

LMT monitoring report: progress and insights from the Tees Valley Hydrogen Transport Hub programme



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Our ref: Our ref: 245-747-02

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List of acronyms and abbreviations

Acronym	Meaning
CCAM	Commercialising connected and automated mobility (programme)
DBT	Department for Business and Trade
DfT	Department for Transport
FOAK	First of a Kind (programme)
FEPS	Field Energy Power System
FTE	Full Time Equivalent
HGV	Heavy Goods Vehicle
HUT	Hydrogen Utility Truck
HYVE	Tees Valley Hydrogen Vehicle Ecosystem
IMS	Impact Management System
IUK	Innovate UK
Ive	Innervated Vehicle Engineering [company]
LGV	Light Goods Vehicle
LMT	Land and Maritime Transport
MATT	Medium Aircraft Towing Tractor
MoD	Ministry of Defence
MSP	Monitoring Service Providers
OEM	Original Equipment Manufacturers
QRM	Quarterly Review Meetings
QMS	Quarterly Monitoring Scores (refers to the scores IUK MSPs report against projects, as part of the Quarterly Review Meeting – QRM)
RAF	Royal Air Force
RIAT	Royal International Air Tattoo
SAF	Sustainable Aviation Fuel
TCO	Total Cost of Ownership
TDD	Transport Decarbonisation Demonstrator (programme)
TIA	Teesside International Airport
TIAL	Teesside International Airport Hydrogen Refuelling Hub
TRL	Technology Readiness Level
TVH	Tees Valley Hydrogen
UKRI	UK Research & Innovation
ZEHID	Zero Emission Heavy Goods Vehicle and Infrastructure Demonstrator (programme)
ZEHyDA-2	Zero Emission Hydrogen Demonstration in Airport Applications at Teesside International Airport and RAF-Leeming

Executive Summary

Overview

Steer-ED and Technopolis were commissioned to conduct monitoring on the Land and Maritime Transport (LMT) portfolio, which comprises seven grant-funding programmes covering a range of technologies, transport modes and objectives. This report focuses on the Tees Valley Hydrogen Transport (TVH) programme.

The TVH programme consisted of a single competition for projects that would demonstrate the use of hydrogen powered vehicles in commercial settings within the Tees Valley region. The programme awarded £12.5m across three projects:

- ZEHYDA-2 (Zero Emission Hydrogen Demonstration in Airport Applications at TIA and RAF-Leeming), £2.7m, five partners - demonstrating a range of hydrogen-fuelled airside vehicles at Teesside International Airport (TIA) and Royal Air Force (RAF) Leeming, including a new hydrogen fuelling station.
- Teesside International Airport Hydrogen Refuelling Hub, £2.8m, three partners - to build a publicly accessible hydrogen refuelling station at TIA, to be used to demonstrate goods vehicles, including supermarket deliveries.
- Tees Valley Hydrogen Vehicle Ecosystem (HYVE), £7.0m, four partners – to deploy a publicly accessible green hydrogen refuelling station that would serve HGVs

The projects started in September and October 2023 and were originally expected to conclude by March 2025. Two were subsequently extended to March 2026, because of delays with vehicle availability, and securing planning permission. Activity is therefore still ongoing. The ZEHYDA-2 demonstration period will run from February 2026, while (at the time of the Wave 3 research) the Refuelling Hub was working towards finalising the hydrogen refuelling station, before demonstrations at the Teesside International Airport¹.

The third project (HYVE) was terminated in March 2025 after a full review. Having lost and replaced a key lead and a partner early on, the project hit delays in planning and construction of the station, and consequently reduced interest from potential customers.

Delivery

At their latest quarterly assessment, the two live projects were found to be broadly on track with (updated) milestones and deliverables, and while underspending slightly (due to delays and descope), both were assessed as on course to deliver on objectives (though not fully by the end of March 2026).

Beneficiaries generally spoke very positively about their experience of working with Innovate UK (IUK), and their satisfaction with monitoring expectations and financial processes. Some (non-lead) partners wanted more interaction and updates from IUK and leads, while there were also calls for more information and coordination across TVH projects (in line with the idea of multiple developments around a single ‘hub’).

¹ 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.

Partnerships

The TVH programme has enabled the formation of new partnerships (ten out of the eleven beneficiaries surveyed in Wave 2 were working with at least one new partner), as well as helping to further develop others (eight out of eleven reported a strengthening of relationships). It has brought together organisations that often would not have been able to work together otherwise, and has provided direct access to potential customers and suppliers, as well as various complementary skills and expertise. Partner relationships were rated highly by most TVH beneficiaries, with consultees reporting good collaborations and collective hard effort.

Development, deployment and commercialisation

With the two ongoing projects about to move into the demonstration phase, there is little to report at this stage in terms commercial progress. However, in both cases the funding is enabling them to start producing hydrogen vehicles and infrastructure, despite a lack of demand and high costs, and they remain positive about demonstrators and future opportunities for wider rollout. Beneficiaries also suggest that there will be significant dissemination efforts alongside the demonstrations.

Skills

A majority of TVH beneficiaries (ten out of the eleven surveyed in Wave 2) reported their project had positively contributed to skill development in areas such as site design, energy procurement, and permitting, as well as commercial viability. Projects also anticipate acquiring further new knowledge via the project demonstrations, by collecting data and information on operators' experiences. TVH projects have supported at least 19 existing jobs, and created at least three more. The (permanent) infrastructure being developed is also expected to help attract more skilled talent to the region in future.

Wider framework conditions

There is no evidence that TVH projects have so far had any significant influence over wider framework conditions, although it is hoped (expected) that the upcoming demonstration activities will play a role.

Wider outcomes and impacts

Similarly, it is too early to see wider or longer term outcomes from the projects, although beneficiaries expect contributions to reducing the environmental impact of transport and to developing solutions that can be exported. There are also challenges ahead, including a lack of hydrogen infrastructure, the high cost of hydrogen, limited market demand, and regulatory hurdles.

Next steps for the programme

As there are now only two projects in the TVH programme and both are only now entering demonstration phase, there is currently limited knowledge of the programme and projects outside of those who are directly involved. Looking to the future, stakeholders therefore spoke more generally about supporting hydrogen for transport, rather than specifically about the TVH programme. They reported that the cost of hydrogen and the lack of infrastructure remain major challenges. Continuing to invest in demonstrating hydrogen refuelling / transport in several specific geographical areas (hubs, clusters or corridors) was therefore seen as the priority, with this being done at sufficient scale and with a coordinated approach to investment across infrastructure, vehicles and users.

Future evaluation

Impacts of the TVH programme will only become clear over time, as the demonstrations take place and projects conclude, and as results are taken forward. Further evaluation, once all projects have closed, and one or two years after, will therefore be important to capture these longer-term benefits.

1 Introduction & methodology

Introducing the LMT portfolio

- 1.1 The LMT portfolio comprises seven grant-funding programmes spanning a range of technologies and transport modes (including rail, road and maritime). The programmes are: the Zero Emission Heavy Goods Vehicle and Infrastructure Demonstrator (ZEHID); the Maritime Decarbonisation programme; the Commercialising Connected and Automated Mobility (CCAM) programme; the Tees Valley Hydrogen (TVH) Transport Hub programme; the Rail First of a Kind (FOAK) programme; the Net Zero Propulsion programme (NZP); and the Transport Decarbonisation Demonstrator (TDD).
- 1.2 The programmes vary in objectives, size, complexity and duration. Projects range from single applicant six-month feasibility studies costing around £25k, to four-year multi-partner collaborative research and development (R&D) projects costing millions.

Purpose of this report

- 1.3 Steer-ED and Technopolis were commissioned by IUK, in partnership with the Department for Transport (DfT) to conduct a monitoring commission on behalf of the LMT portfolio and the constituent seven programmes. This report is one of seven LMT programme reports, and focuses on the TVH programme. It presents final findings, synthesised from a range of evidence sources, described below.

Introducing the TVH Programme

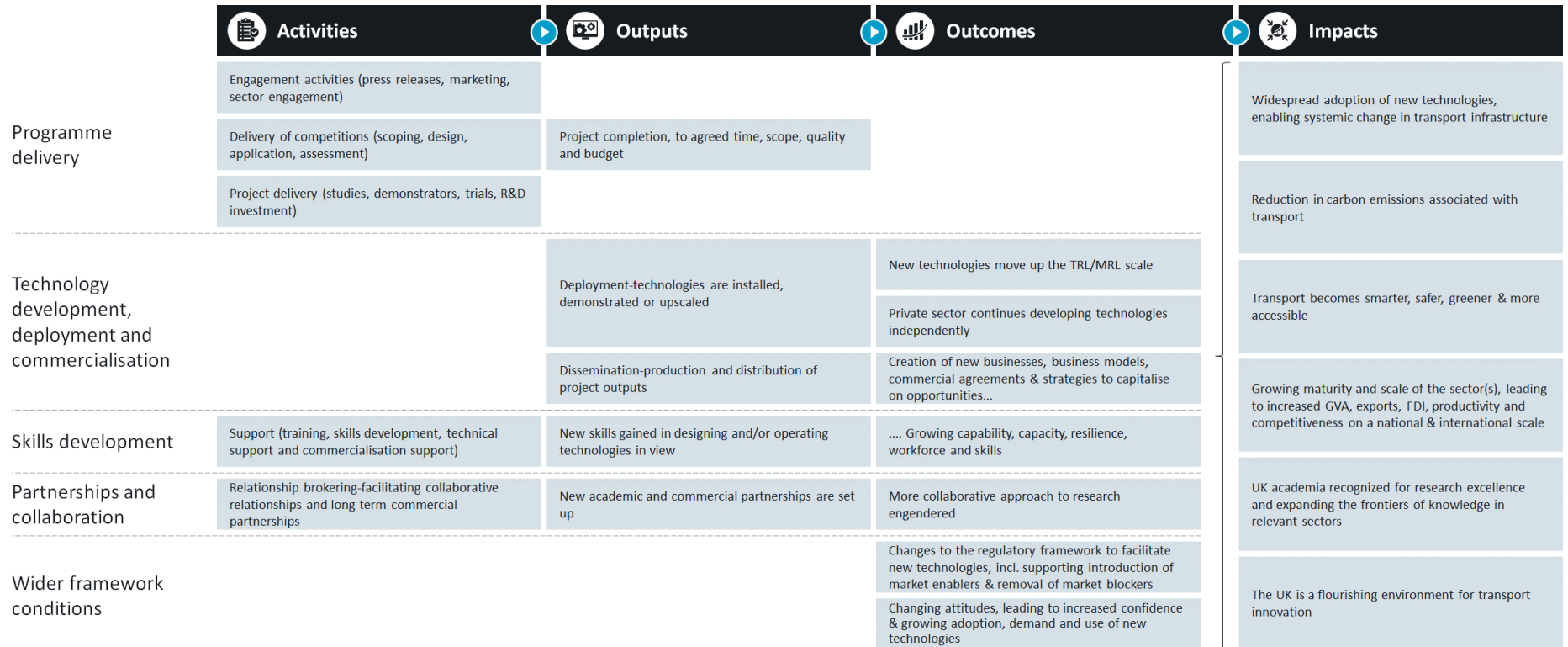
- 1.4 The Tees Valley Hydrogen Transport Hub programme (hereafter ‘the TVH programme’) consists of a single competition for projects to demonstrate hydrogen refuelling infrastructure and the use of hydrogen powered vehicles in commercial settings within the Tees Valley. The programme awarded £12.5m across three projects, to be delivered by 12 beneficiaries. The projects started in September and October 2023 and were originally expected to conclude by March 2025. Two have since been extended (without additional funding) to March 2026. The third project (HYVE) was terminated in March 2025 after a full review and because of delays in planning and construction of the station, and consequently reduced interest from potential customers.

