operations. The control and safety system also provides real-time information which can be used for monitoring purposes, allowing asset owners to evaluate the performance of charging operations by examining their energy usage, carbon savings and emissions reductions. The technology is close to commercialisation, with a spin-out joint venture company having been formed to manufacture and sell the product. The product, which has been named 'Aquarius' will be launched to the market on 31 October 2024, and a first customer has already made a purchase. Beyond this core technology, related products have also been developed, including a power and propulsion system for small (30m) boats to facilitate electrification. Additionally, the project has contributed to the delivery of ShorePower charging solutions – scalable power conversion providing in-port power and charging capabilities. These 'spin-off' products have been self-funded by MJR, thanks to increases in turnover and company growth. The external expert highlighted that in scaling this technology upwards for larger vessels, the true value of offshore power could be realised. A key limitation of offshore power generation for other applications is the energy lost through transmission to shore. By charging vessels at the site of energy generation, this loss is eliminated. The expert partner also pointed out that the existing national grid infrastructure will be far from sufficient to power the needs of ports to support a fully-electrified marine fleet, and so this technology helps to mitigate this challenge to some extent – reducing the pressure on the national grid.
Impacts	The charging system developed is comprehensive and reduces the need for manual handling in an industry where charging automation has not yet been thoroughly established. For MJR, the project has also resulted in new collaboration opportunities, working with organisations such as Blackfish engineering, Catapult and Tidal Transit. MJR have also published academic articles, papers, news articles and press releases related to the project. Government connections have also been enhanced, by working closely with Ofgem, on a framework for how electricity supply is licensed and managed. They have also raised awareness on offshore operations, through regular engagement with the marine classification societies and the British Standards Institute. The external expert noted that eventual scaling-up of the technology would generate economic, environmental and social impacts. Economic impacts would include the creation of new jobs, if several refuelling or charging stations were to be developed offshore. Further, this would contribute to reductions in the cost of electricity which would benefit the environment. Finally, social impacts include the transfer of dangerous equipment, hazardous storage and unsolicited noise away from local communities onshore.
Additionality	Without the SOV project, the offshore charging technology would likely still have been developed, due to the gap in the maritime market and need for clean, reliable

	infrastructure. However, MJR themselves state that they would have been unlikely to develop the technology and would have continued business as usual. Given the project was largely materials and equipment based, the funding primarily supported in the purchase of this. Part of the CMDC competition budget was used to protect the project's IP. The prototype technology developed under CMDC has been simplified and redesigned with bigger capacity under the ZEVI competition. However, with the company being an SME, further investment will be required to launch and sustain the final product into the market. Therefore, while the grant funding assisted in technology development other factors affect the extent to which the technology and associated products will be successful in the market.
Successes and Lessons Learnt	
Key lessons	The LMT programme was received positively particularly regarding the continuous engagement from IUK and DfT and the straightforward application process. The officers involved were helpful in providing introductions, moral support and overcoming obstacles. Minor technical lessons learnt included establishing best-practice and shared language across all parties involved to avoid misinterpretation in documents. The success of the SOV project was multi-faceted. A potential shortcoming of the LMT programme was in the lack of 'protection' and 'security' given to proposed ideas. Without this protection, foreign companies or larger enterprises, with sufficient financial backing, have been able to deliver these ideas – in turn creating barriers to market entry for British competitors in the long run. Further, a barrier to achieving a fully commercialised product over the programme was the length of the project period. Insufficient time has caused delays in product refinement and revision. A key improvement noted for future programmes involves adopting a 'funnel' approach to funding. In doing so, the most favourable projects would be taken forward, with continuous support throughout different competition rounds, eventually leading to product commercialisation.
Next Steps	The offshore charging technology is in the process of being commercialised. Given lots of working capital is required to launch into the market, networks have been created with potential investors looking into supporting manufacturing, product development, sales, marketing and operations.

G.II Case Study: Hydrogen Innovation - Future Infrastructure & Vessel Evaluation and Demonstration (HI-FIVED)

Introduction	
Value	£3,837,335 grant, £1,533,942 match-funding from partners existing reserves.
Duration	Two years
Start date	April 2023
End date	March 2025
Context & Objectives	
Project summary	Led by ACUA Ocean Limited (Ltd), the HI-FIVED project is a collaborative UK innovation initiative focused on demonstrating zero-emission hydrogen technologies for maritime applications. The core aim of the project is to build, test and demonstrate a hydrogen bunkering station and a hydrogen-powered small waterplane area twin hull (SWATH) vessel (a high-stability, zero-emission craft) in real sea conditions- named the USV (uncrewed surface vessel) Pioneer. The two-year project progresses previous work on hydrogen propulsion and aims to achieve Technology Readiness Levels (TRL) 7–8, validating performance, safety, and integration of hydrogen fuel-cell systems for future green maritime corridors. It also engages extensive commercial, technical and regulatory partners, and uses economic and environmental analyses to explore wider investment opportunities in the UK hydrogen supply chain.

