EVALUATION OF UK SHORE

Interim process and impact evaluation findings

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1   Executive Summary

1.1   Context

The Department for Transport (DfT) launched the UK Shipping Office for Reducing Emissions (UK SHORE) in March 2022, with total funding of £206 million.[1,2] UK SHORE aims to address maritime emissions and create skilled jobs across the country by accelerating the research into, and development of, clean maritime technologies.

DfT has commissioned Frontier Economics and SYSTRA Ltd. to design and lead the process, impact and value for money evaluation of the UK SHORE portfolio as a whole, and of its individual schemes. The aim of this project is to generate robust evaluation evidence on whether UK SHORE is on track to meet its objectives and if so, what is working well, what is not, why and for whom.

This report is a summary of findings from the **interim evaluation**:

■   The process evaluation covers all 4 of UK SHORE's main schemes (see Section 1.2) and the UK SHORE portfolio as a whole.

■   The impact evaluation is a preliminary assessment of early outcomes of the schemes that were feasible to report on at this time, namely the first 2 of 4 Clean Maritime Demonstration Competition (CMDC) rounds, 1 years of annual Transport Research and Innovation Grants (TRIG) funding rounds (2021 and 2022), and first 6 months of the 42-month Clean Maritime Research Hub (the Hub). It also includes a very early portfolio-wide assessment. Importantly, CMDC3, CMDC4 and Zero Emission Vessels and Infrastructure (ZEVI) (some of the largest schemes) are not covered in this interim impact evaluation because these schemes are still in the early stages, and so monitoring and other data are not available to assess their outcomes and impacts.

The work will be followed with a framework for a 'Future Evaluation Framework' to assess UK SHORE out to 2028 in spring 2025 and a final evaluation in autumn 2025, covering all schemes and the portfolio in both the process and impact evaluation.

1.2   The UK SHORE portfolio

The current UK SHORE portfolio includes several schemes, with funding committed to the end of 2025. This evaluation focuses on the 4 main schemes:

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[1] DfT launches UK SHORE to take maritime 'back to the future' with green investment, 10 March 2022.

[2] In addition to £23 million of funding for CMDC1, prior to the establishment of UK SHORE.

- CMDC, a total of £129 million to 2025 in match funding over 4 rounds for mid technology readiness level (TRL) maritime decarbonisation technology (see Annex D for more detail).[3]

- ZEVI, a total of £80 million in match funding for high TRL research. Funding is available until March 2025, with project partners providing funding to cover demonstration for at least 3 years from April 2025.

- Early Research Grants, including TRIG and the Hub:

  - TRIG provides 100% grant funding of up to a maximum of £45,000 for proof-of-concept research projects, with cohorts running every year (this evaluation considers TRIG21 and TRIG22; additional funding was offered in TRIG23 and will be offered in TRIG24).

  - From September 2023 to March 2027, UK SHORE and the Engineering and Physical Sciences Research Council (EPSRC) are providing £7.4 million to fund a flagship UK Hub, made up of 13 universities and led by the University of Durham.

In addition to the 4 main schemes, UK SHORE has recently announced 2 additional schemes: CMDC5 – The International Green Corridor Fund and Smart Shipping Acceleration Fund (SSAF), providing £1.5 million and £8 million respectively to support specific clean maritime challenges. These schemes are not in scope as they were not announced at the point when this evaluation was designed.

Schemes are delivered with support from delivery partners including Innovate UK (IUK), EPSRC and the Connected Places Catapult (CPC) and facilitate partnerships and collaborations with industry and academia to further accelerate the development of clean maritime technologies. The University of Durham is leading the Clean Maritime Research Hub.

An important feature of the UK SHORE portfolio is that it supports technology from a range of TRLs. Figure 1 shows the illustrative distribution of TRL across schemes.

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[3] This includes the £23 million of funding for CMDC1, prior to the establishment of UK SHORE.

Figure 1 Illustration of target TRL distribution across schemes
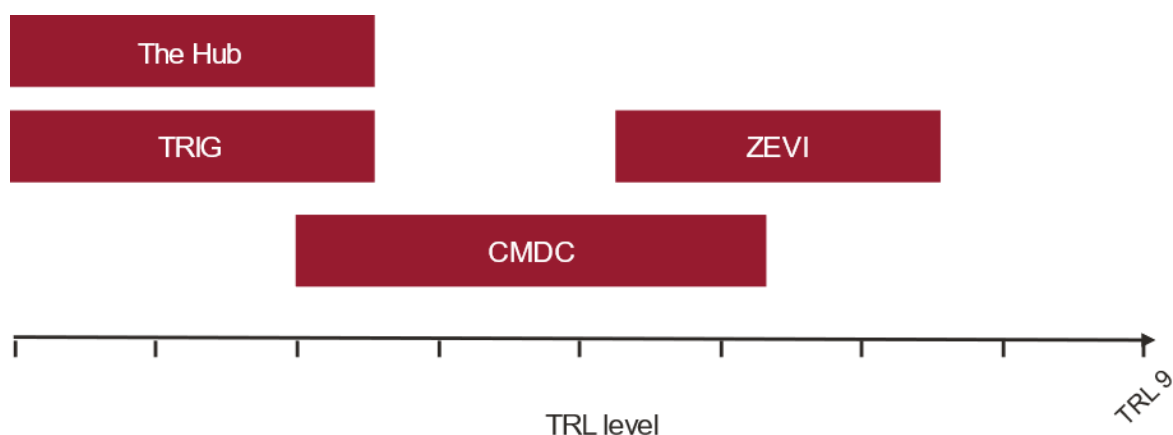
Source: Frontier Economics.

Note: Illustrative, individual projects within portfolios may differ.

The scale of funding differs across schemes. Table 1 shows the allocation of funding across the 4 main schemes included in this report, as well as the split of funding within projects. The majority of funding is to mid and high TRL schemes (CMDC and ZEVI).

Table 1 Public grant funding provided by scheme, 2021 to 2025 (£ million)

Scheme	Number of projects	Average funding per project	Total grant funding
CMDC1	55	£422,000	£23.2 million
CMDC2	31	£279,000	£14.9 million
CMDC3	19	£3.4 million	£63.6 million
CMDC4	34	£957,000	£32.6 million
TRIG21 and 22	26	£30,000	£78,000
ZEVI	10	£9.3 million	£93.3 million
The Hub	1	Not Applicable	£7.4 million

Source: Baseline monitoring data.

Note: Average funding is not reported for the Hub as it is only 1 project. Funding for later TRIG schemes was up to £45,000.

1.3 Evaluation methodology and limitations

The evaluation has been informed by evidence sources available at this early stage:

- **Winners' data**: Administrative data collected for the winning applicants of CMDC1 through 4 and ZEVI (eg project location, funding allocated, type and size of delivery partners).

- **Baseline and end-of-project monitoring data**: For TRIG and CMDC, surveys were conducted by the relevant delivery partners at the start and the end of the schemes. For the Hub, DfT conducted surveys of all organisations involved at the start and end of the first financial year of the Hub. Each scheme was analysed using a separate dataset of monitoring data: CMDC data contained over 400 responses, TRIG data contained 24 responses and the Hub contained 13 responses.

- **End-of-project reports**: CMDC and TRIG participants submitted end-of-project reports (79 CMDC reports and 25 TRIG reports) while the Hub submitted a report at the end of their first year. For the process evaluation, qualitative evidence was taken from a randomly selected sample of 16 CMDC reports. The interim impact evaluation used statements from CMDC and TRIG end-of-project reports and drew on self-assessment from the Hub end-of-year-one report.

- **Survey data (Online survey)**: An online survey was carried out in December 2023 of all successful applicants. Fifty-two applicants responded to the survey, spread across CMDC (38 responses), TRIG (7 responses), and ZEVI (7 responses), representing 37% of successful applicants. For this interim report, the survey focused heavily on the process evaluation.

- **Applicant interviews**: 17 in-depth interviews with CMDC1, CMDC2, ZEVI, TRIG and the Hub participants, both successful and unsuccessful, were carried out, with an emphasis on the process-related aspects of UK SHORE.

- **Delivery partner interviews**: 3 interviews were undertaken with organisations involved in the oversight of the delivery of the UK SHORE portfolio, again focused primarily on the process.

- **Stakeholder interviews**: 3 interviews were carried out with organisations involved in wider aspects of the delivery of the UK SHORE portfolio, including the DfT and the Maritime and Coastguard Agency (MCA).

- **Business case**: The scheme-level business cases have been used to benchmark outcomes, for example job creation can be compared to levels expected in DfT modelling and whether or not outcomes and impacts set out in the logic model have been achieved to data can be compared to expected timescales for these to materialise.

The findings in this interim report should be taken in the context of the wider evaluation, which is at an early stage. Key limitations of the evidence relied on for this initial interim report include:

- **Online survey**: The online survey received 38 responses from applicants to CMDC competitions, with a response rate of 36% for successful applicants. The number of responses from TRIG and ZEVI applicants was 7 for each, with response rates of 54% for TRIG and 70% for ZEVI. As a consequence, limited statistical analysis can be undertaken from this survey, and survey results are presented as absolute numbers rather than percentages.

- **Interviews**: Due to the relatively small number of interviews and the timing of this evaluation activity, views and related quotes at the project level should be considered anecdotal and illustrative to the quantitative findings. They represent the views of each individual interviewed in their professional role rather than representing the competition or portfolio as a whole. Where multiple interviewees have described the same, or similar, experiences, this is made clear in the report, and such findings can be regarded as more conclusive, bearing in mind many projects are still delivering and perceptions may evolve during and after the delivery period.

- **Secondary qualitative data, including end-of-project reports:** A number of secondary qualitative sources were used to add insight and examples to the quantitative data, including a thorough review of documentation provided by the UK SHORE team, such as Lessons Learnt reports and end-of-project reports compiled by project teams. Time and resource constraints meant it was not possible to review all 105 end-of-project reports in depth for this interim evaluation. Around 20% of CMDC reports were reviewed for the process and impact evaluations separately, while all TRIG reports were reviewed at a high level. This evidence should be considered primarily anecdotal and not necessarily representative of views across the whole programme.

- **Baseline and end-of-project monitoring data**: These secondary data sources have good coverage across all projects, but there is some evidence of noise in the data (eg multiple conflicting responses by the same organisation for a given project, outliers in quantitative responses, difficulty interpreting TRL and Commercial Readiness Level [CRL] responses). The sample size for TRIG21 and TRIG22 is small, with only 24 responses in total, reflecting the small number of projects overall in these cohorts. Additionally, some project impacts are intrinsically difficult to measure consistently across projects (eg emissions savings) which limits data comparability. Where responses are used in the impact evaluation, the relevant caveats are highlighted. Higher project coverage in monitoring data compared with the survey means we present results using a mixture of percentages and absolute numbers.

1.4 Early process evaluation findings and future considerations

A process evaluation looks primarily at what worked and what could be improved in relation to the delivery of an intervention (HMT Magenta Book, 2020).

The process evaluation for UK SHORE considers the set-up of the competitions, working processes, and experiences of applicants from application through to delivery. The evaluation

provides evidence of lessons learnt for improving the design and delivery of UK SHORE and other similar schemes in the future and includes a focus on the core inputs, activities and outputs outlined in the logic models (see Annex E). The aims of this process evaluation are to understand:

■   to what extent interventions have been delivered as planned – what was changed and why

■   how far delivery processes have supported the realisation of intended activities and outputs

■   which elements of the scheme delivery are potentially transferable to other programmes

■   the barriers and enablers to delivery of the projects funded by UK SHORE

■   what elements of the schemes have worked well to date, and what could be improved

■   the experiences of applicants (successful and unsuccessful) in applying to the schemes

The process findings and considerations presented in this report are based on research conducted in 2023 and 2024. They, therefore, constitute interim findings as several UK SHORE competitions are still running, and funded projects are still in the delivery stage.