Monitoring approach adopted

The LMT monitoring framework and logic model

- 1.5 This programme level report (and the wider LMT monitoring framework) is structured around the portfolio logic model, presented in Figure 1-1. This 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 chapters of this report is titled after one of these themes, providing a structured exploration of the causal mechanisms.

Figure 1-1: LMT portfolio high level logic model

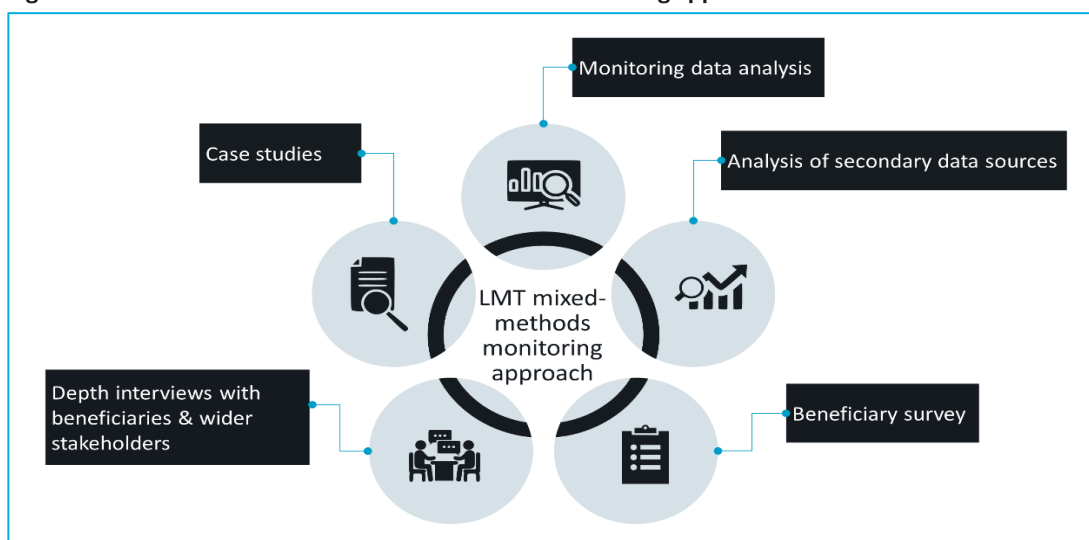


Source: Steer-ED and Technopolis, 2024

Sources of evidence utilised

- 1.6 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.
 - **Wave 2:** Fieldwork took place between July and September 2025.
 - **Wave 3:** Fieldwork took place between January and February 2026.
- 1.7 This final TVH programme report brings together evidence collected across all three research Waves (Waves 1, 2 and 3)², providing a consolidated account of findings to date. This final version builds on the Wave 2 TVH programme report and incorporates newly available evidence from Wave 3.
- 1.8 Figure 1-2 sets out the five types of evidence collection utilised for this monitoring commission. These evidence strands were selected in order 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

- 1.9 A detailed description of the scope and coverage of methods deployed across the portfolio is given in Appendix A and summarised below for the TVH programme:
- 1.10 **Monitoring data analysis** – spanning two data sources: applicant information data and Quarterly Monitoring Scores (QMS)³. [Note that a third source, Impact Management

² 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.

³ QMS scores are provided by MSPs as part of Quarterly Review Meetings (QRM) with each project.

System data, was collected for some parts of the LMT portfolio, but not the TVH programme].

- 1.11 **Analysis of secondary data** – including: Meltwater, a media monitoring platform to assess the public dissemination of LMT projects in the period from 12 August 2024 to 12 August 2025; and Dimensions, a database that provides patent and publication data⁴.
- 1.12 **Beneficiary survey** - An online survey of beneficiaries was developed (a range of multiple choice and free text questions). This was distributed to project leads and partners (enabling multiple responses per project) across all programmes each Wave. The response rates across all research Waves combined is presented within Appendix A. The response rates for Wave 2 and Wave 3 for TVH are detailed below⁵:
- **Wave 2:** There was a 100% response rate, and covering all three TVH projects
 - **Wave 3:** There was a 100% response rate, and covering both TVH projects that were ongoing.
- 1.13 It is important to highlight that the survey respondents from the three Waves differed. As such, while the findings offer valuable insights, they present a cross-sectional comparison rather than a longitudinal comparison across Waves
- 1.14 **Depth interviews** – comprised one-hour depth interviews conducted with programme beneficiaries and a selection of wider stakeholders (knowledgeable industry stakeholders from both commercial and academic institutions) during August and September 2025 in Wave 2 and January and February 2026 for Wave 3. The number of interviews varied by programme, in accordance with the number of stakeholders involved. A total of 18 interviews were conducted across Waves 2 and 3 for the TVH programme (with a further breakdown provided in Appendix A).
- 1.15 **Case studies** – two case studies have been undertaken for this programme (a total of 21 across the portfolio). For TVH, the cases covered the ZEHYDA-2 and TIAL projects. Findings from these are presented as vignettes across the report, with separate full write-ups in the annex. All case studies have been reviewed by the programme’s independent panel of subject-matter experts, selected for their relevant expertise.

Methodological notes

- 1.16 The following considerations should be taken into account when reading the findings:
- **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. This is particularly the case for innovation funding, where numerous steps occur between initial project funding and measurable market outcomes. The findings gathered at this early stage (even if project have

⁴ 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.

⁵ 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.

closed) should therefore be considered indicative of a longer-term trajectory rather than conclusive.

- **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, thus resulting in findings which could overstate the true impact of the portfolio. Wherever possible, the views of wider stakeholders and industry experts have been considered alongside beneficiary viewpoints to mitigate this risk.
- **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, Steer-ED and Technopolis 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.
- **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 still considered good representation (programme specific breakdowns are outlined in Appendix A).

Structure of this report

1.17 The remainder of this report is structured as follows:

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

2 Overview of TVH delivery

Key Messages

- The TVH programme awarded £12.5m across three projects to support the demonstration of hydrogen refuelling infrastructure and hydrogen-powered vehicles across transport modes in real world operational settings in the Tees Valley area.
- The process of applying to the programme was found to be appropriate and relatively straightforward by most beneficiaries, although some found the requirements a little onerous and with some duplication of information required at different stages.
- The projects started in September / October 2023 and were to conclude by March 2025. Two were subsequently extended (without additional funding) to March 2026, because of delays to vehicle availability and planning permission. Activities are therefore still ongoing, with main demonstration phases still to happen.
- The third project (HYVE) was terminated in March 2025 after a full review and because of significant delays in planning and construction of the refuelling station, as well as the knock-on effects of the uncertainty created to other parts of the project.
- At their latest quarterly assessment, the two live projects were found to be broadly on track with milestones and deliverables, while underspending (due to delays and descopeing). Both are on course to deliver on objectives, though this may be after the March 2026 project end date.
- Beneficiaries generally spoke very positively about their experience of working with IUK, as well as the monitoring expectations and financial management processes.
- Some (non-lead) partners wanted more interaction and updates from IUK and lead partners, while there were also calls for more information and coordination across TVH projects (in line with the idea of multiple developments around a single 'hub').

Introduction

- 2.1 This chapter provides a detailed overview of the TVH programme portfolio, outlining the objectives, timelines and key features of the programme, drawing on an analysis of monitoring data plus insights from the beneficiary survey. It goes on to characterise the delivery progress across the projects and offer insights from project delivery drawn from beneficiary interviews.

Introducing the programme

- 2.2 The TVH programme aimed to demonstrate and establish hydrogen as a viable fuel for a wide range of transport, including buses, delivery trucks, and airport ground vehicles. It comprised three projects, with a total grant value of £12.5m and involving 12 partners. These included those listed on the following page:

- ZEHyDA-2 (Zero Emission Hydrogen Demonstration in Airport Applications at Teesside International Airport and RAF-Leeming), £2.7m, five partners - Led by ULEMCo, this project is demonstrating a range of hydrogen-fuelled airside vehicles at Teesside International Airport (TIA) and Royal Air Force (RAF) Leeming. Motive Fuels will utilise their new mobile refuellers (HyKit's SSP, designed and built in the UK alongside JCB) to provide hydrogen refuelling into RAF Leeming, while Newcastle University will capture and analyse data. This project will also utilise the TIAL refuelling station located at the airport (see next bullet).
- Teesside International Airport Hydrogen Refuelling Hub (TIAL), £2.8m, three partners - Element 2 leads this project to build a publicly accessible hydrogen refuelling station at Teesside International Airport, which will be used to demonstrate goods vehicles, including supermarket deliveries, as well as provide hydrogen for some of the ZEHyDA-2 vehicles. Another project partner includes Innervated Vehicle Engineering Limited (IVE) who are delivering hydrogen fuel cell delivery vans.
- Tees Valley Hydrogen Vehicle Ecosystem (HYVE), £7.0m, four partners – A project led by Exolum to deploy a publicly accessible green hydrogen refuelling station at riverside terminal near Middlesbrough that would serve heavy goods vehicles supplied by Electra Commercial Vehicles and Quantron AG (working with Novuna Vehicle Solutions), with Teesside University providing hydrogen and fuel cell expertise.

2.3 The first two projects have had their timelines extended (with no additional grant funding):

- For ZEHyDA-2, this was mainly due to delays in vehicle availability (the number and speed with which operational vehicles could be made available for conversion to Hydrogen). After the extension was granted there have also been further delays caused by a change of personnel at the RAF and a key supplier going into liquidation.
- For the Teesside International Airport Hydrogen Refuelling Hub, delays related to securing planning permission for the site and installing the hydrogen refuelling infrastructure, which took longer than expected.