Context	The project is led by ACUA Ocean Ltd, a company specialising in advanced marine engineering and zero-emission vessel technologies. ACUA Ocean Ltd is working with a consortium to deliver the project, including: maritime technical firms (e.g., NASH Maritime, Trident Marine Electrical); innovation partners (Unitrove Innovation, Composite Manufacturing & Design); and academic research from the University of Southampton. **Industry and technology context** The project exists within the maritime decarbonisation and hydrogen economic landscape - a rapidly evolving area, as governments and industries strive to reduce greenhouse gas emissions in transportation sectors. Green hydrogen (produced with low or zero carbon intensity) is seen as a promising fuel for shipping, especially for short-sea and coastal operations where battery alternatives may be limited. There are broad challenges in developing hydrogen bunkering infrastructure; in particular, designing safe onboard hydrogen storage and fuel-cell propulsion systems that can operate reliably in varied marine conditions, while meeting industry safety and certification standards. Demonstrations like HI-FIVED help bridge the gap between prototype technologies and real-world deployment, addressing both technical maturity and supply-chain integration. **Challenges the project is aiming to solve:** • Transition to zero-emission maritime transport: reducing emissions from sea transport, which remains a substantial contributor to carbon output. • Infrastructure readiness: Building and validating hydrogen refuelling (bunkering) systems suitable for broader commercial use. • Operational validation in marine environments: Demonstrating the vessel's performance across different sea states to show safety and reliability, critical for commercial adoption. • Supply chain integration: Assessing the UK hydrogen supply chain's ability to support future maritime hydrogen use. • Stakeholder engagement: Working with commercial end users and authorities to develop new use cases, supporting adoption and market pull.
Objectives	The project aimed to deliver against five key objectives: • Demonstrate hydrogen-powered maritime technology: validate the performance of ACUA Ocean's hydrogen bunkering station and hydrogen-powered SWATH vessel in operational conditions. • Achieve high Technology Readiness Levels: progress vessel and infrastructure maturity toward TRL 7–8 by completing a full four-week demonstration at sea. • Showcase safety, endurance, and reliability: prove that zero-emission systems can meet rigorous marine safety and operational benchmarks across real-world conditions.

- Assess and strengthen the hydrogen supply chain: use environmental and economic studies to identify future investment opportunities and support broader industry uptake.
- Engage with end users and stakeholders: conduct workshops, demonstrations, and consultations to generate market insights, develop new business cases, and build commercial momentum for hydrogen in maritime transport.

Project Activities

Outline of process activities

The overall aim of the project was to deliver a combined demonstration of a shoreside mobile hydrogen bunkering station and a zero-emission hydrogen powered SWATH vessel.

- **WP1: Project Design and Set Up.** Including confirming of materials needed for subsequent work packages.
- **WP2: Technical Design Phase.** Technical design of the vessel, including manufacturing of a temporary hull mould.
- **WP3: Green Hydrogen Supply Chain.** Assessment of the green hydrogen supply chain that facilitated a decision away from liquid to gaseous hydrogen.
- **WP4: Approvals and Assessments.** Collaboration with Lloyd's Register on the outputs of the technical design phase to move to manufacturing.
- **WP5: Vessel and infrastructure build, and system integration.** Building of bunkering and vessel infrastructure including preliminary demonstration.
- **WP6: Vessel and Hydrogen Systems Factory Acceptance Test.** Including inspection by Lloyd's Register of on water hydrogen bunkering.
- **WP7: Harbour Acceptance test.**
- **WP8: Infrastructure installation and commissioning.** Installing the hydrogen multi-fuelling system.
- **WP9: Vessel and infrastructure commercial demonstration.** Four-week demonstration of the SWATH vessel at Falmouth Harbour.
- **WP10: Green Shipping Corridor Impact Assessment and beyond.** Including an economic impact assessment, an environmental impact assessment, and a GHG emission savings report.

Key challenges

The team encountered significant challenges throughout the process. Most notably, the consortium had to move from liquid to gaseous hydrogen when it became clear that liquid hydrogen was impractical to source, handle, and certify.

There were challenges associated with the changing regulatory landscape, including:

	• Lloyd's Register[1] updated its low flash point fuel rules (standards for fuels that ignite more easily than traditional marine fuels); and • The Maritime Coast Guard Agency (MCA) introduced Work Boat Code 3 - this significantly changed the rules for autonomous vessels. These regulatory changes were further contributors to the change away from liquid hydrogen, which meant that a formal change request process had to be undertaken, pushing back timelines and increasing administrative burden. There were challenges in managing the relatively large consortium. In particular, a critical partner failed to deliver any outputs which resulted in Aqua Ocean having to absorb additional responsibilities at short notice. **Key successes** Despite the obstacles, the project reportedly delivered several notable successes. The vessel became the first autonomous craft certified under Workboat Code 3 in the UK and the first hydrogen powered vessel to receive such certification. The regulatory approvals, in particular, was considered to be a major breakthrough by the project, as it required entirely new interpretations and learning for both the consortium and the regulators. **Experience of the LMT programme** Overall, the project team had a positive experience of working with IUK, citing knowledgeable programme leads and a consistent, supportive monitoring officer. In addition, they noted that, over time, IUK's systems and processes improved, facilitating smoother project delivery. However, there were frustrations around administrative requirements, most notably the change management process (when the project pivoted from liquid to gaseous hydrogen) which was considered to be slow.
Outcomes & Impacts	
Outcomes	The project successfully delivered a fully certified hydrogen powered autonomous vessel and the supporting hydrogen refuelling infrastructure. Alongside this, substantial engineering and operational knowledge was developed that did not previously exist both in the company, or across the wider maritime industry. The vessel has since entered commercial use and is generating revenue. It is also continuing to evolve through integration with other autonomous technologies, such as subsea robotics and aerial drones. ACUA Ocean has generated approximately £1.5 million in revenue since August 2025, when the regulatory approvals for USV Pioneer came through.
Impacts	The project has strengthened the UK's position in maritime autonomy and low emission vessel technology. Regulatory bodies, such as the MCA and Lloyd's Register, have gained significant insight from working on the project, which will benefit future innovators.