Competition Stage

Competition participants surveyed showed a good awareness of the range of competitions across the portfolio, and nearly all would participate in such competitions again. Further, a number of participants interviewed indicated they had already participated in other competitions. Stakeholder and delivery partner organisations shared that competition design was an iterative process, with lessons learnt across rounds and from different competitions. Applicants also unanimously agreed that the strategic objectives of UK SHORE are clear and that these objectives were carried through the portfolio of competitions:

> *"Each competition, we continue to review, rewrite, review that and see what additional things we could potentially tweak or enhance as we go forward, for every competition."*
>
> **Delivery organisation**

Other interview participants highlighted that gathering funding and funding overheads can be a challenge for smaller organisations and that the financial and resource burden was often high. This was more associated with the ZEVI and CMDC competitions, while TRIG was considered quicker and easier to apply for. DfT understands the importance of the industry being prepared for the grant funding process, to enable them to identify and allocate the required resources.

Future Consideration: Ensure DfT continues to provide as much advance warning of competitions as feasible and information and networking opportunities to support organisations.

The majority of survey respondents (42 out of 52) were satisfied with the information and guidance provided by the organisation leading the competition at the bidding stage (see Figure 2).

Figure 2   To what extent were you satisfied or dissatisfied with the information and guidance provided by the organisation leading the competition?
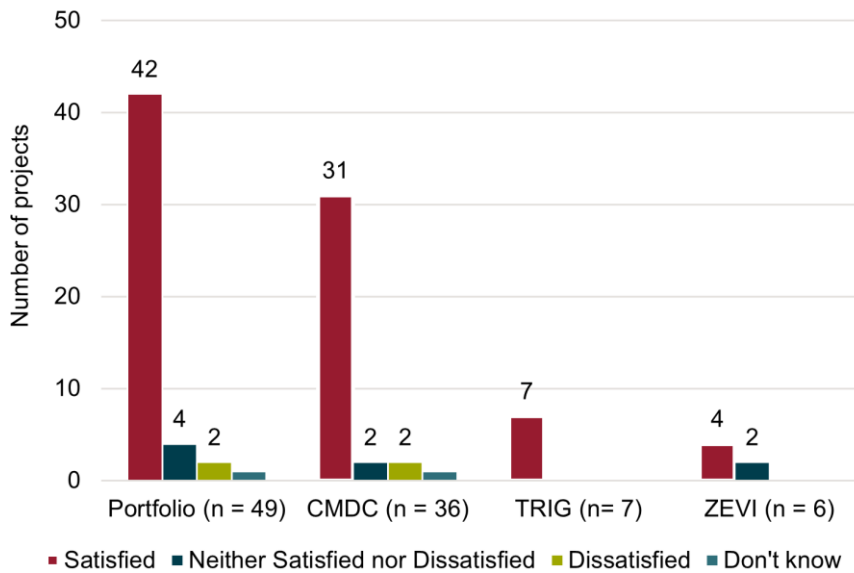
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

Interviews conducted with both successful and unsuccessful applicants generated largely positive feedback on the level of clarity of guidance on the bidding process. Some interview participants would have liked to see more regular engagement from DfT and MCA at an earlier stage, but organisations and applicants noted that the awareness of the regulator and the role of regulatory processes is increasing over time among projects and in delivery organisations.

Future Consideration: Ensure early involvement from both DfT and MCA to widen their knowledge and awareness of the wider portfolio and regulatory processes and requirements.

Around a fifth, 11 out of 49 survey respondents, were dissatisfied with the amount of time available to prepare bids. Figure 3 shows responses across competitions.

Figure 3   To what extent were you satisfied or dissatisfied with the amount of time you had for preparing your bid?
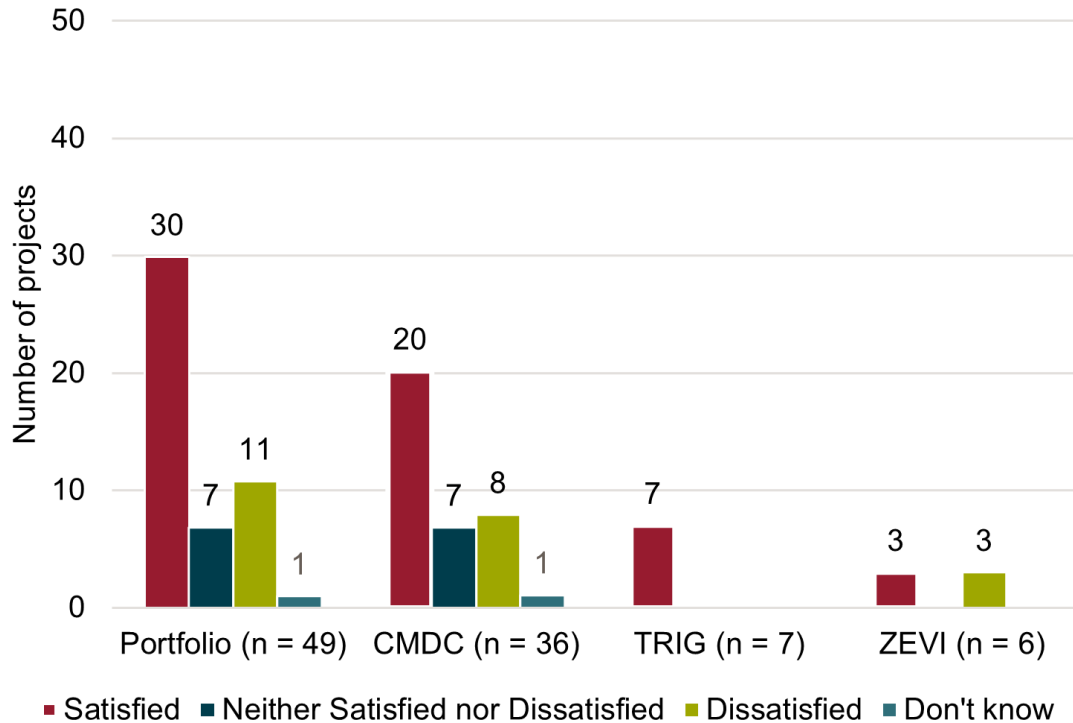
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

For CMDC, satisfaction decreased as the timescale for submissions decreased through the competition rounds. Findings also indicated that some organisations who perceived themselves to be less experienced in bidding needed additional support, with some using the services of professional bid writers. Interviews with applicants indicated that those who found the time available to prepare bids sufficient were used to quick turnarounds. Those who found there was not enough time attributed this to the time-consuming nature of approval processes in large consortia and meeting the requirement for match funding. Smaller applicant organisations found UK SHORE knowledge-sharing events more useful than other, larger organisations. Delivery partners and stakeholders indicated they would like to announce competitions sooner and have a longer window of time for applications. However, they recognised this is difficult due to government processes. Simultaneously, they noted the competitions have become increasingly competitive over time, and 1 delivery organisation described finding reviewing the volume of applications challenging in comparison to the number of technical reviewers they had.

Future Consideration: Align with the 3-month industry-standard timescale for applications. Review the support offered to applicants across the delivery organisations and competitions to ensure consistency in the level of contact organisations have with competition delivery partners. This may help better support those less experienced in competition processes.

Both successful and unsuccessful applicants interviewed expressed some concerns about the perceived insufficient technical knowledge or experience of assessors and a perceived discrepancy between scoring on written and interview stages of the assessments:

> *"[In the interview], I was asked a question by somebody who in my judgment, and I must stress this [was in his judgment], was not particularly well versed in the subject."*
>
> **ZEVI unsuccessful applicant**

Delivery partners and stakeholders were aware of these perceived issues and looked to address them; for example, 1 delivery partner noted they now include a relevant policy lead at the interview stage. Firstly, they noted that the pool of assessors is limited given the niche nature of the industry, but that they have taken steps to increase the number of assessors and noted a particular need for those with regulatory experience. Secondly, delivery organisations described purposefully designing assessments to comprise both written and interview components, as they found this two-stage process enabled a more thorough assessment of projects' feasibility. It was also observed that some applicants would use professional bid writers for the written aspect of their proposals.

Delivery partners were generally content with the processes in place for assessment, and with the demographic diversity of assessors, but acknowledged that that feedback on bids was limited due to resource constraints.

Future Consideration: Where possible, advise applicants on the level and type of feedback to be provided. Additionally, provide transparency on successful bids and consider if there are ways to increase the quality and quantity of feedback to aid future bidding.

Some applicants, particularly unsuccessful ones across different competitions, noted that the same organisations were consistently successful; evidence from winners data found that 30% (110) of organisations were involved in multiple UK SHORE schemes. This was also observed by delivery organisations and stakeholders but was not necessarily considered a negative outcome. Aligned with the UK SHORE programme objectives, stakeholder organisations noted that the competitions are, to some extent, designed to 'ramp up' projects through different stages and TRLs and provide an 'innovation pipeline'. As such, some further consideration of transparency and messaging regarding successful bids may be beneficial.

Future Consideration: Ensure the messaging around competition outcomes is transparent and appropriately framed.

Mobilisation

Nearly all survey respondents across the portfolio were satisfied with the timely notification of the outcome of their bid, and with the timeliness of allocation of funding (see Figure 4). Most interviews with successful applicants echoed this, although the timescale between notification, and having to commence work for the Hub, was felt to be particularly short.

Figure 4   **To what extent were you satisfied or dissatisfied with the timeline of notification of the bid outcome**
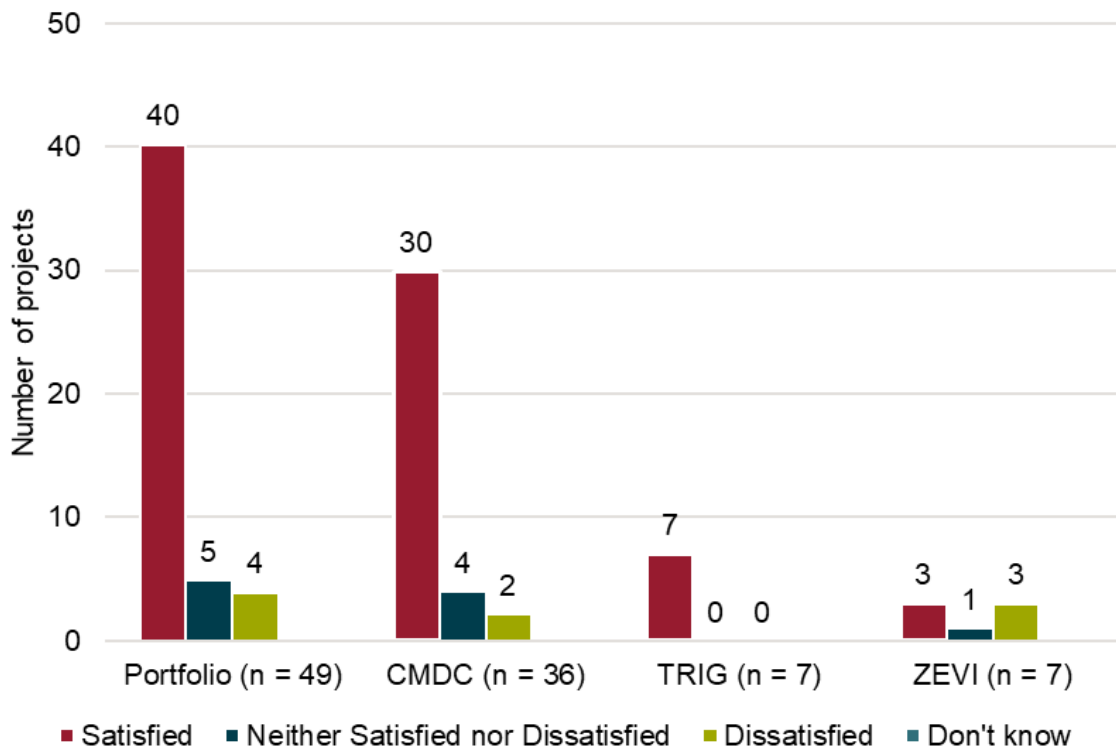
Source: *Online survey.*

Note: *'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.*

Respondents to the survey of successful applicants across the CMDC, TRIG and ZEVI competitions were largely satisfied with how change requests were managed. Looking at all the competitions together, 30 of the 52 respondents indicated they were satisfied with this. However, levels of satisfaction were lower here than across other elements of the competition.