2.4 Project activity is therefore still ongoing. For ZEHyDA-2, the demonstration period is expected to run from February 2026, while (at the time of the Wave 3 research) the Refuelling Hub was working towards finalising the hydrogen refuelling station, before demonstrations at the Teesside International Airport⁶.

2.5 The third project (HYVE) was terminated in March 2025 after a full review. Prior to the project's kick-off, the lead and one of the vehicle providers withdrew from the consortium. They were replaced and the consortium remained optimistic that the project could be delivered, despite shortened timelines. However, unexpected delays in planning and developing the hydrogen station then made it extremely difficult to convince early customer adopters to commit to signing up for suitable commercial vehicles, creating uncertainty then for the vehicle providers (who would have to build vehicles without orders). It was decided that the project could not continue.

⁶ 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.

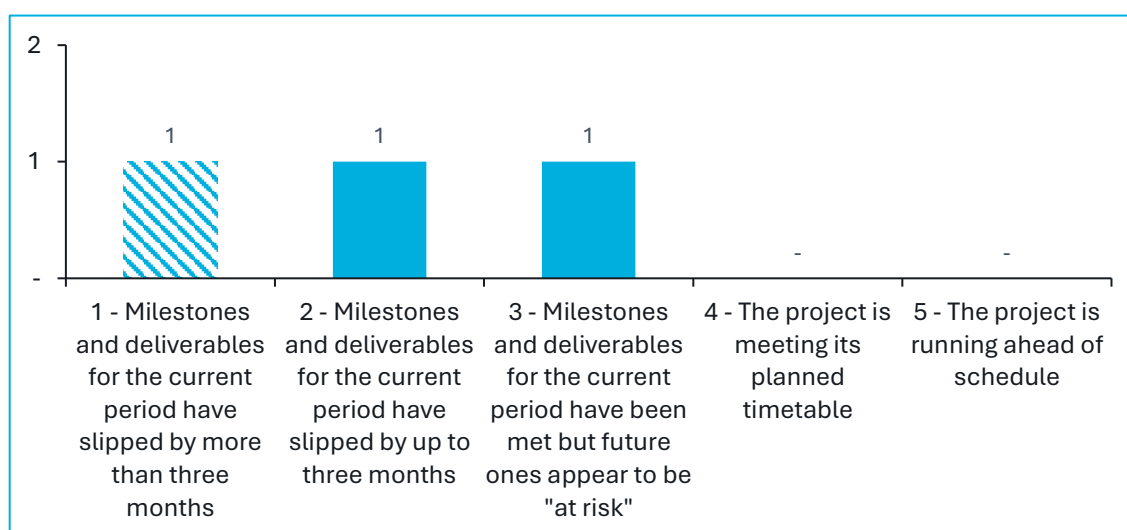
Insights from project delivery

2.6

Quarterly Monitoring Score (QMS) data is provided by IUK MSPs as part of each project's Quarterly Review Meeting (QRM) to track project delivery progress. The latest available QMS data⁷ was used to explore the extent to which milestones and deliverables for TVH projects have been achieved according to timeline (see Figure 2-1).

- ZEHYDA-2 was assessed as meeting its planned timetable, though with a risk of future slippage (no specific reasons were given).
- The milestones for the Refuelling Hub were judged to have slipped by less than three months, with the site itself having been delayed by planning permission taking longer than expected.
- HYVE was judged as having slipped by more than three months (on both the vehicle and station build programmes). At this point, the procurement and planning of the station were not scheduled until mid 2025, which would have drastically affected station availability (July 2026 at the earliest). Future customers required surety of fuel supply and were therefore unwilling to order commercial vehicles. Hence the project was subsequently terminated.

Figure 2-1: Current status of TVH projects (n=3)



Source: Steer-ED analysis, QMS data 2025. Time Scoring Matrix, Scores 1-5. Terminated project shown with striped shading.

2.7

The latest QMS data also provides an assessment of how well TVH projects were delivering against their budget. Figure 2-2 shows that two projects were assessed as having over or under-spend of 11%-15%, with the third having an underspend of >21%.

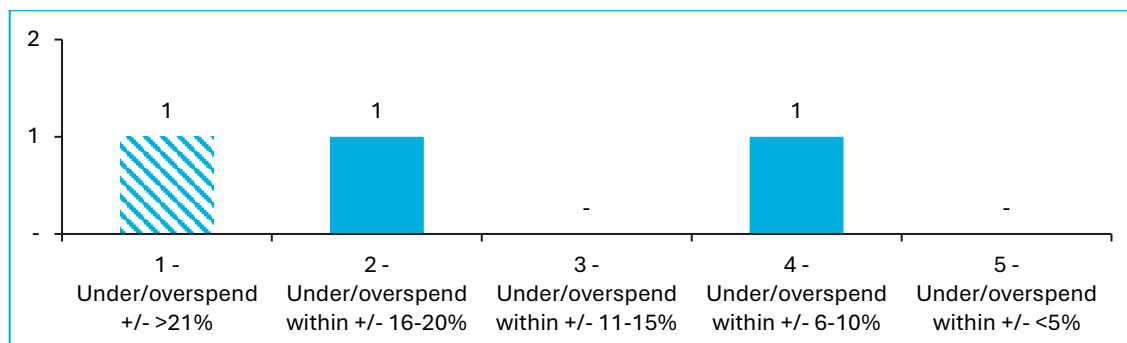
- For ZEHYDA-2, project costs and activity were assessed as being managed well overall. However, delays and challenges with vehicle availability had meant that the number of vehicle conversions was reduced, with lower spend as a result.
- The Teesside International Airport Hydrogen Refuelling Hub had seen significant underspend due to set-up delays. However, costs were expected to increase

⁷ From January 2026 for ZEHYDA-2 and the Teesside International Airport Hydrogen Refuelling Hub projects, and from June 2025 for the terminated HYVE project.

significantly in the final period, with site construction and payment for refuelling equipment.

- The HYVE project was assessed as having an underspend of 21% due to slippage with the station and vehicle building.

Figure 2-2: TVH project delivery against budget (n=3)

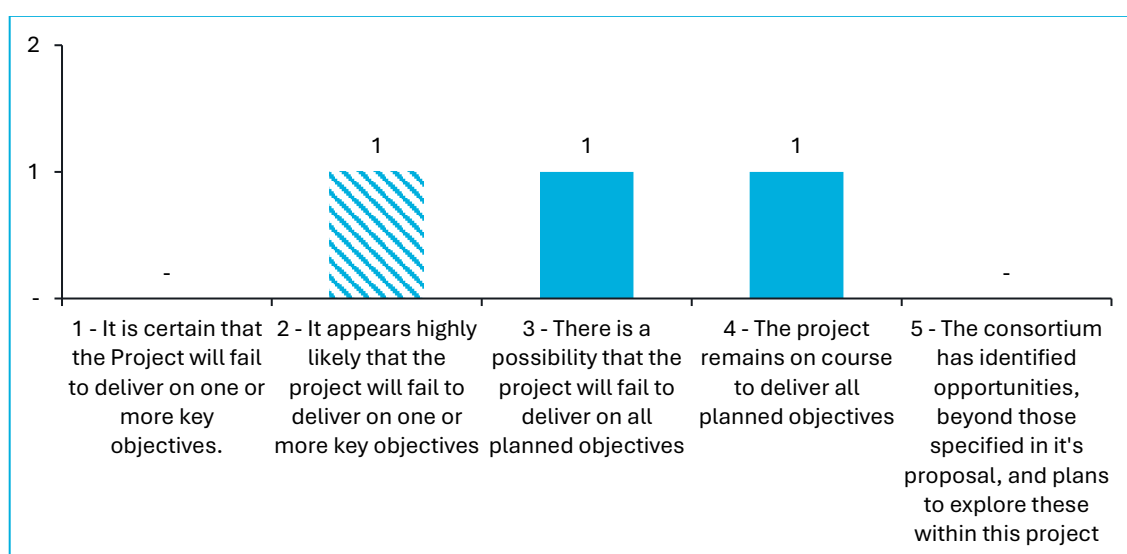


Source: Steer-ED analysis, QMS data 2025. Question: How well has the project been able to deliver against budget? (Answer options: Cost Scoring Matrix, Scores 1-5). Terminated project shown with striped shading.

2.8 Finally, QMS data was also used to investigate the extent to which TVH projects are successfully achieving their objectives (see Figure 2-3).

- ZEHyDA-2 remained on course to deliver its planned objectives. Qualitative interviews revealed that despite project delays, partners remained dedicated to delivering the planned technology and infrastructure in the extended timeline, as per the original objectives
- The Refuelling Hub was considered to be at some risk of not delivering on all objectives. While partners were seen are committed to building a permanent hydrogen refuelling station and vehicle demonstration, the site would not be finished by end of project (31 March 2026).
- The subsequently terminated HYVE project was assessed as highly likely to fail to deliver on one or more of the key objectives.

Figure 2-3: TVH project delivery against scope (n=3)



Source: Steer-ED analysis, QMS data 2025. Question: How well has the project delivered against its objectives? (Answer: Cost Scoring Matrix, Scores 1-5). Terminated project shown with striped shading.

- 2.9 This section goes on to report findings from beneficiaries regarding their experience applying for and delivering TVH projects, collected via interviews.
- 2.10 TVH beneficiaries reported that the programme application process was appropriate and straightforward. Some were particularly complementary about the programme outline that was provided and with the interview process run. A small number did find the resource requirements for developing an application to be onerous, and believed that there was some duplication in information required in the application form and IUK portal.
- 2.11 Beneficiaries also spoke very positively about the experience of working with IUK. Almost all interviewees brought up the role of Monitoring Service Providers (MSPs) speaking positively about the help and support they provided and highlighting that they offered a valuable bridge between the project team and IUK. Beneficiaries were also positive about the events organised by IUK, which allowed information sharing between different UK stakeholders interested in hydrogen. One beneficiary also felt that IUK was particularly helpful in terms of providing links with potential clients, who may have an interest in purchasing or deploying hydrogen vehicles.

“The experience was very good, and they were very helpful. 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, what our barriers were, and how and where we could improve. Overall, the experience was good.” - Wave 2 TVH beneficiary interview

- 2.12 While TVH beneficiaries spoke positively about their experience of working with IUK, there were a couple of opportunities for improvement identified by interviewees:
- **Delays in award announcements** leading to project extensions: TVH beneficiaries noted delays of six months or more in receiving award notifications, which had serious implications for projects – all of which had to be extended, partly as a result. Delays in the award announcement also contributed to one of the vehicle providers withdrawing from the HYVE project. Similarly, ZEHYDA-2 reported staffing changes among consortium partners, as well as disruptions on the hydrogen supply side as a result of the delays.
 - **Lack of communication with project partners:** Whilst most project leads reported regular communication with IUK, wider project partners mentioned that they have not had any exposure to these meetings. Furthermore, some project partners reported feeling out of the loop and not always receiving regular updates on project progress. This was particularly relevant in cases where vehicle manufacturers’ deployment schedules depended on the construction of the refuelling station, making regular updates essential. It was suggested that having consortium wide meetings could help address these knowledge gaps. There was also felt to be a need for greater communication across the programme.
- 2.13 Most beneficiaries felt that project monitoring expectations were reasonable, and reporting requirements were clear and easy to understand. Beneficiaries also felt that the quarterly review meetings (QRMs) helped them address challenges in a timely manner. For instance, one beneficiary mentioned that the meetings helped them familiarise themselves with the key processes and ask valuable questions at the project onset.