	Across Clean Maritime Demonstration Competition 3 (CMDC3), 94% of ACUA OCEAN's spend was in the UK, in which they partnered with 97 British small and medium enterprise (SME) subcontractors, 63% of which were based in the Great South West. The project is estimated to have supported 117 jobs in the marine sector across partners, subcontractors, and suppliers. The current integration with other autonomous technology could open access to major global markets in marine robotics and offshore inspection. With the potential to replace large-crewed vessels, the technology offers major cost, safety, and environmental benefits.
Additionality	Aqua Ocean Ltd stated that without UKRI support, the company and the vessel would not exist at all. The funding unlocked the ability to recruit skilled staff, engage suppliers, develop complex engineering systems, and navigate the regulatory landscape. It also created the foundation for ongoing commercial activity and future innovation in the firm.
Successes and Lessons Learnt	
Key lessons	The main lesson learnt through the project was that the hydrogen economy, specifically in the maritime industry, is still in early stages of maturity. The project highlighted the importance of pursuing pragmatic emissions reductions rather than striving exclusively for zero emission solutions that are currently uneconomic. The team also learned a great deal about the regulatory environment and safety requirements for vessel and shore-side hydrogen systems. **Key factors behind success** The success of the project was driven by a determined engineering team, responsive and knowledgeable programme leads, and strong support from committed partners such as Trident and the University of Southampton. The willingness of the MCA as the regulator and Lloyd's register as the class society to actively participate in the design of the project was essential to ensuring a successful end product. **Barriers and enablers to delivery and impact** Two of the main barriers to project delivery were a) issues surrounding liquid hydrogen, and b) navigating the regulatory system for a nascent technology. Reasons for these barriers are outlined below: • The project moved away from an initial focus on liquid hydrogen to gaseous hydrogen. The liquid hydrogen supply chain in the UK is limited, and this scarcity means that where supply does exist, it is expensive. There are also safety concerns around the flammability of liquid hydrogen when in contact with water, that was uncovered through discussions with the regulators. • As the USV Pioneer was the UK's first hydrogen-powered autonomous vessel, regulatory standards did not fully exist before the project, and had to be written in collaboration with the MCA and Lloyd's register throughout the programme.

	This meant that there were limited pre-defined 'standards' for ACUA Ocean to work to, which made the process more difficult. Other barriers to delivery included consortium management, namely the failure of one of the partners to deliver their contracted work- meaning that ACUA Ocean as the lead partner had to take on this portion of the project in addition to their other responsibilities. The main enabler was the IUK grant funding, without which the project would not have gone ahead. Other enablers included strong subcontractor capability and constructive regulatory collaboration. The strong assistance of most consortium partners was also critical. **Suggested improvements for the future** Four suggestions for improvement were identified by the project team: • Clearer continuity of funding to avoid gaps between competition rounds; • Integration of Innovate UK's finance system with accounting tools to make the administrative burden lighter for SMEs; • More flexible change management process; and • A centralised platform for sharing learning across projects.
Next Steps	ACUA Ocean is currently integrating their SWATH vessel with other autonomous technologies, and will likely pursue further CMDC funding rounds to enable this. CMDC3 has enabled the commercialisation of the USV Pioneer for offshore monitoring and maintenance, and they are hopeful that these revenue streams will enable them to gradually become less reliant on CMDC funding in the long-term.

G.III Case Study: Retrofit 20m Mercurio CTV - 100% Electric)