Future Consideration: Review the efficiency and effectiveness of change control procedures.

Project Delivery

The majority of survey respondents experienced barriers to delivery, with barriers shown in Figure 5.

Figure 5   To what extent did you experience any of the barriers below in the delivery phase of your project? (multi-response)
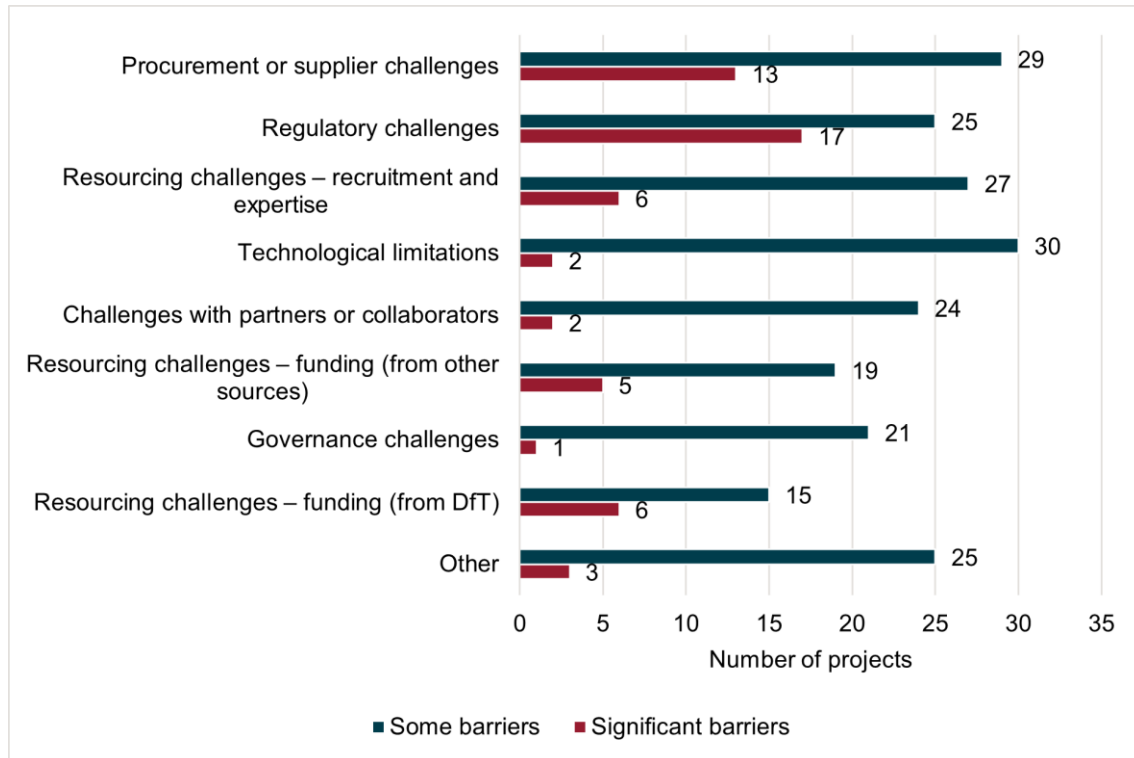
Source: Online survey.
Note: From a base of 53 respondents across the CMDC, TRIG and ZEVI competitions. Percentage of projects which had experienced either significant or some barriers with different project elements.

Of the 52 respondents, 42 experienced 'some' or 'significant' barriers with regards to 'regulatory challenges' or 'procurement or supplier challenges', and 21 respondents were satisfied with the support they received regarding necessary regulatory approvals. Despite this, qualitative evidence shows that most achieved their planned objectives for their projects. Recruitment and technology were also an issue: nearly two-thirds of respondents (32) to the online survey experienced 'some' or 'significant' barriers with recruitment or technological limitations. In addition, up to half of respondents experienced some or significant barriers with other aspects: challenges with partners or collaborators (26), funding (DfT 21, other 24), and governance (22).

In interviews, delivery partners expressed having developed a closer working relationship with MCA over time, including having MCA provide guidance to applicants and projects, as well as

helping with assessing applications. This increased engagement from MCA was welcomed by all parties:

> *"I would argue that the early rounds of the CMDC, we were not sufficiently involved in the appropriate fashion. We were involved, but we were involved as a recipient of the project, not as a designer of the programme. That's a failing from both the UK SHORE and an MCA point of view, because corporately, neither group really understood what would be needed, and I think we've collectively learned and fixed that as we've moved forward … we are taking a much more active role now."*

MCA

Future Consideration: Review how engagement with regulators can be best facilitated throughout the lifecycle of the projects.

In the survey, 47 of the 52 respondents were satisfied with the guidance provided by delivery partners at the delivery stage. Qualitative feedback noted that not all successful applicants felt that their Monitoring Officer had the technical or industry knowledge to support them but were able to support them on a project management level. Delivery partners noted that mixed feedback on Monitoring Officers had been received. Also, delivery partner organisations expressed that they would like to be able to offer more support in financial and investment planning.

Future Consideration: Review how project teams are supported from a technical point of view throughout the lifecycle of the projects, covering wider issues such as health and safety, and financial planning.

Future Consideration: Ensure the remit of the Monitoring Officer is made clear to project teams at the outset, and that communication channels to regulatory bodies are also clearly defined.

Survey respondents across successful applicants of CMDC, TRIG and ZEVI mostly reported being satisfied with elements of the monitoring and reporting requirement during project delivery, with the majority (44 of the 52 respondents) agreeing that the nature of the data and information requested was appropriate; that the timescale of the requests was appropriate (43); and that the format of templates and reports was clear and easy to understand (38). Qualitative feedback highlighted some challenges that arose, with the structure of reporting only being defined at a late stage, and information requirements that felt repetitive.

Future Consideration: Ensure clear expectations for reporting are set out at an early stage and ensure this is communicated effectively to all relevant parties.

There were mixed levels of satisfaction with the engagement and knowledge sharing with other participants in the competition. Across all competitions, 17 of the 52 respondents were satisfied, 24 were neither dissatisfied nor satisfied, and 6 were dissatisfied. Likewise, qualitative feedback on knowledge-sharing activities was relatively neutral. Stakeholder and delivery partner organisations expressed an ambition to improve knowledge sharing for project 'alumni' and unsuccessful applicants by planning for this at an earlier stage. The organisations

noted such engagement could help retain both successful and unsuccessful applicants, maintain their interest in UK SHORE, and generate future collaboration and investment in the decarbonisation of the maritime sector.

Future Consideration: Maximising the opportunities for knowledge sharing and engagement between project teams, delivery partners, DfT and other core stakeholders should remain a priority for the UK SHORE programme, as well as exploring new ways to increase opportunities and participation.

1.5   Preliminary impact evaluation findings and future considerations

The impact evaluation draws on best practice guidance for evaluation as outlined in the TAG unit E-1 and the Magenta Book (HMT, 2020). In line with the validated Theory of Change that was developed as a part of the UK SHORE Evaluation Framework in November 2023 (see Annex E for the logic models summarising the Theory of Change), the impact evaluation is organised around a set of evaluation questions (EQs):

1. To what extent and through what mechanisms did UK SHORE help to accelerate and support the development of clean maritime technologies relative to what would have happened in the absence of UK SHORE?
2. To what extent and through what mechanisms can environmental benefits be attributed to UK SHORE?
3. To what extent, and through what mechanisms, did UK SHORE improve the commercial prospects and opportunities for clean maritime in the UK?
4. To what extent is there evidence that UK SHORE has generated positive spillover benefits?
5. To what extent has UK SHORE achieved wider social objectives?

The extent to which outcomes and impacts will have materialised by this stage is limited. Much of the focus is, therefore, on understanding what inputs have been used, what activities have been undertaken (discussed in the process evaluation), what outputs have been delivered and the extent to which these outputs are in line with those intended as reflected in the UK SHORE business case. The focus is also on what can be learnt about short-term outcomes through the quantitative data that is available, or that can be collected through primary research, alongside qualitative data from applicants' and delivery partners' perceptions of the contribution and additionality of UK SHORE. For earlier schemes where longer-term outcomes may be expected to have started (such as CMDC1 and TRIG21), follow-on evidence is not available to assess these outcomes. In addition, findings related to the Hub must be caveated since data is only available for around 6 months of a 42-month funded scheme.

This impact evaluation does not include CMDC3, CMDC4 and ZEVI. The total grants allocated to these schemes makes up around 90% of the £206 million of UK SHORE funding and so any portfolio-wide assessment fails to capture a significant majority of UK SHORE's expected impact.

In the following sections, 'CMDC' refers to CMDC1 and CMDC2 and 'TRIG' refers to TRIG21 and TRIG22.

Development of clean maritime technologies

As outlined in Figure 6, UK SHORE funding has **supported technology across a range of technology readiness levels (TRLs)**. This is in line with the objectives of UK SHORE:

> *"From the beginning … there was always a clear strategic objective behind the UK SHORE programme that we wanted to address challenges at all levels of the technology readiness scale."*
>
> DfT

Self-reported responses of success indicate that this **funding has been successful at improving technology**. In monitoring data, 83% of CMDC projects and 88% of TRIG projects reported their project was successful. Early indications suggest the Hub is performing well against its Key Performance Indicators (KPIs), including research, publications and conferences.

Fewer than half of CMDC projects reported TRL improvement between the start and the end of projects. Some projects reported a decrease in TRL during their project. These were typically in feasibility study project-types (13 out of 14 reported declines). This suggests that project testing and validation highlighted problems which required returning to an earlier design phase. However, insufficient evidence is available to validate this hypothesis directly or to determine why reported TRLs declined in other contexts.