- 2.14 The only concern raised was around the ending of the HYVE project, with one beneficiary noting that it would have been helpful for this to be communicated to the other projects earlier, as all three were interconnected and had a joint objective to support hydrogen-powered transport in the area. A related issue emerged in relation to the ZEHyDA-2 project, which has received limited information on the progress of the Refuelling Hub project (which should be providing one of the ZEHyDA-2 sites with hydrogen).
- 2.15 Most TVH beneficiaries felt that the financial management processes were straightforward. However, one felt that the cost claim process (withholding of 10%) could have been communicated more effectively. Another highlighted that delays in the project announcement and delivery were not accompanied by corresponding adjustments to the financial and budgetary end dates. One also felt that the independent auditor's report required was quite costly for an organisation of a smaller size, and thought that there might be more cost-effective ways of acquiring information.

"The independent auditor's report is quite challenging, quite costly. That's the part that could probably be done better and more economically, because every time we have to get that done to do a drawdown, it's quite a big cost to us." – Wave 2 TVH beneficiary interview

- 2.16 There were several key barriers to delivery that were mentioned across beneficiaries:
- **Project timelines** – many stated again that the delayed announcement of successful applications, combined with already short timelines, reduced the feasibility of the complex project activities that had been proposed.
 - **Project costs** – some stated that whilst programme funding was helpful, the cost of developing hydrogen vehicles and infrastructure remains very high. One respondent felt that this was exacerbated by low customer interest in cases where technology was years from commercialisation, with development activities still underway. One beneficiary also reported an increase in the costs of hydrogen which acted as a barrier during the deployment stage.
 - **Infrastructure** – A small number of beneficiaries also highlighted particular challenges with developing infrastructure, which caused delays due to the long time required to secure planning permissions and electricity agreements.
 - **Vehicle procurement** – A small number of beneficiaries also mentioned difficulties with the vehicle design, procurement and manufacturing, which were overcome over the course of the projects.
- 2.17 Despite these challenges, most beneficiaries were positive about their project's progress and achievements. They highlighted several enabling factors:
- Collaborative working and ongoing technological and operational learning
 - The ongoing support from IUK throughout project delivery
 - Finding creative solutions to challenges (within the partnerships and with IUK)
 - Using the teams' skills and expertise to lead technological progress
 - Extended project timelines, enabling consortia the space to overcome difficulties
- 2.18 Beneficiaries had also drawn some other lessons from their participation in the TVH programme. For instance, some smaller organisations had learned how to apply for government funding and about how to deliver a grant-funded project. A lot of

administrative learnings were also identified around securing planning permission for infrastructure projects.

Conclusion

- 2.19 The TVH programme awarded £12.5m across three projects to support the demonstration of hydrogen refuelling infrastructure and hydrogen-powered vehicles across transport modes in real world operational settings in the Tees Valley area.
- 2.20 The process of applying to the programme was found to be appropriate and relatively straightforward by most beneficiaries, although some found the requirements a little onerous and with some duplication of information required at different stages.
- 2.21 The projects started in September and October 2023 and were to conclude by March 2025. Two have since been extended (without additional funding) to March 2026, because of delays to vehicle availability in one case, and delays with securing planning permission in the other. These two projects were therefore both still ongoing at the time of writing, and were only now about to enter into their main demonstration phases.
- 2.22 The third project (HYVE) was terminated in March 2025 after a full review and because of significant delays in planning and construction of the refuelling station, as well as the knock-on effects of the uncertainty created to other parts of the project.
- 2.23 At the latest quarterly assessment, the two live projects were found to be broadly on track with milestones and deliverables, although underspending (due to delays and descoping). Both are on course to deliver planned objectives, though in both cases this may only be after the March 2026 project end date.
- 2.24 Delays to award announcements did initially raise significant challenges for the projects, but this was largely resolved through extensions and adjustments to scope. Beneficiaries also generally spoke very positively about their experience of working with IUK, the support from MSPs, quarterly meetings, and the events organised to share information. They generally felt that the monitoring expectations were reasonable and that financial management processes were quite straightforward.
- 2.25 Some of the (non-lead) partners reported wanting more interaction and updates, both from IUK and sometimes also from their lead partner, while leads wanted more information and coordination across the different TVH projects (in line with the idea of multiple developments around a single 'hub').

3 Building and strengthening partnerships through programme delivery

Key Messages

- A key objective of the LMT portfolio is to encourage a more collaborative approach to research through new academic and commercial partnerships.
- The TVH programme has enabled the formation of new partnerships (10/11 beneficiaries surveyed in Wave 2 were working with at least one new partner), as well as helping to further develop others (most report a strengthening of relationships in the past year).
- It has brought together organisations that often would not have been able to work together otherwise. It has provided direct access to potential customers and suppliers, as well as various complementary skills, expertise and insight.
- Partner relationships were rated highly by most TVH beneficiaries, with consultees reporting good collaborations and collective hard effort. Those providing the highest ratings commented on the quality and professionalism of the project management and the level of personal interaction across partners.
- A key benefit has been being able to gather intelligence on customer requirements, such that solutions are well-suited to needs.

Introduction

- 3.1 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, TVH programme applicants were required to deliver their project in partnership with at least one other organisation. Participating organisations could include businesses, charities, academic institutions, public sector organisations and research and technology organisations.
- 3.2 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 TVH programme'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.

Exploring the Role of TVH in Partnership Development

- 3.3 Responses to the Wave 2 beneficiary survey indicated that the majority of TVH beneficiaries (ten out of eleven) had formed one or more new partnerships through participating in the programme.
- 3.4 Most interviewed beneficiaries mentioned having identified their partners on the basis of their project-specific supply and demand chain. They were often aware of the partner organisations and their expertise beforehand, but the project had helped cement and formalise the partnerships, with the organisations working together towards a common goal. Some also highlighted that, even though they were previously aware of the business commonalities between their work and their partners', the partnership would not have happened without IUK funding because of the substantial investment, time and resource requirements involved.

"Such projects are uncommon at this scale – so we would likely not have engaged. Our partner also would not have engaged considering the true price of hydrogen at this point. De-risking the customer in terms of cost was helpful, it made the project financially viable and accelerated a lot of infrastructure roll out." – Wave 2 TVH beneficiary interview

"This partnership is effectively built around the idea of supply and demand of hydrogen. So, two partners were responsible for the deployment of the vehicles and for the manufacturing of the vehicles. The project partner who are going to be responsible for deploying are effectively a leasing company, and the other project partner is a vehicle manufacturer." – Wave 2 TVH beneficiary interview

Types of partnerships formed, and how they have been used

- 3.5 Beneficiaries described the types of partnerships formed or strengthened through working together on TVH projects. These included partnerships across the supply chain (e.g. infrastructure and fuel providers, vehicle manufacturers, operators), partners providing specific expertise (e.g. partnerships with universities), and those who could help ensure compatibility with current or forthcoming regulations (e.g. working with government departments).
- 3.6 Two of the three partnerships formed within projects are still working closely together to deliver the project activities. Working collaboratively to deliver a common goal was considered a key enabling factor for both projects, with partners striving to showcase that hydrogen is a safe and viable fuel for a range of transport options. Another key enabling factor mentioned was regular communication between project partners, and engaging in knowledge sharing activities. Working closely with their project partners enabled beneficiaries to understand each others' organisational priorities, and helped to build trust.

- 3.7 HYVE's lead organisation has also remained in contact with some of the partners post-project in order to identify opportunities for future collaboration.
- 3.8 In the Wave 2 survey of TVH beneficiaries nine out of eleven rated their consortium relationships as 'good' or 'very good'. Wave 3 survey results reinforce this, with five out of seven rating their consortium relationships as 'good' or 'very good'. Similarly, in interviews, most beneficiaries agreed that the quality of the partnerships was good, and that individual consortium members worked hard to deliver project outputs and achieve the originally set objectives. The survey also showed that the majority of TVH beneficiaries (eight out of eleven in the Wave 2 survey, four out of seven in the Wave 3 survey) believed that their relationship with consortium partners had grown stronger over the past year.
- 3.9 Those providing the highest ratings commented on the quality and professionalism of the project management and the level of personal interaction across the partners. For one project, the regular (weekly) consortium calls were highlighted by all partners as having been important for the relationship, helping to ensure the project stayed on track, that issues were resolved and that everyone was aware of progress. This contrasts with another project (where ratings were still good, but not as high), where partners suggested that they had sometimes felt marginalised and that information exchange across the project could have been improved.
- 3.10 Some beneficiaries reported that the project was particularly effective in helping them build stronger relationships with a range of suppliers, which will be essential for advancing their work in the hydrogen sector.

"We have had the ability to develop a stronger relationship with our supply base and through the project with potential customers, one of whom is running one of our vehicles."
– Wave 3 TVH beneficiary survey

"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 interview

"I think the project has given us some advantages which allow us to build up relationships with fuel cell suppliers and do market research with hydrogen storage systems, and build up these relationships in the UK, Europe and China." – Wave 3 TVH beneficiary interview

- 3.11 They explained further that working closely with their project partners enabled them to understand individual organisational capabilities in terms of skills and expertise, which led to building trust and strengthening the relationship.

"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

“Without participation in the project it is unlikely we would have worked alongside the other vehicle manufacturers and leasing company involved. Everybody attempted to drive the project forwards with really close collaboration and idea sharing.” – Wave 2 TVH beneficiary survey

“Working collaboratively towards a common goal has allowed the various partners to align themselves within the industry to support one another when potential opportunities arise.” – Wave 3 TVH beneficiary survey

“The consortium included major industry players, with whom we maintain close engagement, facilitating introductions to other stakeholders, and delivering courses on hydrogen alongside their technical experts.” – Wave 2 TVH beneficiary survey

Beneficiary perspectives on the benefits of partnerships

- 3.12 Beneficiaries were asked to further explain any benefits realised because of partnerships formed or strengthened through their TVH project. A key point was being able to gather intelligence on customer requirements, such as that they could ensure their solution was well-suited to needs. They also gained a better understanding of the overall hydrogen ecosystem, and had contributed to knowledge exchange activities such as seminars and training courses with partners. One other beneficiary highlighted that relationships built during the programme could help advance their academic research and result in more and better-informed publications in the hydrogen space.