Introduction	
Value	£6,344,092
Duration	Five years
Start date	October 2023
End date	September 2028
Context & Objectives	
Project summary	The retrofit 20m Mercurio CTV project, led by offshore energy solutions provider, Tidal Transit, demonstrates how crew transfer vessels (CTVs) serving the offshore wind sector can be decarbonised through full electrification of an existing vessel. By converting a conventional diesel-powered CTV into a fully electric crew transfer vessel (E-CTV), the project provides a practical and scalable pathway to reducing maritime emissions. Rather than pursuing a new build, the project focuses on the retrofit of a 20 m Mercurio CTV, namely 'Ginny Louise'. Note that the retrofitted vessel is named 'e-Ginny'. This approach avoids the substantial embodied carbon associated with manufacturing new vessels while extending the operational life of existing assets. It also exemplifies a circular-economy model, maximising the value of in-service vessels while significantly reducing lifecycle emissions. The retrofit involves a complete replacement of the vessel's propulsion and energy systems. Diesel engines, fuel tanks and associated systems are removed and replaced with electric motors, propulsion pods, and a multi-megawatt-hour battery system. The resulting vessel aims to deliver zero-emission operation, reduced noise, improved manoeuvrability and lower maintenance requirements compared to its diesel predecessor. Over a three-year demonstration period, the project will gather operational, environmental and economic performance data. This evidence will quantify emissions reductions, cost savings and wider operational benefits, supporting the case for vessel retrofit as a viable and repeatable alternative to new builds in achieving net-zero maritime operations.
Context	The project sits within the offshore wind operations and maintenance sector, where crew transfer vessels play a vital role in enabling daily access to offshore wind farms. As offshore wind capacity continues to expand across Europe, demand is increasing for reliable, efficient and low-emission marine transport. Despite this growth, most CTVs remain diesel-powered, collectively consuming an estimated 164 million litres of diesel per year in Europe. This results in significant CO_2 emissions alongside other environmental impacts, including noise pollution,

	poor air quality and fuel spill risk. Operators are also facing rising fuel costs and increasing regulatory pressure to reduce emissions. Decarbonising offshore crew transfer presents specific challenges. While battery-electric ferries have proven effective on short, predictable routes, offshore wind operations typically involve longer distances, higher power demands, rapid turnaround times and limited access to offshore charging infrastructure. Historically, these constraints have limited the feasibility of full electrification. However, advances in battery technology, electric propulsion, power management and high-capacity charging systems are rapidly expanding what is technically and operationally possible. Within this evolving landscape, retrofitting existing CTVs offers a compelling solution. It enables faster deployment, lower upfront and embodied carbon impacts, and reduced risk compared to new builds, while allowing operators to build on existing fleets and expertise. This approach positions the offshore wind industry for a meaningful transition toward fully electric operations, aligned with long-term net-zero and sustainability goals.
Objectives	The central objective of the Mercurio project was to complete a successful and fully tested retrofit reconstruction of the vessel hull and power system. Adjacent to this, the demonstrator provides an opportunity to integrate proven commercial electric propulsion technologies, including Corvus batteries, Danfoss motors, and Volvo IPS pods, into a demanding offshore workboat environment. In doing so, the project aimed to generate new insights into the feasibility and limitations of retrofitting older vessels, informing when retrofits are appropriate and when purpose-built electric vessels offer a better long-term solution. The project also sought to establish offshore charging as a scalable and practical solution for the offshore wind sector. This meant demonstrating that vessels could use power generated by the turbines they service, enabling longer-range electric operations that are not limited by shoreside infrastructure alone. The project sought to show that offshore charging could support day-to-day operations, reduce diesel dependency, and provide a model for decarbonising the wider marine logistics chain. Beyond technical development, the project intended to build industry confidence, stimulate wider adoption, and support future regulatory and commercial pathways needed for green marine operations. By delivering a real-world demonstrator, the project aimed to catalyse progress across the supply chain and support the offshore wind sector in meeting emerging policy and sustainability requirements.
Project Activities	
	The project involved the full electrification of the Mercurio CTV, later named E-Ginny, and the development of an associated offshore charging solution. Funding covered the physical retrofit of the vessel, the purchase of offshore and shoreside charging systems, and the engineering effort required to redesign the vessel's systems and safely integrate a large-scale battery and electric propulsion architecture.

The retrofit required substantial technical adaptation. This was in response to two key challenges:

- The vessel required a significantly larger battery size which was not anticipated at the start of the project. Specifically, the battery system was expanded to nearly 3.5 MWh (originally intended to be over 2 MWh), requiring extensive reconfiguration of the vessel's interior, electrical systems, and cabling.
- Many turbine platforms lacked the necessary space or access for large transformers. As a result, the chargers were re-engineered to allow installation on substations as well.

By the end of this initial funding period, retrofitting was near completion, with commissioning and sea trials scheduled to verify real-world performance.

Key challenges

The project lead noted the following technical challenges encountered in delivery:

- The fibreglass hull was thicker than expected, requiring far more cutting and grinding. Diesel residue within the structure complicated modifications, and the volume of high-voltage cabling required far exceeded initial estimates. The larger battery system also pushed the vessel to its physical limits, adding unplanned cost and complexity.
- Infrastructure challenges centred on the realities of installing charging systems in offshore wind environments. Limited turbine platform space and access constraints meant the charger had to be redesigned to enable installation on substations. Onshore, ports lacked sufficient grid capacity to support megawatt-scale charging, highlighting a major national barrier to scaling electric CTVs. Commercial challenges were dominated by difficulties in securing a demonstration partner. Despite sustainability commitments, wind-farm operators face rigid financial frameworks and multi-department governance structures that make additional capital expenditure difficult to justify. The estimated cost of participating in a three-year demonstration created further hesitation.