Figure 6   TRL development for CMDC
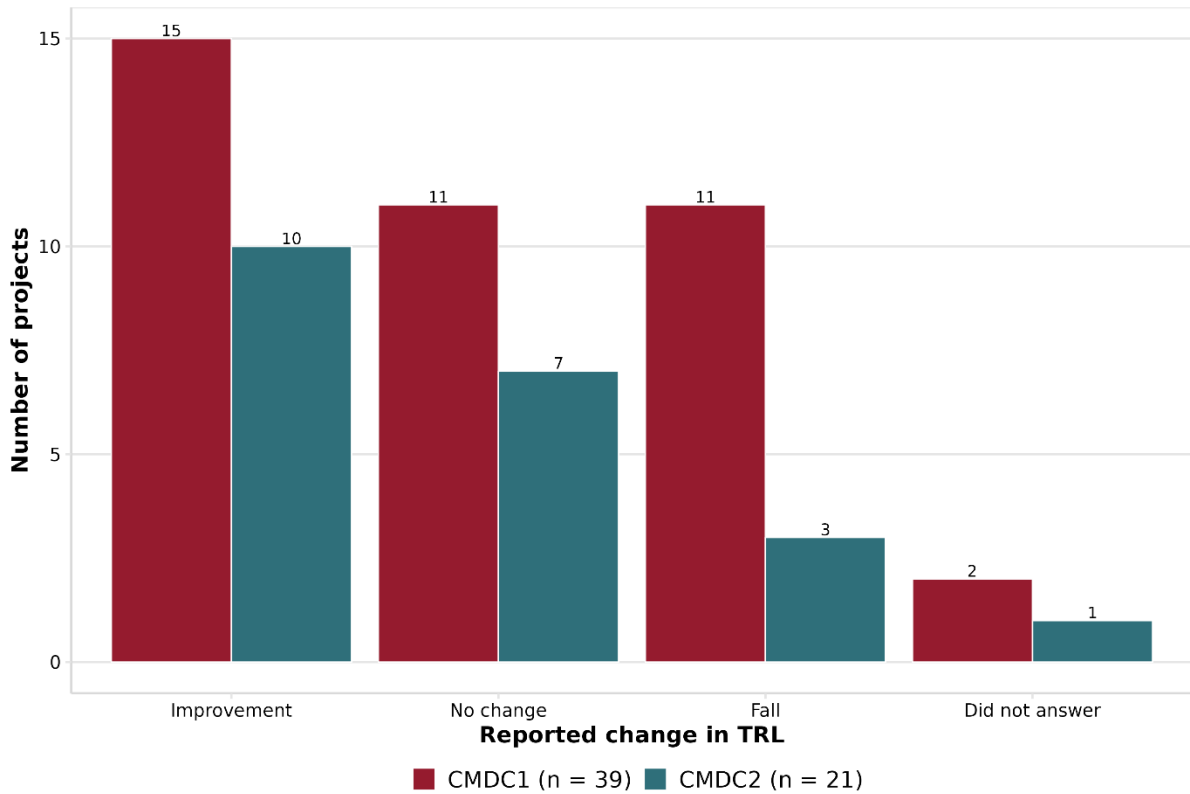
Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: Compared answers to the question: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)', asked at the start and the end of projects.

All TRIG projects reported TRL progress when asked directly about the level of progress they had achieved as part of the end-of-project monitoring survey. However, the level of progress reported by some projects was not consistent with the actual TRL they reported in the monitoring survey at the start and then at the end of their projects. These indicated only 13 out of 17 respondents saw TRL development. This data inconsistency could suggest reliability issues with the data, likely stemming from the self-reported nature. In either measurement, development has exceeded business case expectations that projects may move up within a TRL, rather than up to the next level. It is surprising that a more significant proportion of TRIG projects saw TRL progress compared with CMDC, given higher funding for CMDC projects, although TRIG focuses on earlier TRL investments, and it may be less costly to move projects along until they are nearer to readiness.

Only a limited number of Hub research projects could be matched between the baseline and end of year 1 survey and so it was not possible to assess the extent of TRL development. On average, the TRL of projects is higher at baseline than at the end of year one but this is not a like-for-like comparison as consistent projects are not used to calculate the averages.

Improvement in TRL is a common success indicator for research and innovation programmes, suggesting that public support has helped ideas progress towards commercial potential. It is, of course, possible for TRL to regress as innovation is not a linear process: projects may reveal that technologies are not at the stage of development envisaged. Indeed, this potential was built into scheme-level business case expectations for UK SHORE, reflecting the uncertain innovation process. One benefit of funding might be that some projects 'fail faster', allowing funding and resources to be redeployed. At the same time, it has not been possible to ascertain with confidence whether examples of TRL regression we saw in the data reflected data issues or were genuine reflections of what happened on specific projects. The conflicting evidence in some data, even within the scheme, suggests that data quality is at least a factor in play. This is an issue that will be explored in more depth in the final evaluation.

Future Consideration: Review how TRL and project technology outcomes are monitored so that the results can be more clearly interpreted. This will be encompassed in participant surveys at future stages of this evaluation.

In the monitoring data, most CMDC (83% of CMDC1, 86% of CMDC2) **organisations reported positive experiences with their consortia** and intentions to continue working with collaborators. In both the monitoring data and survey data, most CMDC respondents also reported gaining long-term benefits associated with collaboration, such as developing collaborative skills and building new partnerships.

Collaboration was a key theme for TRIG with the majority of survey respondents reporting having between 1 and 5 collaboration partners. End-of-project reports highlight benefits including plans to apply for additional funding with collaborators, commercial benefits via sales offers and operational requirements.

All evidence sources highlighted the **benefits of collaboration from the Hub**; this relates to collaboration within organisations involved in the Hub, with other academics and research bodies and with industry partners. In interviews with delivery partners, the Hub lead emphasised that the scale of the Hub allowed them to get buy-in and collaborate with a broader range of stakeholders (both academic and from industry) than they may otherwise have been able to:

> *"If it was just a small project, we'd never have got that interest and that kind of investment. It triggers more buy-in from stakeholders and more sense of an idea that something more tangible is going to come out from the activity."*

Hub Lead

Across all schemes, UK SHORE's success in connecting organisations across the clean maritime sector will likely aid future technology development, even if, in some cases, it is too early to see significant technology development to date (for example, limited TRL progress for CMDC projects).

The majority of CMDC participants (63% of CMDC1 and 78% of CMDC2 participants) reported in monitoring data that they **would not have gone ahead without UK SHORE funding**, with a significant minority reporting that they would have proceeded but at a slower pace (29% of CMDC1 and 16% of CMDC2 participants) or smaller scale or scope (21% and 14%). Some stated that they would have experienced both a slower pace and smaller scale without UK SHORE funding: 15 CMDC1 participants and 7 (8%) CMDC2 participants. **No participant reported that the project would have continued unchanged**.

All TRIG projects felt that the TRIG programme **helped their project process towards proof of concept or feasibility**. The majority of TRIG21 projects indicated that the funding meant they undertook specific work they would not have done without TRIG, while a minority felt that the project would not have gone ahead at all without the funding. In interviews, 1 unsuccessful applicant conducted their project but was unable to validate their concept without funding due to a lack of data (which they believed funding would have provided).

The Hub has a dedicated 'Clean Maritime Policy Unit' and have been **engaged in work to support government policy.** Smaller research projects would have been unlikely to have an explicit focus on policy influence and so this is likely an example of additionality of the Hub. However, applicant interviews and project reports provide evidence that, **at this stage, policy outputs are at a smaller scale than expected**.

Environmental benefits

Both CMDC and TRIG projects **self-reported future expected environmental benefits** in monitoring data and end-of-project reports. It is too early to determine the extent to which their project technologies will ultimately achieve their environmental objectives, as many projects were feasibility studies and developed technologies that are not yet near commercialisation. This is particularly true for TRIG projects. For CMDC, a majority of survey respondents (31 out of 52) reported that they had not yet identified carbon savings.

Across these schemes (CMDC and TRIG), **reporting of carbon savings was not consistent**. In the end-of-project reports, CMDC1 and CMDC2 projects were explicitly asked about their emission savings and reported emissions estimates with a variety of different units and assumptions, which prevented comparison and aggregation of the estimates. This report provides a set of measures and issues for UK SHORE to consider in its future emissions guidance.

Future Consideration: Review reporting standards relating to, but not limited to, emissions impacts for future monitoring and evaluation activities.

Commercial opportunities

The UK SHORE portfolio generated £103 million of match funding as of December 2023, according to monitoring data; this is in line with UK SHORE expectations of match funding.[4] Figure 7 shows match funding across schemes.

Figure 7   Match funding
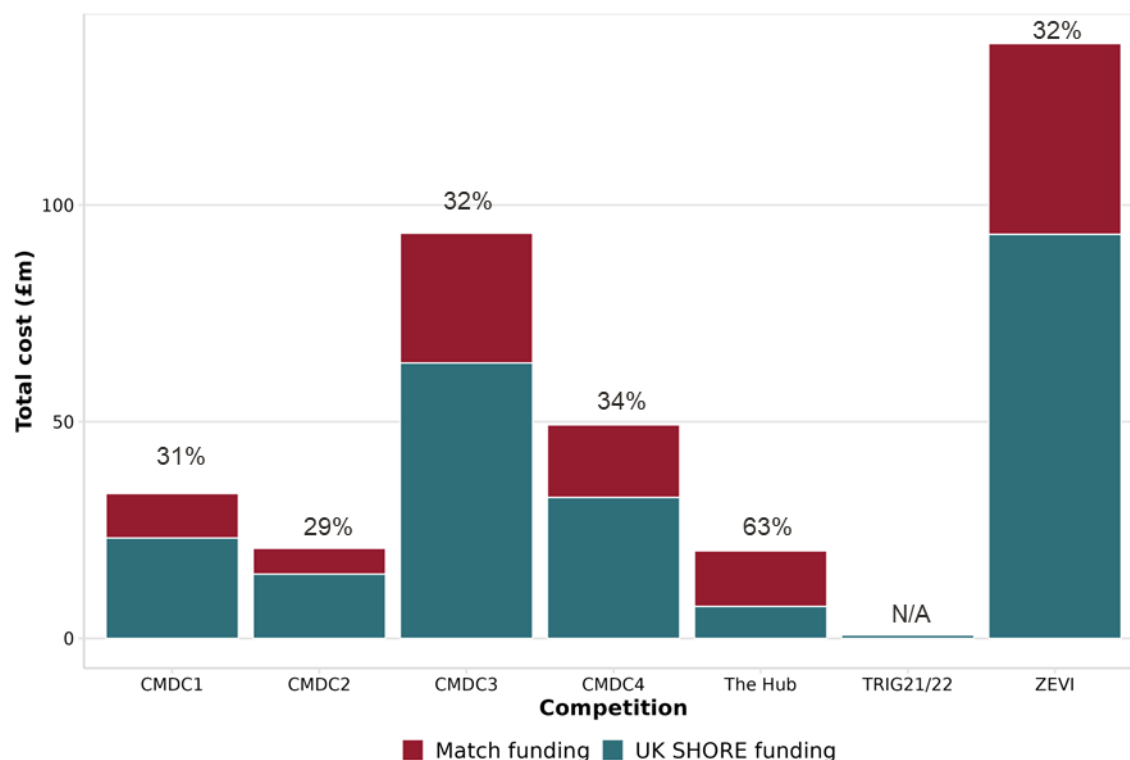
Beyond this funding, online survey respondents from CMDC typically reported having secured or were expecting to secure follow-on funding to support the further development of their projects. However, in monitoring data, only a minority of CMDC organisations reported raising further funding as a result of participation. A minority of TRIG (6 out of 21) reported receiving investment during the programme, but the majority (12 out of 21) reported receiving grant funding.

This interim evaluation has focused primarily on low- and mid-TRL schemes, so significant commercial benefits are not necessarily expected at this stage. However, there is evidence that commercial benefits are either being realised or being on track. For example, monitoring data shows that two-thirds of CMDC projects achieved Commercial Readiness Level (CRL) development (39 out of 60), although the achievement was slightly below the projects'

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[4]   Data limitations mean it has not been possible to split investment into public and private.

expectations, as reported at the start of the projects. Like TRL, a small number of projects reported a decrease in CRL during their project (6 out of 60) (albeit fewer than those reporting a fall in TRL).