“Stakeholder engagement is a big benefit for us through our dissemination and publication activities. It gave us the chance to participate in a real-world deployment project from the design and procurement to the vehicle conversion and the real-world showcase.” – Wave 3 TVH beneficiary interview

“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 interviewee

- 3.13 TVH beneficiaries also mentioned examples of how partnerships developed during the programme could be of use in future. For instance, many beneficiaries mentioned that they expect to continue to work with their partners beyond the programme duration. The programme was also felt to have successfully influenced access to the wider hydrogen ecosystem which might lead to future engagements between project partners and leading Original Equipment Manufacturers (OEMs), customers and supply chain companies that have not been directly involved in the projects.

“We are also talking to Hydrogen companies that are making generators that run on hydrogen that can create electricity. So, it has opened a lot of different doors to a lot of different hydrogen sectors and businesses that do different things in the space and it has been very helpful.” – Wave 2 TVH beneficiary interview

“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

Case study vignette showcasing partnership development and benefits to the project and organisation

Element 2 is developing a permanent, hydrogen refuelling station at the Teesside International Airport (Appendix C). The facility will serve hydrogen-powered trucks, vans, cars and airport vehicles, providing vital infrastructure for the growing use of hydrogen as transport fuel. The project builds on previous trials of hydrogen-fuelled vehicles at the airport.

One of the key outcomes of the project so far was a strengthening of the partnership between the lead organisation (Element 2) and the two delivery partners – Teesside International Airport and Innervated Vehicle Engineering (IVe). Even though the project was delayed, the three organisations worked closely together to overcome obstacles and identify strategies to achieve the project objectives, including through use of a shared risk matrix that helped monitor and address challenges.

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. 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.

Working together on the project will have lasting benefits, with partners expecting to continue to expand their activities in this space. Developing a permanent refuelling station at the 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, rolling out more stations and vehicles across the UK, attracting more customers and suppliers.

Conclusion

- 3.14 A key objective of the LMT portfolio is to encourage a more collaborative approach to research through fostering new academic and commercial partnerships.
- 3.15 The TVH programme has enabled the formation of large numbers of new partnerships (ten out of the eleven beneficiaries surveyed in Wave 2 were working with at least one new partner), as well as helping to further develop others (a majority reported a strengthening of relationships with partners over the past year). It has brought together organisations that often would not have been able to work together otherwise. It has provided direct access to potential customers and suppliers, as well as various complementary skills, expertise and insight across different partner organisations.
- 3.16 Partner relationships were rated highly by most TVH beneficiaries, with consultees reporting good collaborations and collective hard effort to showcase that hydrogen is a safe and viable fuel for a range of transport options. Those providing the highest ratings commented on the quality and professionalism of the project management and the level of personal interaction across the partners. Where a small number of partners were more neutral, this was because they had sometimes felt marginalised and thought that information exchange across the project could have been improved.
- 3.17 Through the TVH projects, ideas have been shared, trust has been built, and relationships have been strengthened. A key point was being able to gather intelligence on customer requirements, such that they could ensure solutions were well-suited to needs. They also gained a better understanding of the overall hydrogen ecosystem.

4 Development, commercialisation and deployment of new technologies

Key Messages

- With the two ongoing projects about to move into the demonstration phase, there is limited information to report at this stage in terms commercial progress.
- However, in both cases the funding is enabling them to start producing hydrogen vehicles and infrastructure, despite a lack of demand and high costs, and they remain positive about demonstrators and future opportunities for wider rollout.
- Beneficiaries also suggested that there will be significant dissemination efforts alongside the demonstrations. Even so, 74 media items relating to TVH were already identified for the period August 2024 to August 2025, including in airport-related publications and energy-related media, plus other local, national and international sources.

Introduction

- 4.1 This chapter explores the extent to which TVH projects have been successful in developing and deploying technologies, as well as progressing towards commercialisation.

Reported TRL progression across projects, and mechanisms driving this

- 4.2 The Technology Readiness Level (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 status of projects, and the technological advancement that has been made via project delivery.

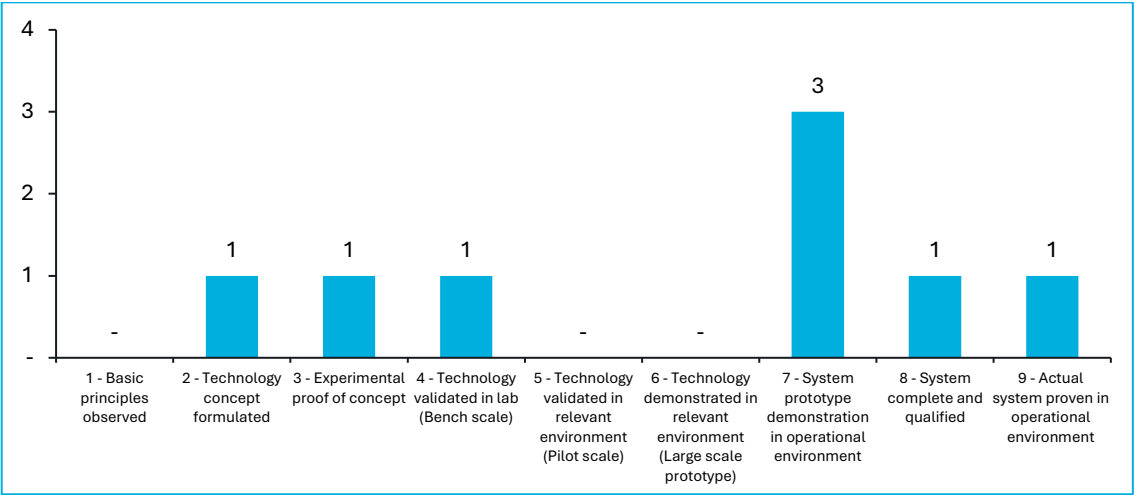
- 4.3 In interviews with beneficiaries, there was a clear rationale for how the project activities were helping to progress the technology up the TRL scale – for example building and testing prototypes, and conducting trials with customers. Beneficiaries were able to express clearly how the project was helping advance the technology in question.

“Testing was all about the functionality of the fuel cell in this particular orientation. We changed the standard orientation of how the fuel cell is normally fitted in the vehicle. 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 interview

“There were three prototypes built 6-8 months ago which have been tested and undergone trials with customers. They have gone back to the factory for re-engineering to build second generation assets. Our sister company has acquired a manufacturing facility and is aiming to serialise production of these assets with a target of multiple 100s by the late 2020s.” – Wave 2 TVH beneficiary interview

- 4.4 In response to the Wave 2 survey, beneficiaries were asked to report on the current TRL of their technology. As shown in Figure 4-1, three respondents reported progression to level 2-4, while five reported being at level 7 or above.

Figure 4-1: Reported current TRL of TVH projects (n=8)



Source: Steer-ED analysis of Wave 2 beneficiary survey that took place between July and September 2025. Question: ‘With reference to the TRL scale, what is the TRL of the technology now?’ (Answer options: Numeric (1-9), Unsure)

- 4.5 The Wave 2 survey also asked the same respondents about the TRL at application stage, for comparison. Only three provided an answer, but in all cases this showed an increase from the TRL at application stage to currently (increases from TRL 4 to 7, 6 to 7 and 7 to 8 respectively). Wave 3 survey findings reinforce this, with three beneficiaries reporting an

increase in their TRL since application stage (increases from TRL 5 to 7, 3 to 8 and 3 to 5), whilst two beneficiaries reported that their TRL remained unchanged at levels 3 and 7 respectively.

- 4.6 Dimensions data shows no patents associated with any of the three TVH projects so far. In the beneficiary survey, respondents were also asked about patents. One respondent reported in the Wave 3 survey that they had held one patent relevant to their project before the project started, and that they now held two further patents as a result of the project.

Dissemination

- 4.7 Dissemination via production and distribution of project outputs is one of the expected outcomes from the TVH programme. Six out of eleven beneficiaries surveyed at Wave 2 indicated that their TVH project had already been featured in news reports, while three reported being featured in trade press and one reported being featured in a blog.
- 4.8 Project partners also regularly highlighted during interviews that they are working closely together to disseminate any emerging findings by developing project-specific webpages, producing social media content or attending industry conferences.

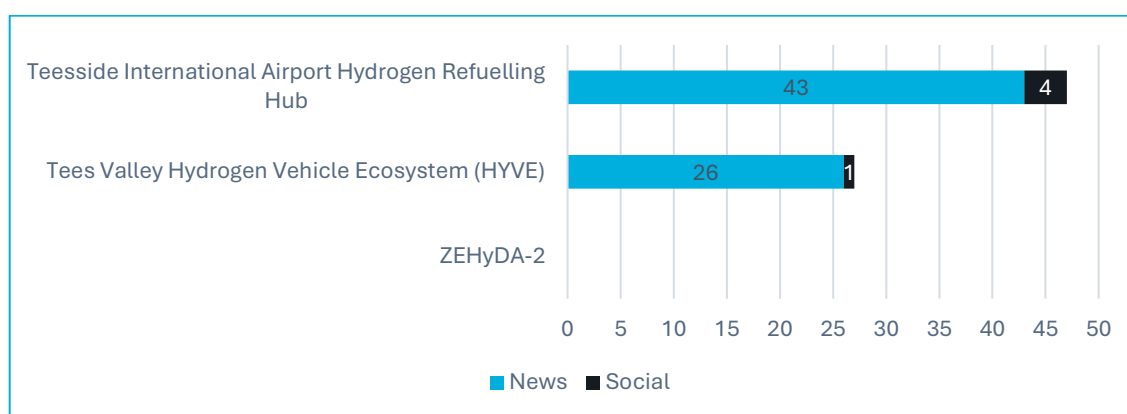
“At the end of March 2026, we will be doing a final report that will be externally promoted to showcase what we have learned from the innovation programme. Overall, we really want to market the site to fleet managers and to media organisations. We want to be showing it, because we know fleets and organisations want to see what a hydrogen refuelling station is. We will be working with various media agents, and we will probably do a couple of videos as well.” – Wave 2 TVH beneficiary interview

“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 interview

- 4.9 Mentions of LMT projects in the media (news media, trade press, industry publications, social media, blogs, and other sources) have been further explored using the Meltwater platform, with searches undertaken for each of the TVH projects based on keywords, and covering the period between August 2024 and August 2025.
- 4.10 Figure 4-2 shows that media items were found in that year for two out of the three TVH projects. This included 74 media items in total, with the Teesside International Airport Hydrogen Refuelling Hub accounting for approximately two-thirds, and HYVE accounting for the remainder. The estimated views of these media items total over 47,000 collectively.