Key successes

Despite these challenges, the project achieved several important successes:

- Collaboration across partners, MJR Power & Automation, Blackfish Engineering, Artemis Technologies, and Goodchild Marine Services, was a major strength. These relationships deepened over the course of the project and led to the creation of Charge Offshore, a joint venture established to commercialise offshore charging solutions.
- The project also generated substantial public visibility, supported by proactive communications and a dedicated project blog. This helped position the company as a leading innovator in marine electrification and attracted interest from global operators and developers. Importantly, the work has produced immediate commercial benefits: lessons from the retrofit directly informed the specifications of newbuild electric CTVs now under construction in Spain. The

	project has therefore contributed to a broader shift in the sector, helping to stimulate the emergence of new offshore charging providers and accelerating industry readiness for electric operations. **Experience of the LMT programme** The project team's experience with the LMT programme was largely positive. The application and interview processes were clear and well supported, benefitting from the experience of partners who had participated in previous competitions. However, the team identified several areas for improvement. The timeline was considered tight for a first of its-kind retrofit, and the three-year demonstration period was viewed as excessive, particularly because it cannot begin until all elements, including offshore charging infrastructure, are fully deployed. Delays in securing a host have therefore created structural barriers that sit outside of the project team's control. The experience with monitoring officers varied, with a mid project change creating some administrative disruption. While IUK was supportive, its ability to influence commercial partners, especially major utilities, was limited. The team identified a need for stronger support to help innovators secure demonstration environments, particularly where operational costs are intrinsically high.
Outcomes & Impacts	
Outcomes	The project achieved a number of significant outcomes. Technically, the vessel retrofit is now close to completion, incorporating a high-capacity battery system, new propulsion equipment, and major structural adjustments. The offshore charger design has matured and undergone testing, with new flexibility allowing installation on turbines or substations. Shoreside charging units are complete and ready for deployment. Commercially, it strengthened partnerships, enhanced brand visibility, and generated valuable operational learning that is now shaping new-build vessels already in production. The project has helped catalyse a wider market shift, with offshore charging providers entering the sector, suggesting that the project's signalling effect has been strong.
Impacts	The project's technological impact includes validating the integration of commercially proven propulsion components and identifying the next generation of batteries suitable for electric CTVs. The redesign of the offshore charger broadens its deployment potential across windfarm assets. Commercial impacts are emerging through new vessel orders, strengthened investor confidence, and the creation of Charge Offshore as a dedicated commercial pathway. Industry impacts include demonstrable shifts in attitudes: according to the consultee, where stakeholders were once sceptical, there is growing acceptance that electric and hybrid operations will become standard. The project aligns with

	evolving international regulatory expectations, positioning the UK supply chain to respond to future demand. Environmental impacts are expected to be significant. Once operational, the vessel will produce no direct emissions and will be capable of charging using curtailed offshore wind energy, turning wasted renewable electricity into productive activity. These impacts could be further amplified if design and retrofitting challenges are shared with CTV manufacturers and if offshore charging design requirements are communicated with windfarm operators or constructors.
Additionality	Without Innovate UK funding, the retrofit would not have been financially viable, and private investors would not have committed at the scale required. The project produced unique technical learning, influenced newbuild programmes, and accelerated market development around offshore charging. It has positioned the company and its partners at the forefront of a rapidly emerging market and helped trigger broader sectoral momentum that would not have occurred otherwise.
Successes and Lessons Learnt	
Key lessons	**Lessons learnt** The retrofit demonstrated that while electrification of older vessels is possible, it is costly and cumbersome. Newbuild electric CTVs will ultimately deliver better performance and cost efficiency. It also highlighted the importance of early design integration for offshore charging and the need for realistic assumptions about battery size and cabling requirements. Commercially, the team learned that stakeholder alignment is essential, and that windfarm operators require clear commercial incentives and internally accountable champions to adopt new technologies. **Barriers and enablers to delivery and impact** Key barriers included structural constraints during retrofitting, insufficient portside electrical infrastructure, and difficulties securing a demonstration partner due to internal cost and governance restrictions within utilities. The three-year demonstration requirement added further rigidity. Key enablers included strong cross partner collaboration, investor backing, the creation of Charge Offshore, and the increased visibility and credibility generated through communications and public engagement. **Suggested improvements** Future programmes should allow more flexible timelines and consider shorter, phased demonstration periods. There is a clear need for targeted support to help innovators secure demonstration partners, and for demonstration phase funding mechanisms to bridge the gap between technical delivery and commercial deployment.

Next Steps	The immediate next step is to commission the vessel and begin sea trials, validating its performance and refining operational parameters. Securing a demonstration partner remains the priority, as the formal demonstration cannot begin until both the vessel and offshore charger are deployed on a live wind farm. Beyond the retrofit, the company is now focused on purpose-built electric vessels, with two already under construction in Spain and more planned as part of a staged order. These vessels benefit directly from the technical learning generated through the retrofit. Commercialisation plans involve offering a combined vessel and charger package, supported by flexible ownership and leasing models enabled through investor backing. Engagement with regulators and the Crown Estate[9] will continue, with the aim of integrating offshore charging and port electrification more effectively into future offshore wind development.

[9] An independent commercial business that manages a diverse portfolio of land and property owned by the UK monarch in right of the Crown.

H Sources of evidence utilised

Monitoring data analysis

H.1 Three forms of programme monitoring data are captured by IUK and were provided to Steer-ED for analysis, as described below.