Future Consideration: Review the monitoring approach for CRL, together with reviewing TRL as suggested above, to ensure that results are accurate and interpretable.

Both the monitoring and survey data suggest that most CMDC organisations reported seeing improvements in commercial opportunities and have plans to develop their projects further. Increased exposure to clients and investors was a key driver of benefits identified from delivery partner interviews.

TRIG projects also benefitted from improved private sector connections (9 out of 11 TRIG22 projects plus additional qualitative evidence) and improved market understanding and skills relevant to commercialisation. However, the next steps were typically related to additional research, and only 3 out of 9 TRIG22 business organisations reported commercial future activities and output:

> *"During the project, we established valuable collaborations with key industry stakeholders and research institutions. These collaborations are integral to the successful implementation and adoption of our technologies."*

TRIG22 end-of-project report

The Hub is establishing **strong collaboration with the industry**: 8 out of 13 Hub organisations report being involved in 17 projects with the industry. The industry would be unlikely to collaborate with the Hub if it did not expect to see commercial benefits. Nonetheless, benefits are expected to be predominantly against EQ 1 (technology development): in monitoring data, the Hub report expects to see an average of half a CRL increase across their research projects, compared with a whole level of TRL improvement.

Wider social objectives

Monitoring data suggested that **few CMDC organisations created jobs during the delivery phase** of their projects (only around 40% – 86 out of 238), but organisations expected job creation and retention to increase in the future. Nonetheless, job creation and retention, as reported in monitoring data during the delivery phase of CMDC2, **broadly met business case expectations**.

For TRIG, **4 out of 9 organisations reported job creation** of 1 to 5 Full-time equivalent (FTE) employees.[5] Those organisations who reported job creation had fewer than 10 employees at the start of the programme and so this addition can be seen as a reasonably large increase. Employment figures are also substantial given business case expectations that participants may only maintain the number of employees. However, each TRIG project only received up to £45,000 of funding, so it is unrealistic to attribute job creation directly to TRIG. Instead, job

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[5]   TRIG21 and academic institutions were not asked this question.

creation may be an indicator that TRIG is supporting the project moving on, and, therefore, more employees are needed.

Based on monitoring data, the large majority of CMDC jobs created and retained are **high-skill** (93% of jobs created and retained during the delivery phase for CMDC) and **green jobs** (97%). This is also true of the Hub, where all 28 FTEs supported are green, high-skilled jobs except for 1 administrator role. These initial findings only relate to employment directly within organisations associated with CMDC and the Hub; evidence is not yet available to assess the impact on the sector more broadly, nor to assess TRIG jobs in similar ways. This finding is not surprising, given the nature of the funding.

Survey data suggest projects are typically located in coastal areas, aligning with UK SHORE objectives to support coastal communities. In the absence of specific departmental benchmarks for supporting coastal areas and areas outside the South East, it is challenging to assess whether UK SHORE has met targets for regional development. One indirect measure is that **funding for CMDC1 through 4 and ZEVI is slightly less concentrated in the Greater South East than total government research and development (R&D) spending** (42% of CMDC and ZEVI funding, compared to 52% of total government R&D);[6] Table 2 shows the regional distributional of funding. Hub organisations are distributed across the UK, in all regions except Wales and the South West. The final evaluation will seek to understand stakeholder views on the distribution of funding across regions and the reasons behind this.

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[6] Using data from House of Commons (2023) Research and development funding. The 2019 to 22 Johnson Conservative Government's Levelling Up White Paper included an objective to increase domestic public R&D investment outside of London, the South East and East of England by 40% by 2030, with UK SHORE funding counting as public R&D. Specific objectives for regional growth are not set out for the new government at this stage.

Table 2   Regional split of UK SHORE funding

Region	Funding (£m)
East Midlands	8.84
East of England	12.60
London	15.37
North East	9.71
North West	29.80
Northern Ireland	18.68
Scotland	32.68
South East	66.68
South West	24.36
Wales	0.71
West Midlands	4.54
Yorkshire and The Humber	0.74
Unknown	2.69

Source: *Frontier Economics analysis of DfT monitoring data.*

Note: *Grant funding is allocated to regions based on the 'Work Region' of organisations and the £ value of funding they receive from DfT. Monitoring data reports the £ value of funding for each organisation within a project. The sum does not align with values reported elsewhere due to some organisations not reporting their region.*

Portfolio-wide findings

This interim evaluation has been conducted at a scheme-level, considering a subset of UK SHORE schemes and excluding some of the largest schemes (CMDC3, 4 and ZEVI). Much of the qualitative engagement and the online survey was also focused on the process evaluation. As a result, at this stage there has been limited consideration of whether the portfolio approach to clean maritime funding has had benefits above and beyond the schemes.

The portfolio has been designed to create a 'pipeline' of projects where projects can progress from lower to higher TRL schemes. **Of the organisations involved in UK SHORE, 30% (110) received funding from multiple schemes**. There is some evidence of cross-scheme collaboration; for example, some of the Hub organisations are collaborating with the industry through CMDC4 projects.

Early Value for Money findings

The interim Value for Money assessment considers 2 key questions:

1. To what extent have UK SHORE and its component schemes demonstrated strategic fit with government priorities?
2. To what extent have UK SHORE and its component schemes been delivered in an economic and effective way?

Strategic fit

Two of the [five government missions](#) are relevant to UK SHORE:

1. kickstart economic growth, specifically "in every part of the country"
2. make Britain a clean energy superpower

The early evidence around the regional distribution of funding and positive expectations around employment benefits (in particular around high-quality jobs) suggest some positive economic impacts, albeit limited to the directly supported organisations and not as yet clearly having wider growth impacts across the maritime sector or more broadly. Similarly, the size of UK SHORE funding across the TRL scale, positive evidence around the impact on collaboration, very tentative evidence around potential future environmental impacts, and the scale of funding enabling the Hub to have greater reach also suggest some benefits relating to the clean energy superpower mission.

Economic and effective delivery

Economic and effective delivery compares UK SHORE's anticipated costs and outputs.

UK SHORE's total budget of £206 million has been allocated to the schemes as expected, and the total number of projects is in line with the expectations set out in the business case. There is **no evidence of projects that failed to complete delivery requirements**, and projects met expectations in terms of **supporting a range of technologies and a spread of TRLs**.

The process evaluation **did not identify any obvious inefficiencies** in the competition, mobilisation or delivery stages of UK SHORE. Projects did not identify issues with receiving their grant funding, and timelines mostly stuck to expectations. All UK SHORE schemes were designed from previous successful projects, and the portfolio-wide approach supported effective delivery as **learnings from previous schemes were used to improve the process of later schemes**. The final evaluation will consider the extent to which the portfolio-wide approach has enhanced economic delivery, for example by reducing programme management costs since individuals were able to manage multiple schemes.

Some delivery partners identified **potential areas for improvement in the efficiency of delivery** both from the perspective of UK SHORE and of the costs invested by applicants. As an example, 1 applicant highlighted that there is a high time cost for organisations submitting a bid that may not be successful; this applicant felt that an 'expressions of interest' stage would be beneficial.

1.6   Next steps in the UK SHORE evaluation

The findings of this report will be developed in the final stage of evaluation in autumn 2025 (the final report), which will update findings and include impact evaluation evidence from schemes not included in this interim evaluation. The schemes that are not included in this impact evaluation but will be included in the final evaluation (CMDC3 and CMDC4 and ZEVI) make up a significant proportion of UK SHORE funding (90%). In addition, a 'Future Evaluation Framework' in spring 2025 will build out the methodology for assessing the impact of UK SHORE over a longer timescale.

2   Introduction

The Department for Transport (DfT) launched the UK Shipping Office for Reducing Emissions (UK SHORE) in March 2022. UK SHORE aims to further the UK Government's aims in tackling shipping emissions and advancing the UK towards a sustainable shipping future. This was identified as a strategic priority for DfT by the 2019-22 Johnson Conservative Government , as detailed in [the Transport Decarbonisation Plan](#).

UK SHORE has a principal ambition to tackle shipping emissions with the aim that all vessels will be zero or near-zero GHG emissions by 2050. To facilitate this, UK SHORE will accelerate research into and development of clean maritime technologies and create skilled jobs across the country. It will work in partnership with the industry to tackle supply and demand issues with shipbuilding, help build greener vessels, help develop the infrastructure to enable zero-emission technologies and the physical infrastructure needed to power zero-emission vessels.

2.1   Objectives of UK SHORE

To achieve its aims, UK SHORE has developed a portfolio of schemes, building on the successful uptake of the first Clean Maritime Demonstration Competition (CMDC), which was launched in March 2021. The specific objectives of the UK SHORE portfolio are:

- clarify the tools and barriers to achieving Net Zero within the UK maritime sector

- create long-term growth for clean maritime in the UK

- boost UK jobs in clean maritime technology

- support the deployment of infrastructure to facilitate Net Zero

- leverage private investment from industry in emerging clean maritime technologies

- facilitate the reduction of emissions within the UK maritime sector

Various technologies to decarbonise maritime already exist, some specific to maritime and others developed in the context of other sectors, such as battery-electric automotive vehicles. However, a major challenge for UK maritime is advancing these technologies to commercial readiness within the timescale needed to meet Net Zero. UK SHORE has, therefore, implemented a portfolio of schemes across various technology readiness levels (TRLs), as described in UK SHORE Schemes3.

2.2   Funding and delivery partners

In March 2022, UK SHORE launched with £206 million to invest in its portfolio of interventions to the end of March 2025. This built on the £23 million that was invested in the first round of

the CMDC (prior to UK SHORE's inception) to deliver 55 projects in 2021, which formed a blueprint for the remaining rounds of CMDC.

Each of the schemes within the UK SHORE portfolio has clear eligibility criteria, with most operating on a match funding basis, therefore leveraging private sector investment to support the advancement of clean maritime technologies.

Although the majority of the public funding for the UK SHORE portfolio derives from DfT, other partners are involved in the delivery of the schemes. These partners include Innovate UK (IUK), the Engineering and Physical Sciences Research Council (EPSRC), Connected Places Catapult (CPC), and the Maritime and Coastguard Agency (MCA).

2.3   Evaluation of the UK SHORE portfolio

UK SHORE's funding period from 2022 to 2025 offers an ideal opportunity to generate robust learning about the UK SHORE portfolio and the individual schemes within it, in terms of the process of designing, delivering and managing the operation of the various schemes; the impacts and effectiveness of the portfolio and the individual schemes; and the value for money of the portfolio and individual schemes.

With the novel and innovative nature of UK SHORE, the aim of this evaluation is to generate robust evaluation evidence on whether UK SHORE is on track to meet its objectives and, if so what, is working well, what is not, why and for whom. The evaluation intends to elicit valuable lessons learnt to inform ongoing and future strategy, policy-making and scheme design and delivery. The evaluation will proceed in 6 main stages, as illustrated in Figure 8. Implementation starts with this interim report and with a second interim report in June 2024. The final evaluation report is planned for autumn 2025.