- 4.11 The media included airport-related publications (e.g. Airport Industry News, Airports International) and energy-related media (e.g. Bioenergy International, Energy World, Global Hydrogen Review), as well as other local (e.g. Middlesbrough Evening Gazette, Newcastle-upon-Tyne Journal, Teesside Live), national (Business Live, the Telegraph) and international (e.g. MSN, Yahoo) sources.
- 4.12 For the Refuelling Hub, most of the articles were tied to the application and granting of planning permission and the start of work to build the hydrogen refuelling station. For HYVE, most of the media actually related to another IUK project that has recently been awarded to Exolum (as part of the Hydrogen Storage and Distribution Supply Chain Collaborative R&D programme), but the items also explained the ongoing HYVE project as well.
- 4.13 Across the programme, most of the media items found were news items (93%), while social media posts accounted for just seven per cent. However, beneficiaries suggested that a substantial amount of further social media activity is planned when projects close and/or when project demonstrations take place.

Figure 4-2: Media coverage of TVH projects



Source: Analysis of media coverage of the TVH programme based on 2025 Meltwater platform. 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).

Commercial progress made by organisations

- 4.14 With two projects about to move into the demonstration phase (and the other project closed), there is limited to report at this stage in relation to commercial progress.
- The lead of the ZEHYDA-2 project reported that *“the project has allowed more work to be completed in developing our hydrogen-hybrid technology, and we hope to see wider interest in the solution. However, there are still some “holes” in the market that are really required to be filled to make the product cost-effective and market competitive”*. QMS reporting similarly notes that *“there is a risk that the retrofit solution will currently prove too expensive from a Total Cost of Ownership (TCO) perspective for other vehicles to be converted”*.
 - The other lead expects commercial benefits in future, explaining that this project *“will represent our first hydrogen refuelling station and we expect to roll out many more in the coming years”*. However, the QMS reporting notes a significant risk that *“there will continue to be limited demand for hydrogen due to high hydrogen prices (2-3x the*

price of diesel), legislative uncertainty for manufacturers, investors and fleets, and consequently a lack of vehicles requiring hydrogen”.

Case study vignette showcasing a project which has made notable commercial progress

The ZEHyDA-2 (Appendix B) project aims 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.

Despite initial delays with the start of the project and being able to release vehicles from their usual operations (plus further challenges with changes of partner personnel and a key supplier going into liquidation), the conversions of four vehicles (from diesel to hydrogen combustion and electric) are now nearly complete, with the delivery of the first vehicles back to the airports in February 2026.

Demonstrations are expected to then commence, and continue past March 2026. After this, 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. ULEMCo foresee a growing market for converted vehicles, and are targeting a £5m-£10m income stream within five years.

Barriers and enablers to technological and commercial development

4.15 The potential barriers to commercial development were discussed with both TVH beneficiaries and wider stakeholders, who collectively pointed to a wide range of hurdles that might prevent hydrogen-powered transport technologies from achieving commercial success. The key barriers mentioned by both groups included:

- **Funding** was discussed as a key challenge for commercialising hydrogen technology, both in terms of building infrastructure and launching vehicles. Despite the government grants available, one beneficiary stated that the availability of hydrogen vehicles is still limited. There is also a lack of incentives for fleet operators to develop hydrogen-powered vehicles, as there is currently no sufficient infrastructure to power them. Finally, the actual cost of producing hydrogen was considered higher in the UK, as opposed to other European countries such as France and Germany, due to higher costs of the grid electricity required.
- **A need for regulatory mechanisms to incentivise change** was identified by TVH beneficiaries (see case study vignette), who mentioned struggles with securing planning permissions to commence building infrastructure.
- **Lack of market demand** was also mentioned as a key concern, with one TVH beneficiary stating for example that *“getting volumes of hydrogen demand has been challenging, once it becomes affordable, people will buy it.”*

- **Public acceptance** was also mentioned as one of the key blockers of the technology as hydrogen is a highly flammable gas. However, beneficiaries stated that they are working to conduct demonstrations to showcase that hydrogen refuelling is not only safe but also fast and easy.
- **Vehicle procurement** was identified by one beneficiary as a key challenge, as it took a long time to identify suitable vehicles for retrofitting, resulting in fewer conversions to hydrogen than originally planned.
- **Supply delays** were identified as a barrier by one beneficiary, who explained that a reduction in hydrogen demand had led some suppliers to go into liquidation, making it challenging to source relevant technical components.

“Getting commitment from the end user has been the biggest challenge. There is a reluctance from end users to commit to the commercial aspects and take on or pay for refuelling contracts.” – Wave 3 TVH beneficiary interview

“It took a long time to identify vehicles for conversion and procure those vehicles, especially as they had to be taken out of actual service or procured from elsewhere.” – Wave 3 TVH beneficiary interview

“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 interview

- 4.16 Whilst beneficiaries and wider stakeholders were more readily able to identify barriers than enablers to commercialisation, most agreed that government funding has been key in achieving progress. The funding has enabled beneficiaries to bridge the market gap and start producing hydrogen vehicles and infrastructure, despite lack of demand and high production costs as mentioned previously. Beneficiaries were also positive that if government support continues supporting hydrogen production, commercialisation efforts are more likely to be fruitful in future.

“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 interview

“We had already started looking at fuel cells before the funding was announced, however, the high cost was prohibitive. The opportunity to use the funding kick started our work in the Tees Valley, which was seen as a great step forwards.” – Wave 3 TVH beneficiary interview

“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 interview

Case study vignette showcasing a project which has faced barriers to commercialisation

The ZEHyDA-2 (Appendix B) project 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. To move beyond these, a national hydrogen infrastructure would be needed, and this would probably need a big public policy and 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.

In the more immediate term, a key enabler for achieving the project outcomes is the availability of hydrogen supply at TIA, which is being provided through the separate 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 will only be able to proceed once this supply is in place (the timing of which currently remains uncertain)

Conclusion

- 4.17 With the two ongoing projects about to move into the demonstration phase (and the other project closed), there is limited to report at this stage in terms commercial progress.
- 4.18 However, in both cases the projects are clear that the funding is enabling them to bridge the market gap, and to start producing hydrogen vehicles and infrastructure, despite a lack of demand and high costs. They also remain positive about future opportunities for wider rollout.
- 4.19 Beneficiaries also suggested that a substantial amount of dissemination activity (social media, media, conferences / events) is planned for later in projects, alongside the demonstrations. As of August 2025, 74 media items relating to the projects could already be identified from the previous year, with the Refuelling Hub accounting for approximately two thirds of this (with articles the application and granting of planning permission and the start of work to build the hydrogen refuelling station). The projects have been picked up in airport-related publications and energy-related media, as well as other local, national and international sources.

5 Growing skills and organisational maturity through programme delivery

Key Messages

- TVH project delivery is expected to grow the capability, capacity, resilience, workforce and skills of beneficiary organisations.
- A majority of TVH beneficiaries (ten out of the eleven surveyed in Wave 2) reported their project had positively contributed to skill development in areas such as site design, energy procurement, and permitting, as well as commercial viability.
- Projects also anticipate acquiring further new knowledge via the project demonstrations, by collecting data and information on operators' experiences.
- TVH projects have supported at least 19 existing jobs, and created at least three more. The (permanent) infrastructure being developed is also expected to help attract more skilled talent to the region in future.

Introduction

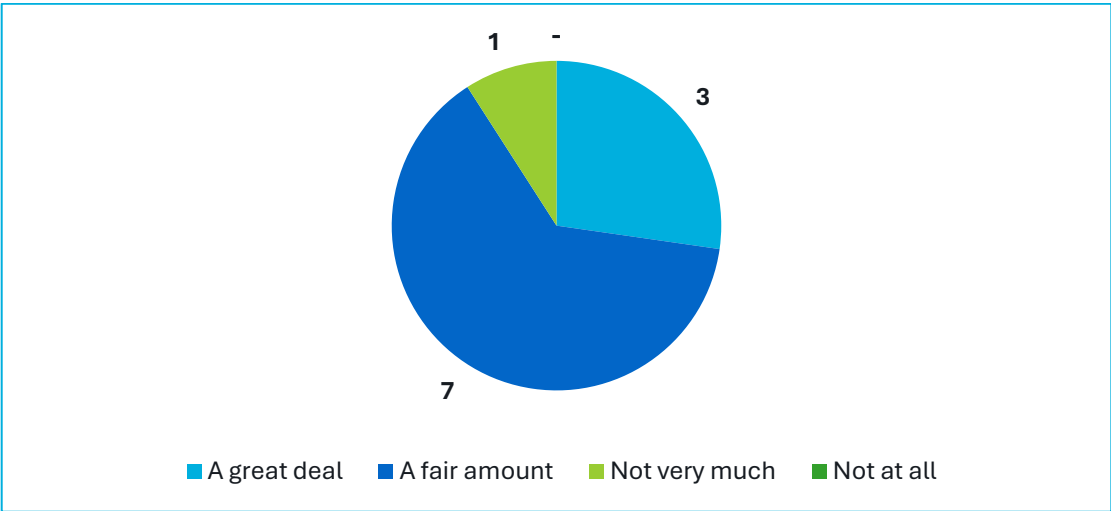
- 5.1 Delivery of TVH projects is expected to stimulate growth in the capability, capacity, resilience, workforce and skills of beneficiary organisations, ultimately leading to growth in the maturity and scale of the sector, with corresponding economic benefits. This chapter sets out the mechanisms by 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 and growth in organisational maturity amongst partner organisations

- 5.2 The majority of beneficiaries (ten out of the eleven surveyed in Wave 2) reported that their TVH project had positively contributed to the skills within their organisation either to “a fair amount” or “a great deal”. Similarly, Wave 3 survey findings support this, with six out of seven respondents highlighting that their TVH project had positively contributed to the skills within their organisation either to “a fair amount” or “a great deal”. Through surveys and interviews they explained that this included upskilling and new knowledge in areas

such as site design, energy procurement, and permitting, as well as in relation to the commercial viability of their project.