Applicant information data

H.2 Basic 'demographic' data covering organisations awarded funding. The data includes the beneficiary's name, project name, project description, competition programme, the total amount of funding, which was initially bid for, the grant funding amount provided, project start and end date.

Quarterly Monitoring Scores (QMS) monitoring reports

H.3 Quarterly assessments undertaken by external MSPs; typically, industry professionals who are knowledgeable about the technology in question and are contracted to provide an independent assessment of project progress on a quarterly basis. Their assessment covers the project's scope, time, cost, exploitation, risk, and project management. Officers score each of these project aspects as well as providing commentary as to the reasoning behind their scores.

H.4 For Wave 3, QMS data was only provided for five programmes; CCAM, FOAK (2025 specifically), TVH, Maritime and ZEHID.

IUK's impact management system (IMS)

H.5 IMS is a data collection system which, at the time of writing, is being rolled out across all IUK programmes. It captures data upon project commencement, during project delivery, and following project completion, and is provided in the form of short-answer multiple choice, quantitative, or character-limited free-text responses. It covers subjects including patents, technology progression and partnerships (amongst others).

H.6 For wave 3, IMS data was provided for only three programmes: CCAM, FOAK (2025 specifically); and Maritime.

- These programmes had additional data available in wave 3 and this information was therefore included within this Monitoring Report (as text updates rather than generation of new graphs).
- It should also be noted that the data available varied across these four programmes, with fewer questions being asked of FOAK beneficiaries compared to CCAM beneficiaries. We anticipate additional data from IMS will be available for subsequent monitoring activities.

Analysis of secondary data sources

H.7 Three sources of secondary data were explored for inclusion within this document:

Crunchbase

H.8 To further explore whether businesses participating in LMT programmes are attracting external investment, and whether LMT participation aligns with investment-raising events, Technopolis have made use of Crunchbase – a platform that provides information on businesses and funding events.

H.9 Of the ~430 unique organisations participating in LMT projects (at the time of undertaking Wave 2 analysis), Technopolis were able to identify 215 (50%) in Crunchbase (the remainder were mainly public orgs and universities). Of these, 88 have one or more instances of securing external funding (251 deals in total, 2010- July 2025). Crunchbase provides details on the type of funding, the date and the financial amount.

H.10 Findings evidenced that investment/ funding activity was relatively low pre-project participation, and increased gradually, peaking during IUK LMT project period — with the highest number of investment/funding rounds in 2023 (63). This suggests a clear increase in funding and investment round announcements following the start of IUK LMT project participation.

H.11 Table H.1 shows the different types of funding / investment round that are captured.

Table H.1: Funding / investment round

Investment Type	Number	Investment Type	Number
Grant	131*	Non-equity assistance	4
Seed	28	Post-IPO debt	5
Pre-seed	7	Private equity	3
Series-A	16	Series-B	6
Equity crowdfunding	5	Corporate Round	2
Convertible Note	2	Series-C	2
Debt Financing	7	Undisclosed / Unknown	28
		Grand Total	**251***

Source: Technopolis Crunchbase data, 2025. *Note: 13 LMT grants are included, which have then been removed from the subsequent analysis.

H.12 For the 88 companies with funding data, Technopolis have tracked deals (both volume and value) over time at the company level. Technopolis have analysed the total number and value of deals for each company since the start of their LMT project, and then also compared this with the number and value of deals achieved in an equivalent period prior to the project start date (i.e. if the LMT project started two years ago, Technopolis has compared the two years, pre- and post- this start date).

H.13 At the overall portfolio level, this reveals:

- LMT participants have achieved 110 deals since their project started. This is 43% higher than the 77 deals they achieved in the same length of time before project start.
- LMT participants have achieved deals worth $4.7bn since their project started. This is more than five times higher than the $0.8bn achieved in the same length of time before project start.
- On average (per company, amongst these 88), organisations have secured 1.3 deals worth $52.9m since project start, and 1.0 deals worth $9.7m in the same period before.

H.14 An additional, updated analysis was also undertaken in Wave 3 for the Maritime and FOAK programmes, covering the period 2018 to the end of 2025. This update also included the additional 26 FOAK projects awarded in 2025.

Meltwater analysis

H.15 To assess the public dissemination of LMT projects, a structured search of media output was conducted using Meltwater, a media monitoring and analytics platform. The data collection for each project covered the one year period from 12 August 2024 to 12 August 2025, capturing online news and print, as well as social media activity on platforms, blogs, and forums. An additional, updated analysis was also undertaken in Wave 3 for the Maritime and FOAK programmes, covering the period from 30 January 2025 to 29 January 2026. This updated analysis also includes 26 FOAK projects awarded in 2025.

H.16 For accuracy, search queries were tailored for each project by combining project titles or acronyms with lead organisation names, and articles were manually screened to remove irrelevant results. The search process also involved an iterative refinement of keywords to ensure that retrieved content was directly attributable to the projects.