Figure 8   Evaluation implementation stages
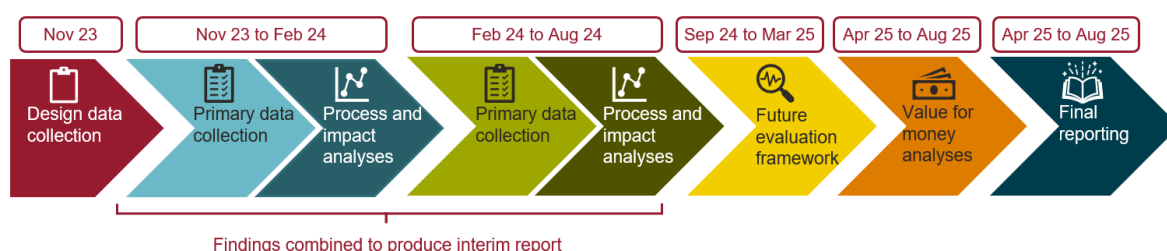
Source: Frontier Economics.

This report contains the findings of the interim evaluation. It analyses the following data sources:

- **Winners data**: Administrative data collected for the winning applicants of CMDC, and Zero Emission Vessels and Infrastructure (ZEVI) (project location, funding allocated, type and size of delivery partners). This is used to produce summary statistics in Section 3

- **Baseline and end-of-project monitoring data**: Two rounds of surveys on impact aspects conducted by IUK at the start and the end of schemes, for CMDC1 and 2, Transport Research and Innovation Grants (TRIG) and the Clean Maritime Research Hub (the Hub). Each scheme was analysed using a separate dataset of monitoring data: CMDC data contained over 400 responses, TRIG data contained 24 responses and the Hub contained 13 responses

- **End-of-project reports**:

  □ Fifty CMDC1 participants and 29 CMDC2 have submitted end-of-project reports. The process evaluation drew on evidence from a randomly selected sample of 16 end-of-project reports. Evidence was also used for the impact evaluation

  □ Twelve TRIG21 and 13 TRIG22 end-of-project reports have been made available for the evaluation (1 TRIG21 project was not available). A high-level review of reports provided evidence for the impact evaluation

  □ The Hub has submitted an end-of-year-one report, although this report covers the period of 1 September 2023 to 31 March 2024 only, reflecting the project starting in September 2023. The report informs the impact evaluation of the Hub

- **Survey data**: An online survey was carried out in December 2023 with 52 successful applicants to schemes including CMDC (38 responses), TRIG (7 responses) and ZEVI (7 responses), representing 37% of successful applicants

- **In-depth interviews**:

  □ Eight in-depth interviews with CMDC1 and CMDC2 participants, both successful and unsuccess applicants, were carried out in December 2023

  □ Between April and July 2024, 13 in-depth interviews were carried out:

    – Two with members of the DfT UK SHORE team in April and May 2024

    – One with MCA staff in May 2024

    – One with CPC staff in May 2024

    – One with IUK staff in June 2024

    – Three with unsuccessful ZEVI applicants in May 2024

    – Two with successful ZEVI applicants

    – Two with unsuccessful TRIG applicants in July 2024

    – Two with the lead organisation of the Hub

■ **Business case**: Estimates and expectations from the UK SHORE business case were used to benchmark outcomes

Survey data and interviews relate to primary data collected for the purpose of this evaluation. All other data is secondary, collected by other bodies, such as IUK and CPC, and provided by DfT for the purpose of this evaluation.

This evidence base will be further developed throughout the evaluation, with qualitative research extended to project delivery partners, additional competition applicants, regulators and DfT, as well as utilising further secondary data once it becomes available for other competitions. At this early stage, the outcome analysis is preliminary as evidence over a longer time period is needed to robustly assess outcomes and additionality. The process evaluation covers all schemes, while the impact evaluation focuses on schemes where project monitoring data is available (beyond the baseline date): CMDC1 and CMDC2, TRIG21 and TRIG22 and the Hub.

Future Evaluation Framework. This framework will be forward-looking to 2028. This will involve scoping the primary data collection to capture data over a longer time period, and the potential for counterfactual analysis to be deployed, drawing on econometric methods such as difference-in-difference analysis (this will enable a more robust estimate of the changes in observed outcomes that can be attributed to UK SHORE schemes, as opposed to other policies or factors). The appropriate and proportionate approach will be developed based on data availability and the suitability of these methods. Incorporating DfT feedback via a workshop, the framework will be developed into a Future Evaluation Framework report in spring 2025.

Value-for-money evaluation (VfM). This will assess the extent to which the benefits of the UK SHORE schemes and portfolio as a whole are meeting their strategic objectives and delivering benefits (quantified and non-quantified) that are likely to exceed UK SHORE's investment. A core input to the VfM analysis is the evidence on outcomes that will derive from the impact evaluation. To ensure sufficient data and evidence is available, a substantive VfM analysis would need to follow the impact evaluation and be undertaken by autumn 2025. An interim VfM analysis is included in this interim report, covering the extent to which UK SHORE has delivered strategic fit-for-government objectives and the programme has been delivered economically and effectively.

Final reporting. A final report will be produced for the UK SHORE portfolio and its 4 main schemes, which will contain the process, impact, and VfM evaluation. The report will highlight scheme-specific learnings and make comparisons across schemes as well as presenting the evaluation findings for the UK SHORE portfolio as a whole. Final reporting is planned for

autumn 2025, with dissemination activities to build awareness of the learnings and ensure that the value of the evaluation is maximised.

2.4   Structure of the report

The remainder of this report is structured as follows:

■ Section 3 presents descriptive statistics on the key UK SHORE schemes that make up this evaluation.

■ Section 4 sets out the evaluation approach, including the key questions and aims of the process and impact evaluations, as well as more details on the evidence sources used.

■ Section 5 presents the findings of the process evaluation.

■ Sections 6 to 9 present the findings of the impact evaluation relating to: CMDC1 and CMDC2, TRIG, the Hub and an early portfolio-wide assessment. Section 9 includes an early VfM assessment.

■ Section 10 presents the key themes across the process and impact evaluation.

3   UK SHORE Schemes

This section provides information about the scale and nature of each of the 4 main schemes in this evaluation. This provides context to help interpret the results and findings in this report and later evaluation report. The data sources used below are discussed in Section 4.2.

The schemes within the UK SHORE portfolio target high, medium and low TRL projects:

- **Zero Emissions Vessels and Infrastructure (ZEVI) competition**: this offers £80 million in match funding to support high TRL research in close-to-commercial clean maritime technology. UK SHORE funding has been made available to cover the construction and set-up of projects until March 2025, with project partners covering all costs of demonstrating in an operational environment until March 2028. Its aim is to generate learning about the efficacy of technologies in real-world and operational settings. All projects must include on-vessel technology and shoreside infrastructure. Project partners include ports or infrastructure owners and operators, as well as vessel owners and operators.

- **Clean Maritime Demonstration Competition (CMDC)**: this has offered up to £129 million to 2025 (including the first round of funding, which was prior to the establishment of UK SHORE) in match funding over 4 rounds to support the acceleration of mid-TRL maritime decarbonisation technology options towards commercialisation. The technological focus varies for each round: there was no technology prioritisation for CMDC1 (September 2021 to March 2022); CMDC2 (January 2023 to August 2023) prioritised hydrogen engines, domestic and international green shipping corridors, safe on-board storage of hydrogen and ammonia, larger marinised fuel cell systems; CMDC 3 (April 2023 to March 2025) prioritises domestic shipping corridors; CMDC 4 (April 2024 to March 2025) prioritises large vessels, international ferries, and ammonia solutions.

- **Early Research Grants**, including **Transport Research and Innovation Grants (TRIG)** and the **Clean Maritime Research Hub (the Hub)**: these schemes target new concepts and early-stage Research and Development (R&D) with low TRL. Working in partnership with the Connected Places Catapult, UK SHORE offers TRIG funding to provide 100% grant funding for proof-of-concept research projects in support of innovative ideas or concepts that facilitate the decarbonisation of maritime. These projects are 6 months long, and cohorts run every year. From September 2023 to March 2027, UK SHORE and EPSRC are providing £7.4 million to fund a flagship UK Hub. The centre focuses on the fundamental science behind clean maritime technologies (TRL 1 to 3), as well as developing partnerships with industry and civic organisations. It aims to be a centre of excellence, supporting knowledge exchange, skills development and evidence-based policymaking.

This interim report covers each of the schemes above, as well as the UK SHORE portfolio as a whole, given the interactions and interdependencies across the schemes within the portfolio.

In addition, UK SHORE has recently announced 2 additional schemes. These schemes are not explicitly included in this UK SHORE evaluation but may be considered as part of the final portfolio-wide evaluation as it is an important feature of the context in which UK SHORE operates:

■ **International Green Corridor Fund (IGCF)**, announced September 2023**:** this has offered £1.5 million of match funding to feasibility studies examining green corridor routes[7] between the UK and international partner countries.

■ **Smart Shipping Acceleration Fund (SSAF)**, announced April 2024**:** this will offer £8 million to support feasibility studies developing smart shipping technologies such as AI, robotics and autonomous vessels.

3.1   Funding allocated

By 2025, UK SHORE will have allocated funding in order to distribute £206 million in funding,[8] on top of £23 million allocated to CMDC1 before UK SHORE was established. Figure 9, Figure 10 and Figure 11 show the allocation of funds across schemes, the number of projects per scheme and the median funding per project. The schemes vary substantially in their level of funding (ZEVI, CMDC3 and CMDC4 have higher total funding), in the number of projects they support, and in the median grant funding per project. The UK SHORE portfolio funded fewer high TRL projects (as compared to low TRL), but those that were funded were allocated larger than average grants.

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[7]   A green corridor is a route between 2 ports for which zero-emissions shipping has been deployed.

[8]   UK SHORE over-programmes some of its competitions in order to account for expected drop-out rates on R&D competitions. Therefore, the funding that has nominally been allocated to projects adds up to more than the total funds allocated for the competitions (more than £206 million), although not all of this allocation will be distributed.

Figure 9   Grant funding provided by scheme from 2021 to 2025
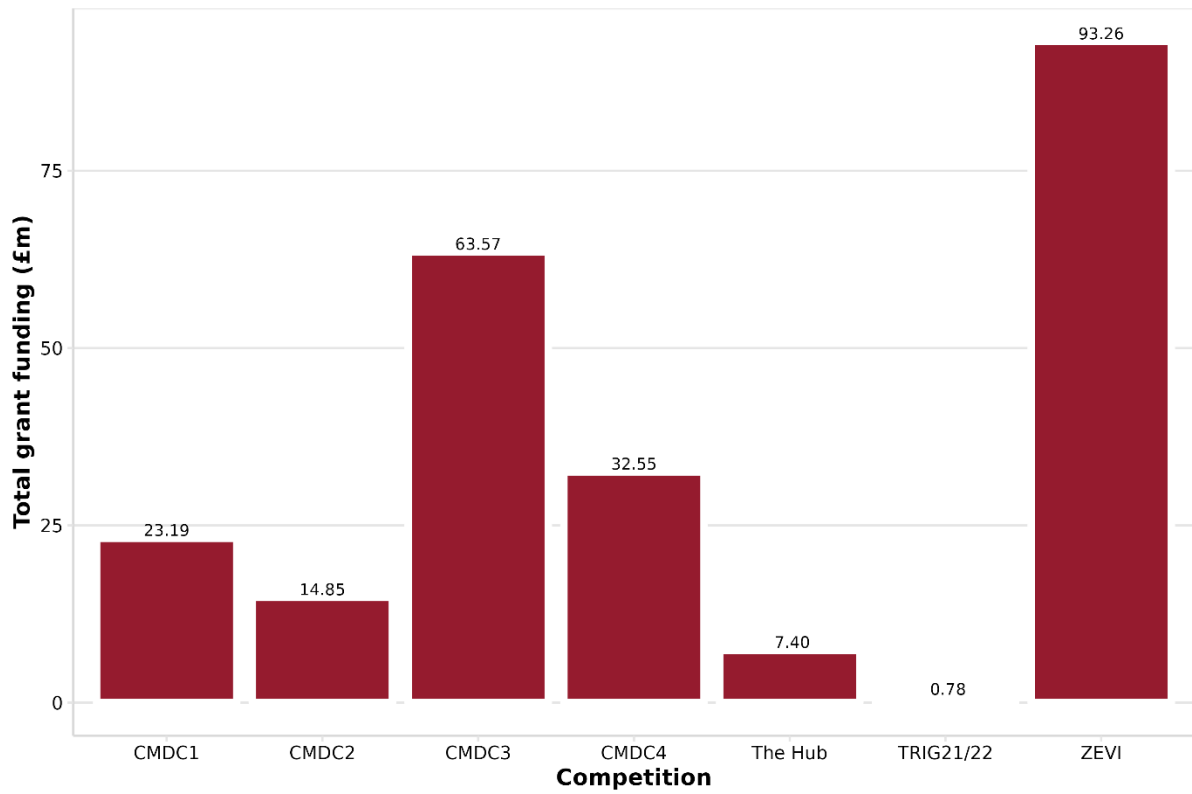
Source: Baseline monitoring data.