Figure 5-1: Self-reported impact of the TVH project on organisation skill (n=11)



Source: Beneficiary Survey Wave 2, Steer-ED analysis (September 2025), 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

“The project has had more of an impact on learning how we ensure hydrogen products are sited, used safely and within regulation on our sites.” – Wave 3 TVH beneficiary survey

“We have developed new skills in manufacturing and assembly.” – Wave 3 TVH beneficiary survey

“Due to the added complexity of using different vehicles and applications, it has resulted in us learning and developing our skills dramatically.” – Wave 3 TVH beneficiary survey

5.3 Beyond the technological knowledge gained, beneficiaries mentioned that the projects enabled them to commence building a business case for launching the technology more widely to make it more commercially viable. They also anticipate acquiring new knowledge via project demonstrations, through collecting data on operators’ experiences, collating key lessons learnt and developing case studies for future use. One project beneficiary mentioned the importance of working directly with government departments, such as the DfT, as well as various hydrogen and vehicle associations, to gain understanding of the regulatory context in which the technology operates and actively engage in advocacy activities. Another project beneficiary also highlighted the benefits of academia working jointly with industry to better understand the technical core of the project and to disseminate findings more widely, both to current students and through academic publications.

“Our work with stakeholders, especially in the commercial environment, helped us understand the alternative fuel technology and its perceived constraints, whether those

are technical or organisational, which has been very valuable.” – Wave 3 TVH beneficiary interview

“As part of the project evaluation, we published a journal paper, which has a positive impact on knowledge development in the hydrogen domain, evidenced by improved understanding of hydrogen technologies.” – Wave 3 TVH beneficiary survey

“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

“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

- 5.4 The following vignette presents a summary from one of the case study projects, showcasing skills and knowledge development and the benefits of this to the project and organisations involved.

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

Element 2 is developing a pioneering, permanent, hydrogen refuelling station at Teesside International Airport (see Appendix C for full case study). 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 has already contributed to an increase in both Element 2’s and IVE’s technical skills and operational knowledge.

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. While 700 bar offers greater fuel density for light vehicles, it requires more complex and costly tanks made of advanced materials like carbon fibre. 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).

The Element 2 team also worked closely with the University of Teesside to perform monthly product quality testing of the hydrogen itself. Full testing could take weeks, but the university developed quicker assessments of the key. Getting more regular data on product quality is valuable for ensuring customers have confidence when refuelling, and with no damage to fuel cells in the process.

The IVE team also reported an increase in their technical skills, knowledge and operational capabilities. The vehicles developed as part of the project were retrofitted with hydrogen fuel cell and powertrain technology to replace the existing diesel engine. The van that IVE developed has comparable weight and height 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 testing was 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 considering this type of conversion.

The role of programmes in creating and safeguarding jobs

- 5.5 Around half of beneficiaries (6 out of 11 responding to the Wave 2 survey) reported that their TVH project had supported existing jobs (19 jobs in total), while three of the beneficiaries said that new jobs had been created (4 jobs in total), including a technical lead, an apprentice and a research fellow (note that two of the three beneficiaries reporting new jobs also reported supporting existing jobs).⁸
- 5.6 In terms of outlook for the future, some of the wider stakeholders interviewed were confident that the hydrogen infrastructure in the Tees Valley has the potential to grow, attract more skilled talent and build the local economy.

"It is about building that ecosystem and getting lots of different organisations to work together. These organisations will hopefully continue their journey and continue to recruit skilled workers into this space." – TVH wider stakeholder interview

"This project has helped support approximately 10 existing jobs across engineering, delivery, operations, and general project management." – Wave 3 TVH beneficiary survey

"We wouldn't be here without the funding. We would have had to apply for research funding in order to pay our wages, so our jobs were certainly safeguarded, and we were able to do this really key work on user reception to hydrogen." – Wave 3 TVH beneficiary interview

Conclusion

- 5.7 TVH project delivery is expected to grow the capability, capacity, resilience, workforce and skills of beneficiary organisations.
- 5.8 A majority of TVH beneficiaries (ten out of the eleven surveyed in Wave 2) reported that their project had positively contributed to skill development within their organisation. This

⁸ Note that for the Wave 1 interim report beneficiaries reported a higher total number of jobs created (9) and supported (30). The lower numbers reported in Wave 2 are not caused by the closure of one of the TVH projects [respondents from that project had reported no new / supported jobs to the earlier survey). Instead, other beneficiaries have reduced their jobs created / supported estimations slightly between the two surveys.

included upskilling and new knowledge in areas such as site design, energy procurement, and permitting, as well as in relation to the commercial viability of their project.

- 5.9 Projects also anticipate acquiring further new knowledge via the project demonstrations, by collecting data and information on operators' experiences, collating key lessons learnt and developing case studies for future use.
- 5.10 Around half of beneficiaries (6 out of 11 surveyed in Wave 2) reported that their TVH project had supported existing jobs (19 in total), while three said that new jobs had been created (4 jobs in total), including a technical lead, an apprentice and a research fellow. Wider stakeholders interviewed were also confident that the hydrogen infrastructure in the Tees Valley has the potential to attract more skilled talent in future.

6 Impacts on wider framework conditions and long-term outcomes

Key Messages

- There is no evidence that TVH projects have so far had any significant influence over wider framework conditions, although it is hoped (expected) that the upcoming demonstration activities will play a role.
- Similarly, it is too early to see wider or longer term outcomes from the projects, although beneficiaries expect contributions to reducing the environmental impact of transport and to developing solutions that can be exported.
- There are also challenges ahead, including a lack of hydrogen infrastructure, the high cost of hydrogen, limited market demand, and regulatory hurdles.

Introduction

- 6.1 This chapter discusses the role that projects have played in affecting trust in, and adoption of, new technologies, plus contributions to the regulatory environment. It then goes on to discuss evidence about potential longer-term outcomes that may be delivered by the portfolio.

The role of projects in driving adoption of new technologies

- 6.2 Via interviews, beneficiaries discussed the extent to which they had observed changes in the acceptance and willingness to use the technologies they are developing. While most said that it was too early to tell, one explained that interest in hydrogen had grown and that their project had already demonstrated a use case to the market.
- 6.3 Two beneficiaries also highlighted that a key strategy for increasing users' willingness to adopt the new technology is to provide opportunities to observe first-hand demonstrations and participate in vehicle trials. However, the limited number of vehicles available currently restricts opportunities to deliver such activities at scale. Beneficiaries were positive that the upcoming project demonstrations could help provide these opportunities.

"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 interview

"I think willingness to use could be increased by making our customers and users aware of our technology and the opportunities that it can bring, because being part of trying to get people engaged with Tees Valley was going out there talking to customers, meeting them, showing them the technology." – Wave 3 TVH beneficiary interview

- 6.4 Wider stakeholders consulted broadly agreed on a growing interest in hydrogen during the life of the TVH programme. Although the picture was mixed, with the view that some firms may also have slowed down their commitment to hydrogen fuel cell technologies during the period.

The role of projects in shaping the regulatory environment

- 6.5 Beyond demonstrating the technologies in question, another potential role of TVH projects was to influence the regulatory framework itself – particularly in identifying areas where regulations are not fit for purpose or where additional regulatory intervention may be required to facilitate technological progression.
- 6.6 One survey respondent explained that the inclusion of government representatives at dissemination events enabled stakeholders and customers to express their views on the uptake of hydrogen vehicle technology. This type of direct engagement with policy makers has the potential to inform or influence policy. Another beneficiary – via interview – also noted that the project had provided the opportunity to engage with governmental bodies and to understand more about their thinking. Having the support of the local government in the Tees Valley was also highlighted as a positive step by interviewees as they could engage with local policymakers first hand.
- 6.7 One interviewee emphasised the need for a coordinated national hydrogen strategy, rather than isolated local or regional approaches. They suggested that closer collaboration between government, industry stakeholders, and OEMs could help define priority areas of focus and identify the types of projects required to support a coherent nationwide hydrogen rollout plan.

"I do know that we had quite a senior representative from the DfT at one of our consortium gatherings where we discussed the regulatory aspects of the project. There was a lot of information being passed back and forth between government and industry partners, so they continue to learn from each other and push things forward on both sides." – TVH wider stakeholder interview

Long-term outcomes

- 6.8 In the Wave 2 beneficiary survey, respondents were asked their view on the extent to which their project would contribute to a range of societal impacts, once fully commercialised. The most commonly selected areas were “reducing the carbon impact of transport”, “reducing other environmental impacts of transport”, and “developing solutions which can be exported globally”. Wave 3 survey findings were similar, with respondents selecting the same three options most commonly.
- 6.9 Beneficiaries interviewed were able to speak about the potential for their technology to deliver long term benefits for the economy and society. They mentioned the following:

Efficiency savings: *“Trucks with fuel cells can go a long distance without having to refuel, which eventually (when hydrogen costs come down) will really drive savings in logistics, and as a result, prices to consumers.”* – Wave 2 TVH beneficiary interview

Cost savings: *“A project like this can prove that the technological approach works and the business case for the technology stacks up, and there could be cost savings for fleet operators who want to convert some of their vehicles rather than buy new ones.”* – Wave 3 TVH beneficiary interview

Economic benefits: *“Production of fuel in the UK leading to less reliance on imports and more control over fuel costs.”* – Wave 2 TVH beneficiary interview

Fleet decarbonisation: *“A lot of companies have got big fleets of diesel vehicles in operation today, and at the moment they don't know what the solution is to transition and decarbonize between now and 2030. Converting a number of those trucks to hydrogenized engines at a fraction of the cost of a fuel cell, if hydrogen is at the right price, it will actually be cheaper for them.”* – Wave 2 TVH beneficiary interview

- 6.10 Wider stakeholders interviewed were also positive about the potential long-term impacts that could be achieved via the technology and identified key enabling factors, including:

Encouraging R&D collaboration: *“The Advanced Propulsion Centre, as well as the Department for Business and Trade are both looking at their hydrogen strategy. The government are also working on their automated vehicle strategy which could include hydrogen, so is the Scottish government. There are some hydrogen schemes running in collaboration between regions in the UK and Europe. It is worth building on those synergies, for instance having conversations with Germany because they are heavily investing in hydrogen.”* – TVH wider stakeholder interview

Regulatory support: *“I think the technology needs a strong signal of government support, because the companies would not invest in it if they do not know that there is willingness*

to accept it. Monetary support is not all that is needed, to allow inverse investment, there needs to be regulatory support. The technology is there, but demand needs to be accelerated.” – TVH wider stakeholder interview

Working at scale: *“This [programme] has to be a catalyst to impact at much larger scale if we talk about heavy goods vehicles (HGVs). More generally, there are something like 600,000 HGVs in the UK running on diesel, and the scale of the challenge to switch all those to 0 emission is what we need to be focused on. If we manage to get to a couple of hundred and then even thousands in five years’ time, we can make a real impact.”* – TVH wider stakeholder interview

- 6.11 Interviewees were positive that these benefits could be achieved (see the following case study vignette for an example). However, they mentioned a number of challenges and barriers including a lack of nationwide infrastructure for hydrogen, the high cost of transport-grade hydrogen, and overall low and slow demand. A set of regulatory hurdles were also discussed, including the current requirement for a large safety distance for hydrogen vehicles (unlike for diesel vehicles), and overly bureaucratic planning and permitting rules.