H.17 Meltwater's metrics enabled assessment of both the quantity and quality of media coverage. Estimated views gauged the average exposure of articles, reach measured the potential audience size, and engagement captured interactions across platforms including Facebook and Twitter. These data points were collected for each project and aggregated at the programme level, providing a comprehensive overview of LMT projects' media performance.

Dimensions

H.18 Dimensions is a comprehensive research database that provides patent and publication data. The LMT projects were identified within the Dimensions dataset. However, only FOAK of the seven programmes were associated with patents and only FOAK and CCAM were associated with publications within the dataset.

H.19 As not all the programmes were associated with patents and publications from the dataset, there is some discrepancy to self-reported information from project beneficiaries which will be further explored with the Dimensions team. Dimension data has therefore only been included for programmes where patents and publications have been linked.

H.20 It should be highlighted that for wave 3 specifically[10]:

- A dimensions search was done for FOAK 2025, however there was no data regarding linked patents or publications for these. This is likely due to Rail awards are quite recent compared to the Maritime awards and are subsequently yet to be added to Gateway to Research.
- A dimensions data search was also undertaken for Maritime.

Beneficiary survey

H.21 online survey of beneficiaries was developed and distributed to all project beneficiaries during each of the research waves across the full portfolio, amounting to 582 recipients. Both project leads and partners were invited to complete the survey, meaning that multiple responses could be captured from each project. The survey included a range of multiple choice and free text questions and allowed for the gathering of valuable additional data beyond the core data collected by IUK via IMS, QMS monitoring reports and applicant information data.

H.22 Unique surveys were created for each programme and whether a beneficiary had responded in the previous wave. The number of questions therefore varied slightly between programmes and whether a beneficiary had responded in the previous wave. However, the core survey questions remained consistent between programmes and whether a beneficiary had responded in the previous wave.

- **For Wave 1:** The survey was open for a period of approximately three weeks from 15 July 2024 to 3 August 2024 (for six programmes) and for approximately four weeks between 16 September 2024 to 11 October 2024 for the TDD programme. Overall, the survey was issued to 464 recipients across the portfolio (236 responded).
- **For Wave 2:** The survey was open for a period of approximately six weeks from July to September 2025, issued to 220 recipients across the portfolio (145 responded).
- **For Wave 3:** The survey was open for approximately four weeks between January and February 2026, issued to 347 recipients across the portfolio (201 responded).

H.23 Table H.2 shows the beneficiary survey response rates and number of responses from unique organisations within each of the seven programmes.

[10] This data was based on metadata [as of 01/09/2025 for wave 2 and 10/02/2026 for wave 3] from Digital Science's Dimensions platform, available at **https://ukri.dimensions.ai/**. Access was granted under licence agreement with UKRI.

Table H.2: Beneficiary survey response rates and overall number of responses (all waves)

Programme	Number of responses	Number of beneficiaries sent the survey	Response rate
ZEHID	85	125	68%
CCAM	146	179	82%
Hydrogen	26	29	90%
FOAK	74	102	73%
Maritime	196	481	41%
Net Zero propulsion	28	76	37%
TDD	27	39	69%
Total	**582**	**1,031**	**56%**

Source: Steer-ED survey response analysis, 2026

H.24 Across the LMT portfolio, the beneficiary survey achieved the following project response rates per wave:

- Wave 1 = 51%, which is still considered good representation.
- Wave 2 = 66%, which is still considered good representation.
- Wave 3 = 58%, which is still considered good representation.

Depth interviews with beneficiaries and wider stakeholders

H.25 The qualitative research component comprised one-hour depth interviews conducted with programme beneficiaries and a selection of wider stakeholders. The interviews were held using MS Teams and were guided by a topic guide.

Beneficiary interviews

H.26 As Table H.3 shows, a total of 183 interviews were undertaken with project beneficiaries (project leads, and in some cases project partners) during the three-year LMT research period, split per wave as follows:

- Wave 1 – 70 interviews.
- Wave 2 – 61 interviews.
- Wave 3 – 52 interviews.

H.27 The number of interviews undertaken varied by programme, in accordance with the number of stakeholders involved in the programme. The ZEHID and CCAM programmes

were a key focus for beneficiary interviews due to the substantial number of beneficiaries participating in these initiatives.

Wider stakeholder interviews

H.28 Interviews with wider stakeholders took the same format and were conducted with a selection of knowledgeable industry stakeholders (from both commercial and academic institutions), based on recommendation by IUK and programme sponsors. These interviews were conducted over the three-year research period under the LMT portfolio. As Table H.3 shows, a total of 118 interviews with wider stakeholders were completed across all three research waves combined.

- Wave 1 – 53 interviews.
- Wave 2 – 50 interviews.
- Wave 3 – 15 interviews.

H.29 Priority was given to programmes with the largest funding allocation, and therefore ZEHID and CCAM were a key focus for wider stakeholder interviews.

Summary

Table H.3: Beneficiary and wider stakeholder interviews (all waves)

Programme	Number of Beneficiary Interviews	Number of Wider Stakeholder Interviews
ZEHID	24	27
CCAM	52	18
Hydrogen	11	16
FOAK	29	16
Maritime	38	22
Net Zero Propulsion	18	9
TDD	11	10
Total	**183**	**118**

Source: Steer-ED interview analysis, 2025

Interview notes and analysis

H.30 All interviews were recorded and transcribed using the automatic transcription facility on Microsoft Teams. A note-taker also attended each interview and took detailed notes of the conversation between the interviewer and the interviewee.