Note: Hub funding includes £3.7 million from UK SHORE and £3.7 million from EPSRC. CMDC1 funding is in addition to the UK SHORE's £206 million funding. Note that only TRIG21 and TRIG22 are considered.

Figure 10   Number of projects per scheme
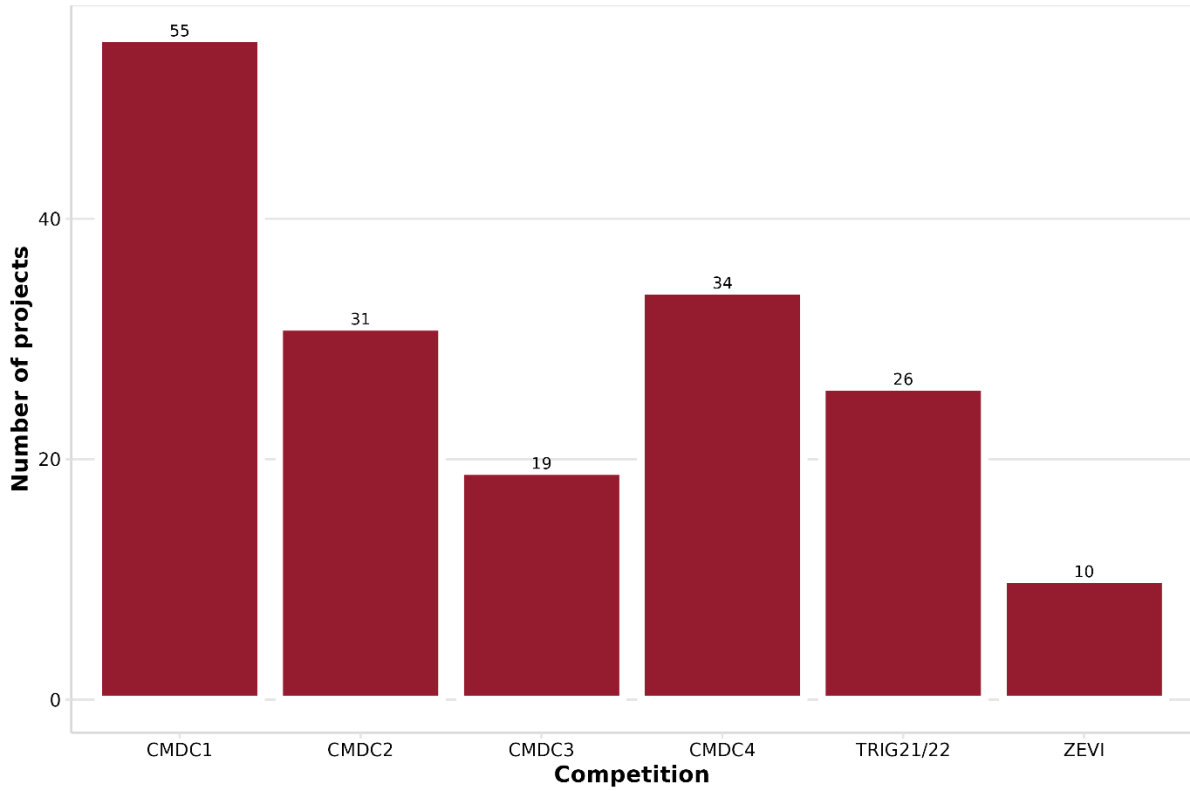
Source: Baseline monitoring data.

Note: Figures are not reported for the Hub since funding was only allocated to 1 project.

Figure 11   Average funding per project by scheme
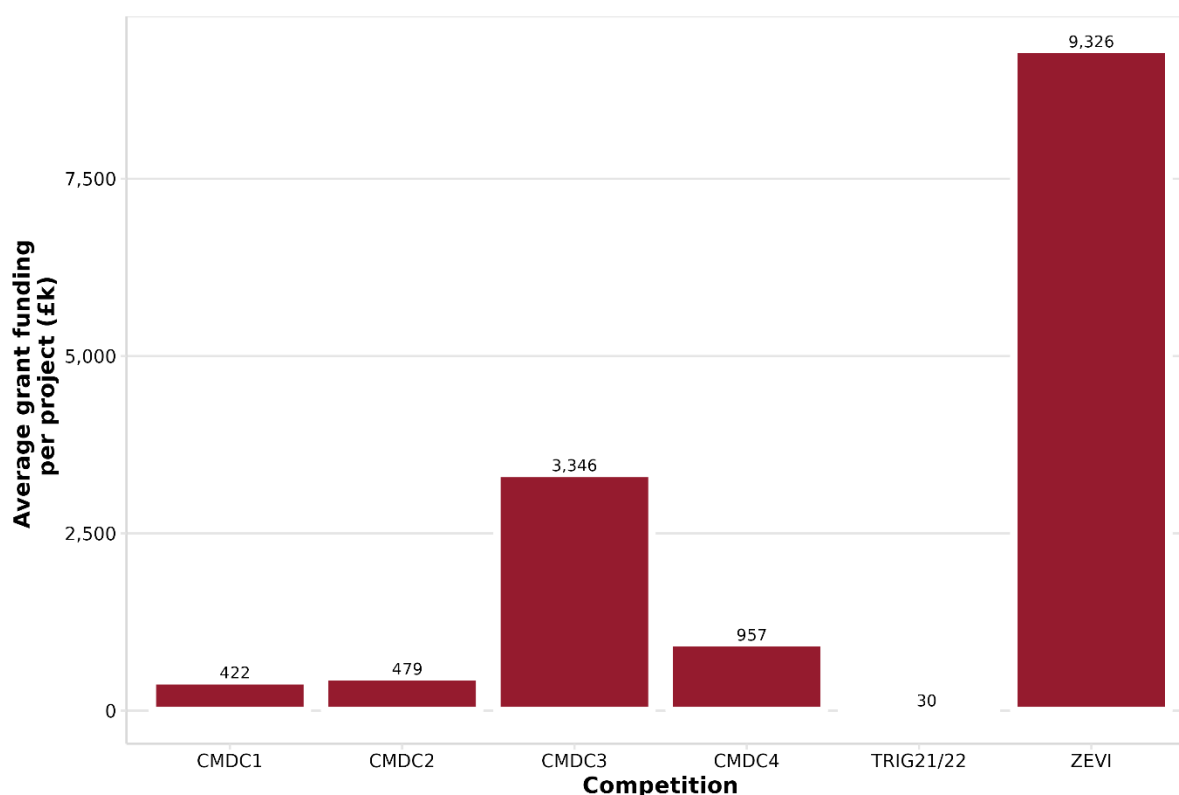
Source: *Baseline monitoring data.*

Note: *Figures are not reported for the Hub since funding was only allocated to 1 project.*

3.2   Geographic distribution of funded projects

Regional split

One of the aims of UK SHORE is to facilitate innovation and investment in new maritime technologies across the UK. To explore the extent to which this has been achieved, Table 3 and Table 4 detail the geographical locations of the 'primary work' region (the main location in which the project activity takes place) of funded projects. There are limitations in the data used to inform this analysis, as some project work may be conducted in locations other than the primary site. The South East contained projects that had received funding from several UK SHORE schemes, namely each of CMDC1, 2 and 3, and ZEVI (total grant funding of £61 million, or 31% of all grant funding). The region with the next highest total grant funding was Scotland (£31 million from CMDC1, 2 and 3, and ZEVI), followed by the North West and South West. Some regions received less than £1 million in funding (Wales, Yorkshire and the Humber). The number of funded organisations has a similar distribution across geographies to that of grant funding.

The South East received the largest proportion of funding from CMDC and ZEVI schemes, including the largest from each individual scheme except CMDC4 (total grant funding of £67

million, or 3% of all grant funding). The region with the next highest total grant funding was Scotland (£33 million), followed by the North West and South West. Some regions received less than £1 million in funding (Wales, Yorkshire and the Humber). This number of funded organisations has a similar distribution across geographies to that of grant funding.

The pattern of funding is similar across schemes, with some notable exceptions. Compared to other schemes, CMDC4 funding was distributed more evenly across a number of different regions (the South East, North West, London and Northern Ireland all received similar amounts of funding). Compared to other schemes, there was a lower proportion of funding in the South East for CMDC3 and much higher funding in the South West (almost a quarter of all funding compared to less than 10% for other schemes). ZEVI funding was concentrated in the North West, Scotland and South East (almost three-quarters of all funding); a high proportion of investment in the North West is expected since both ammonia and hydrogen have comparative advantages in these areas.

Table 3   Regional split of UK SHORE funding

Region	Funding (£m)
East Midlands	8.84
East of England	12.60
London	15.37
North East	9.71
North West	29.80
Northern Ireland	18.68
Scotland	32.68
South East	66.68
South West	24.36
Wales	0.71
West Midlands	4.54
Yorkshire and The Humber	0.74
Unknown	2.69

Source: Frontier Economics analysis of DfT monitoring data.

Note: Grant funding is allocated to regions based on the 'Work Region' of organisations and the £ value of funding they receive from DfT. Monitoring data reports the £ value of funding for each organisation within a project The total does not align with values reported elsewhere due to some organisations not reporting their region.

Table 4   Regional split of UK SHORE funding by competition (£m)

Work Region	CMDC1	CMDC2	CMDC3	CMDC4	ZEVI
East Midlands	0.12	0.41	5.05	0.67	2.59
East of England	1.02	0.75	0.34	1.92	8.58
London	1.59	1.66	3.63	5.39	3.10
North East	2.90	1.01	2.75	2.68	0.36
North West	1.06	0.09	3.36	5.68	19.61
Northern Ireland	0.58	3.20	6.11	4.69	4.10
Scotland	2.49	1.73	11.19	2.78	14.50
South East	8.15	4.32	15.19	5.56	33.46
South West	1.82	0.70	14.33	0.93	6.58
Wales	0.05	0.27	0	0.38	0
West Midlands	0.59	0.66	1.53	1.77	0
Yorkshire and The Humber	0.35	0	0.09	0.10	0.20

Source: Frontier Economics analysis of DfT monitoring data.