“The three fundamental hurdles that need to be overcome are vehicle availability, infrastructure and commercialisation, but in time, I think it will happen. I think the infrastructure is growing, there are a lot of projects going on in Bradford and Scotland. Our hope is that the timing of the infrastructure and vehicles will be close, and we can start seeing an increase in hydrogen vehicles going on the road.” – Wave 2 TVH beneficiary interview

Case study vignette showcasing the long-term impacts of one of the technologies being developed

The Teesside International Hydrogen Refuelling Hub project (Appendix C) aims to construct a facility that will serve hydrogen-powered trucks, vans, cars, as well as airport vehicles, providing infrastructure for the growing use of hydrogen as transport fuel. Multiple long-term impacts are anticipated.

- HGVs are responsible for almost a third of the UK’s transport emissions, and the project will allow for an accelerated shift away from diesel. Element 2’s hydrogen comes from sustainable resources, from renewables such as wind or solar, from waste recycling or as an industrial by-product. Replacing the diesel with hydrogen abates 12kg of carbon dioxide emissions.
- There are also benefits associated with the hydrogen vehicle manufacturing and production. IVE’s fuel cells and structural materials are intended to be highly recyclable, reducing end-of-life environmental burden of the fuel cells. 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.

- The investment in infrastructure will further enable the local hydrogen economy to grow, creating jobs, providing training and stimulating further investment in the Tees Valley. This includes manufacturing, production, storage, supply, delivery and vehicles.
- Element 2 is also generating valuable performance data that should help encourage more British manufacturers to embrace hydrogen.
- The UK is currently behind some of the major competitors leading on hydrogen transport such as China and South Korea, however, UK organisations like Element2 could still roll out hydrogen refuelling stations in other countries as global demand for hydrogen grows.

Conclusion

- 6.12 There is no evidence to suggest that TVH projects have so far had any significant influence over wider framework conditions, although it is hoped (expected) that the upcoming demonstration activities will play a role in increasing awareness and interest in the potential of hydrogen for transport.
- 6.13 Similarly, it is too early to see evidence of any wider or longer term outcomes from the projects, although most beneficiaries expect to make contributions towards reducing the environmental impact of transport and to developing solutions that can be exported.
- 6.14 There are also a number of significant challenges ahead, including a lack of nationwide infrastructure for hydrogen, the high cost of transport-grade hydrogen (in comparison with e.g. diesel), overall low and slow demand currently, and regulatory hurdles (e.g. safety distance rules, or planning and permitting requirements).

7 Conclusion & Next Steps

Summary of monitoring findings

- 7.1 This report is structured around the LMT portfolio logic model, which is divided into five themes: programme delivery; partnerships and collaboration; technology development, deployment and commercialisation; skills development; and wider framework conditions. The key findings from the monitoring commission in each of these areas are set out below.

Delivery

- 7.2 TVH awarded £12.5m across three projects to support the demonstration of hydrogen refuelling infrastructure and hydrogen-powered vehicles across transport modes in real world settings.
- 7.3 Projects started in September and October 2023 and were to conclude by March 2025. Two have been extended to March 2026, because of delays to vehicle availability in one case, and delays with securing planning permission and site construction in the other. Activity is therefore still ongoing, with the main demonstration phases still to take place⁹.
- 7.4 The third project was terminated in March 2025 after a full review and because of significant delays in planning and construction of the refuelling station, and knock-on effects from this.
- 7.5 At their latest quarterly assessment, the two live projects were found to be broadly on track with milestones and deliverables, but underspending slightly (due to delays and descopeing). Both were assessed as on course to deliver planned objectives, though perhaps after March 2026.
- 7.6 Beneficiaries spoke positively about their experience of working with IUK, the support from Monitoring Service Providers, quarterly meetings, and events organised. Monitoring expectations and financial management processes were also considered reasonable. Some partners would like more interaction and updates, from IUK and from project leads, as well as across projects.

Partnerships

- 7.7 The TVH programme has enabled the formation of new partnerships within the project consortia, as well as helping to further develop others. It has brought together

⁹ 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.

organisations that often would not have been able to work together otherwise, and provided direct access to potential customers and suppliers, as well as various complementary skills and expertise.

- 7.8 Partner relationships were rated highly by most TVH beneficiaries, with consultees reporting good collaborations and collective hard effort. A small number of partners felt that they could be more integrated into the wider project through greater information exchange.

Development, deployment and commercialisation

- 7.9 With the ongoing projects about to move into the demonstration phase, there is limited evidence to report at this stage in terms commercial progress.
- 7.10 However, in both cases the projects are clear that the funding is enabling them to bridge the market gap, and to start producing hydrogen vehicles and infrastructure, despite a lack of demand and high costs. They also remain positive about future opportunities for wider rollout.
- 7.11 Beneficiaries also suggested that a substantial amount of dissemination activity (social media, media, conferences / events, academic publications) is planned for later in projects, alongside the demonstrations. 74 media items relating to the projects from the past year have been identified, with the Refuelling Hub accounting for approximately two thirds of this (with articles the application and granting of planning permission and the start of work to build the hydrogen refuelling station). The projects have been picked up in airport-related publications and energy-related media, as well as other local, national and international sources.

Skills

- 7.12 A majority of TVH beneficiaries reported that their project had positively contributed to skill development in their organisation, including in areas such as site design, energy procurement, and permitting, as well as the commercial viability of their project.
- 7.13 Projects also anticipate acquiring further new knowledge via the demonstrations, by collecting data and information on operators' experiences and collating key lessons.
- 7.14 Around half of beneficiaries (6 out of 11) reported that their TVH project had supported existing jobs (19 in total), while three said that new jobs had been created (4 jobs in total). Wider stakeholders were also confident that the hydrogen infrastructure would help attract more skilled talent in future.

Wider outcomes and impacts

- 7.15 There is no evidence to suggest that TVH projects have so far had any significant influence over wider framework conditions, although it is hoped (expected) that the upcoming demonstration activities will play a role in increasing awareness and interest.
- 7.16 Similarly, it is too early to see evidence of any wider or longer term outcomes from the projects, although most beneficiaries expect to make contributions towards reducing the environmental impact of transport and to developing solutions that can be exported.
- 7.17 There are however challenges ahead, including a lack of nationwide infrastructure for hydrogen, the high cost of hydrogen, limited market demand, and regulatory hurdles.

Next steps for the programme

- 7.18 TVH demonstrations will soon begin, showing the use of hydrogen as a fuel for a range of equipment and vehicles, and demonstrating refuelling infrastructure.
- 7.19 Although the TVH programme is soon coming to an end, several recommendations were made by beneficiaries that could be taken forward in other future initiatives. For instance:
- Ensuring quick turn around on competitions and grant awards, allowing sufficient time for projects to be fully implemented.
 - Increasing communication between IUK (and lead contractors) and the wider consortia
 - Increasing knowledge sharing across projects and between programmes
- 7.20 One of the project leads was also keen to highlight that future hydrogen transport programmes and initiatives should look to take a ‘whole system’ approach, including real-life demonstrations, but also supporting infrastructure development, and the wider supply chain at the same time, in a coordinated and joined-up way.
- 7.21 As there are now only two projects in the programme and both are only now entering demonstration phase, there is currently limited knowledge of the programme and projects outside of those who are directly involved. Looking to the future, stakeholders therefore spoke more generally about supporting hydrogen for transport, rather than specifically about the TVH programme.
- 7.22 They reported that the cost of hydrogen (e.g. compared to diesel) remains a big challenge. A decision (expected in 2026) on enabling the blending of hydrogen into the national gas grid could have a big impact on this, but it is likely to continue to be an issue, and be part of the reason for an ongoing need for public investment. The other major challenge is refuelling infrastructure, which is still very limited. Stakeholders pointed to examples in other countries (e.g. Germany and China), where there had been significant recent investment in building national hydrogen infrastructure). In the short term, stakeholders felt that continuing to focus on several specific geographical areas (hubs, clusters or corridors) for hydrogen refuelling/ transport demonstrators was the priority in the UK, with a coordinated approach and investment across infrastructure, vehicles / technology and early users. Several interviewees pointed to a new hub(s) developing in South Wales and along the M4 corridor as a positive example of this.

Recommendations for future evaluation

- 7.23 Impacts of the programme will only become clear over time, as the demonstrations are run, evidence collected and disseminated, and as the results are taken forward, for further development or into the market. Further monitoring and evaluation in future will therefore be important to capture these outcomes.

Economic impact analysis over the longer term is also needed to capture job creation and safeguarding, company growth, inward investment, licensing and exports. Capturing these indicators, together with supply chain development and follow-on finance raised, will be critical to assess the programme’s contribution to growth and the wider industrial strategy.

Appendices

A Sources of evidence utilised

Monitoring data analysis

- A.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

- A.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

- A.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.
- A.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)

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

Analysis of secondary data sources

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

Crunchbase

- A.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.

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

Table A-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.

- A.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).
- A.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.
- A.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

- A.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.
- A.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.
- A.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

- A.18 Dimensions is a comprehensive research database that provides patent and publication data. 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](#). Access was granted under licence agreement with UKRI.
- A.19 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.
- A.20 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.
- A.21 It should be highlighted that for Wave 3 specifically¹⁰:
- 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

- A.22 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,

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.

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.

- A.23
- 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).

- A.24
- Table A-2 shows the beneficiary survey response rates and number of responses from unique organisations within each of the seven programmes.

Table A-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

- A.25
- 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

- A.26
- 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

- A.27 As Table A-1 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.
- A.28 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

- A.29 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 A-1 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.
- A.30 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 A-1: Beneficiary 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

- A.31 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.
- A.32 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.
- A.33 Learnings from these interviews, supported by quotations, have been provided throughout this report.

Case studies

- A.34 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.

B 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 2025¹¹. 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:

¹¹ <https://ulemco.com/ulemco-achievement-in-another-pioneering-project/>

	• 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 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.¹²

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.

¹² 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.

	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.

C 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 demand¹³. 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. 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

¹³ 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).

	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.

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Steer project/proposal number	Client contract/project number
Our ref: 245-747-02	
Author/originator	Reviewer/approver
Neil Brown, Inna Yordanova	Josh Stott, Ali Memory
Other contributors	Distribution
Adebisi Adewusi, Isabel Claydon, Morgan Anthony	Client: Steer:
Version control/issue number	Date
LMT monitoring report: progress and insights from the TVH Programme - DRAFT	26 September 2025
LMT monitoring report: progress and insights from the TVH Programme - FINAL	31 October 2025
LMT monitoring report: progress and insights from the TVH Programme - Wave 3 Draft	13 February 2026
LMT monitoring report: progress and insights from the TVH Programme - Wave 3 Final	20 March 2026

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