H.31 Following the interview, the notes taken by the note-taker and any notes taken by the interviewer were either manually coded or analysed using qualitative analysis software,

Atlas.ti. Both forms of analysis were guided by a coding frame aligned with the study's research questions and topic guide to ensure consistency. Coding was conducted by the programme leads and project team support to ensure consistency and reduce bias, with openness to emerging themes.

H.32 Learnings from these interviews, supported by quotations, have been provided throughout this report.

Case studies

H.33 A total of 21 case studies have been developed for the monitoring commission (two, three or four case studies for each programme). These are presented as vignettes within the report and as separate full write-ups within remaining parts of the appendices. The case studies were developed through interviews with project leads and supporting desk research. All case studies have been reviewed by the programme's independent panel of subject-matter experts, selected for their expertise in relation to the programme or technology in question. This provides a valuable external perspective on the importance and potential long-term impact of the technology in question.

I Description of projects

ZEHID

I.1 **ZEHID** is focused on assessing the feasibility and demonstration of large (40-44t) battery electric trucks and hydrogen fuel cell trucks. There is a wide variety of demonstrator partners including operators, manufacturers and infrastructure stakeholders. Unlike other programmes in the portfolio, ZEHID is targeted at technologies with high technology readiness levels (TRLs), focusing on deployment.

CCAM

I.2 The purpose of **CCAM** is to secure the industrial and economic benefits of Connected and Automated Mobility (CAM) technologies in the UK. It consists of two competitions: the Deployment strand, which demonstrates connected and autonomous passenger and goods vehicles, and the Supply Chain strand, which focuses on developing technologies and capabilities to overcome gaps and barriers to scaling up the UK CAM supply chain.

TVH

I.3 **TVH** supports demonstrations of hydrogen refuelling infrastructure and hydrogen-powered vehicles across transport modes in real world operational settings across the Tees Valley region.

FOAK

I.4 **FOAK** is a programme of late-stage Contracts for Innovation projects, examining first-of-a-kind technology development and deployment in the rail sector. The early-stage technologies in development aim to deliver a range of benefits including reducing emissions, increasing rail accessibility for those with disabilities, and improving the punctuality of trains. FOAK is the only programme in the LMT portfolio that uses the Innovate UK (IUK) 'Contracts for Innovation' mechanism (formerly the Small Business Research Initiative).

NZP

I.5 The **NZP** programme supports future transport propulsion technologies across multiple transport modes. The projects must demonstrate a strong route to market position and validate the chosen technology in a relevant environment (for example a testbed, a development mule or via an adapted vehicle or vessel for higher maturity technologies).

TDD

I.6 **TDD** focuses on innovative projects aimed at decarbonising local transport systems. The programme seeks R&D solutions to reduce carbon emissions, foster collaboration between local authorities and businesses, and align with local strategies such as local transport plans and local net zero strategies. Projects must address emissions reduction challenges, consider local needs, involve local authority support, align with local strategies, and demonstrate how the solution will be implemented.

Maritime

I.7 The **Maritime** programme supports the development and real-world demonstration of clean maritime technologies aimed at reducing greenhouse gas emissions from domestic maritime operations, while strengthening the UK's clean maritime industrial capability. It

targets low- to mid-range technology readiness levels, supporting feasibility studies, pre-deployment trials and large-scale demonstrations to bridge the gap between early-stage innovation and commercial deployment.

Control Information

Prepared by

Steer
14-21 Rushworth Street
London SE1 0RB
+44 20 7910 5000
www.steer-ed.com

Prepared for

UK Research & Innovation
Polaris House,
North Star Avenue,
Swindon SN2 1FL

Steer project/proposal number

245-747-03

Client contract/project number

Author/originator

Isabel Claydon, Ali Memory, Neil Brown, Isabella Thompson, Morgan Anthony, Amber Gunter

Reviewer/approver

Josh Stott, Ali Memory

Other contributors

Distribution

Client: Neale Ryan
Joe Lyford
Tom Watson

Version control/issue number	Date
Wave 2 Portfolio Report: progress and insights from the LMT portfolio – DRAFT	07 November 2025
Wave 2 Portfolio Report: progress and insights from the LMT portfolio – DRAFT V0.1	14 November 2025
Wave 2 Portfolio Report: progress and insights from the LMT portfolio – FINAL	16 December 2025
Portfolio Report: progress and insights from the LMT portfolio – Draft V1.1	13 December 2026
Wave 3 Portfolio Report: progress and insights from the LMT portfolio - DRAFT	23 March 2026
Wave 3 Portfolio Report: progress and insights from the LMT portfolio – DRAFT V0.2	27 March 2026
Wave 3 Portfolio Report: progress and insights from the LMT portfolio – FINAL V0.1	24 April 2026
Wave 3 Portfolio Report: progress and insights from the LMT portfolio – FINAL V0.2	15 May 2026

Progressive thinking
No time for business as usual

steer economic development

steer-ed.com