Note: Grant funding is allocated to regions based on the 'Work Region' of organisations and the £ value of funding they receive from DfT. Monitoring data reports the £ value of funding for each organisation within a project The total does not align with values reported elsewhere due to some organisations not reporting their region.

Type of locations

Another key objective of UK SHORE is to facilitate investment in maritime research and development in coastal communities. In an online survey with successful applicants across CMDC, ZEVI and TRIG (carried out in late 2023), respondents reported the area where most of their projects are being delivered. Figure 12 presents the number of survey responses per location type for each scheme. For each scheme, coastal areas have a plurality of projects. Of 52 total respondents, 50% (26 respondents) reported the coastal area as the primary area of project delivery. Projects may be conducting feasibility studies or research to support maritime technology and, therefore, do not necessarily need to be located on the coast. Respondents who provided this answer were typically private businesses working on vessels.

Figure 12　Location types of UK SHORE projects
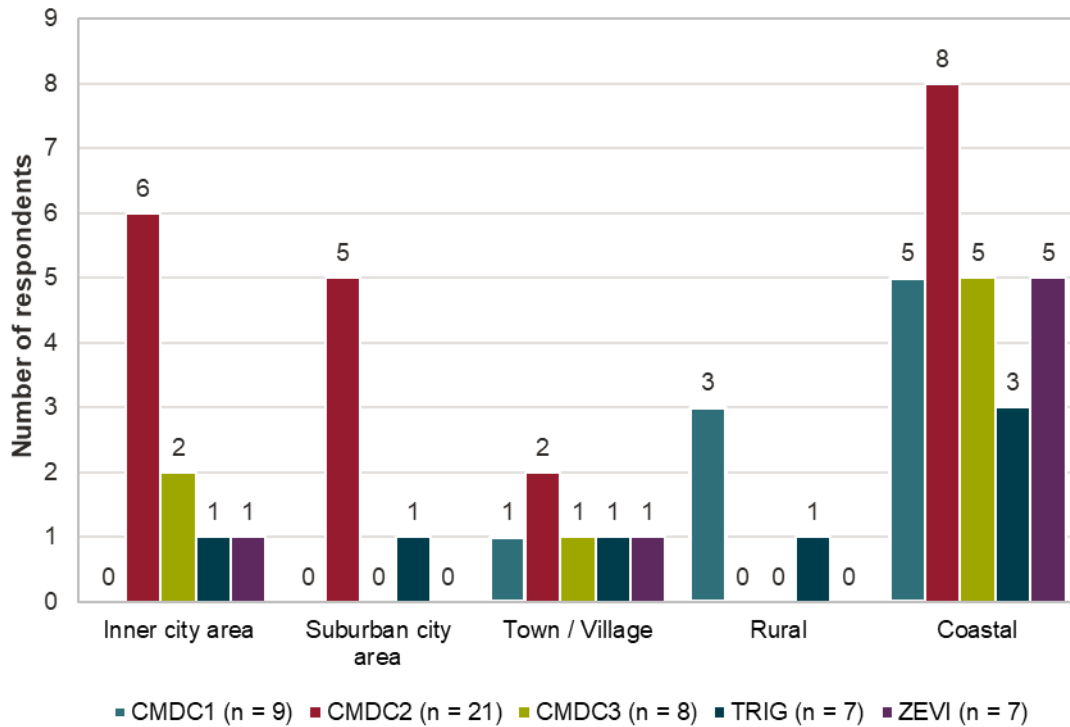
Source:　Survey data.

Note:　Survey respondents were asked: 'Which of the following best classifies the nature of the area in which most of the project is being delivered'.

3.3　Project delivery partners

UK SHORE also seeks to facilitate collaborative relationships and long-term commercial partnerships. To understand the scale and characteristics of collaborative relationships formed, this section examines distributions of consortia size, organisation type and size of private organisations.

Figure 13   Size of consortium across CMDC and ZEVI
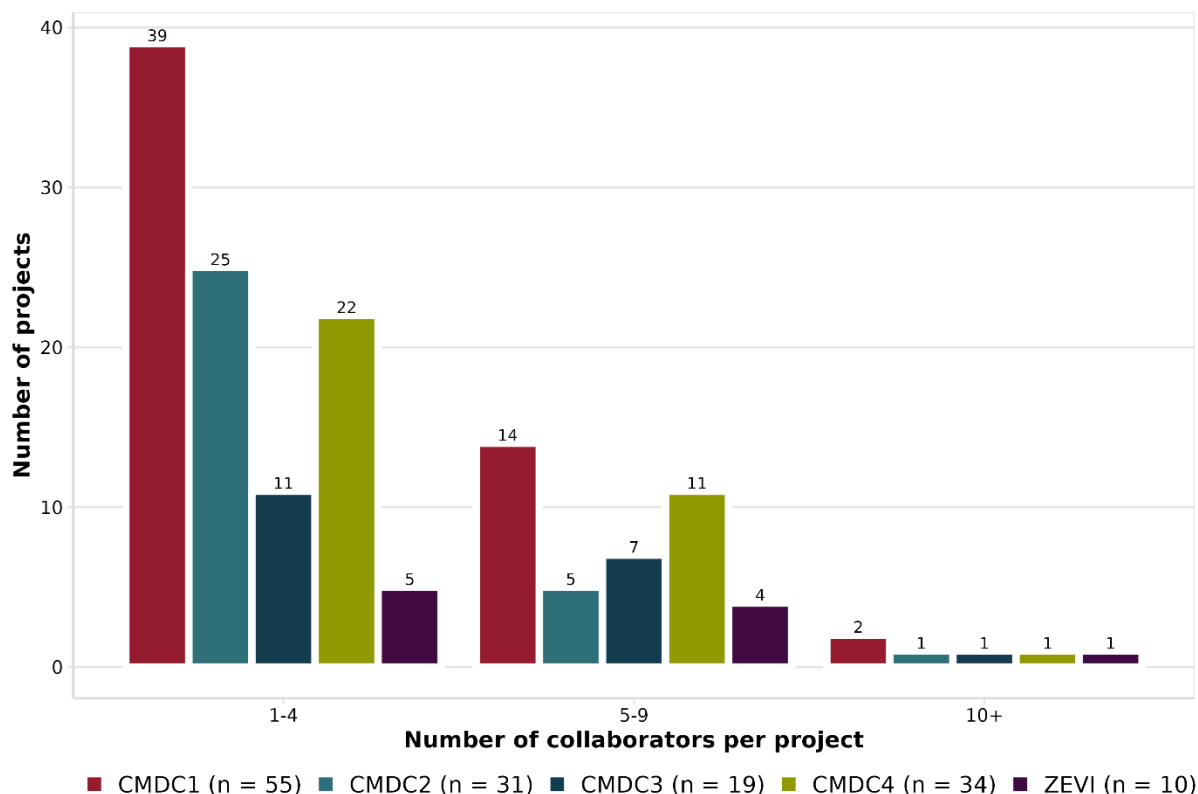
Source: *Baseline monitoring data.*

Note: *We separated the number of collaborators per project into 3 groups: small = 1-4, medium = 5-9, large = 10+. The figure shows the distribution of projects' collaborator numbers across schemes. TRIG is not included since data availability differs. The Hub is not included as this metric is not relevant.*

Figure 13 reports the size of project consortia by scheme, categorised into small consortia (1 to 4 collaborators), medium consortia (5 to 9 collaborators) and large consortia (10 or more collaborators). The majority of CMDC1, CMDC2 and CMDC4 projects are made up of small consortia. CMDC3 and ZEVI have a more even distribution between small and medium consortia. Large consortia of more than 10 organisations are rare for all schemes.

Table 5   Distribution of organisation types

Collaborator type	CMDC1	CMDC2	CMDC3	CMDC4	ZEVI	TRIG
Business	130	76	65	96	40	20
Public sector, charity or non Je-S	8	2	4	4	3	1

Collaborator type	CMDC1	CMDC2	CMDC3	CMDC4	ZEVI	TRIG
registered[9] research organisation						
Research	18	11	11	17	4	4
Research and technology organisation (RTO)[10]	6	7	3	6	4	0
No response	4	0	0	6	0	1
Total	**166**	**96**	**83**	**129**	**51**	**26**

Source: UK SHORE administrative data and TRIG baseline data.
Notes: Data for TRIG only captures project leads.

As shown in Table 5, businesses have the highest levels of involvement in all schemes among the organisation types listed in the table above. The majority of businesses have non-business collaborators. Of the 55 CMDC1 projects, 63.6% (35 projects) have more than 1 type of collaborator. Similarly, 71% (22) of CMDC2 projects, 63.2% (12) of CMDC3 projects, 76,5% (26) of CMDC4 projects and 50% (5) of ZEVI projects have more than 1 type of collaborators. Given the nature of the Hub, all 13 organisations are academic. Data is not available to assess collaborator types for TRIG, so data only reflects the project lead.

Table 6   Distribution of organisation size among businesses in each scheme

Organisation size	CMDC1	CMDC2	CMDC3	CMDC4	ZEVI	TRIG
Large (250 or more employees)	42	22	8	19	11	2
Medium (50 to 249 employees)	16	9	9	12	8	Not Applicable

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[9]   Joint electronic Submission (Je-S) is a system used by government organisations (including UK Research and Innovation [UKRI]) to provide electronic grant services. Table 5 uses the categorisation found in the UK SHORE monitoring data. Innovate UK makes the distinction among non-business organisations for funding purposes. Je-S registered research organisations must first submit their costs through Je-S and can only receive UK SHORE funding for 80% of full economic costs. Public sector, charity, non Je-S registered organisations, and RTOs and apply funding for 100% of eligible costs. Details are available at UKRI General guidance.

[10]   RTOs are specialised not-for-profit knowledge organisations dedicated to the development and transfer of science and technology to the benefit of the economy and society. They include hubs, laboratories, testbeds, factories and offices for cutting-edge R&D. This description is from Innovate UK: Build your capacity for Innovation to Grow and Scale.

Organisation size	CMDC1	CMDC2	CMDC3	CMDC4	ZEVI	TRIG
Medium or small (10 to 249 employees)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	3
Micro or small (0 to 49 employees)	72	45	48	65	21	Not Applicable
Micro (0 to 10 employees)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	15
Total	**130**	**76**	**65**	**96**	**40**	**20**

Source: UK SHORE administrative data and TRIG baseline data.

Note: Only including organisations that identify as businesses (excluding public, research and RTO). Data for TRIG only captures project leads. Classification using UK SHORE monitoring data.

Table 6 shows that the majority of businesses are small and medium-sized enterprises (SMEs), with an especially high concentration of small organisations in CMDC3 (74%) and TRIG (90%). This is in line with the UK SHORE target to support SMEs. This also indicates the level of interest small organisations have in the schemes, and the engagement between SME and large organisations fostered through the projects. High levels of SME engagement is unsurprising for TRIG given the small value of grant funding.

3.4   Match funding

Match funding is defined as the portion of cost not covered by UK SHORE grants, which may come from private investment or other grant funders. DfT specifies the maximum percentage of project costs that can be covered by a UK SHORE grant. The percentage varies depending on the organisation's size and market readiness of the technology. Organisations that are smaller and whose projects are further from commercialisation can receive a higher percentage of grant funding. For instance, in CMDC3, micro or small organisations can receive up to 70% of grant funding for costs on industrial research projects and up to 45% for experimental development projects, compared to 50% and 25%, respectively, for large organisations.

A total of £120 million of match funding has been raised across schemes; this amounts to 50% of total UK SHORE funding and around one-third of all project costs for these schemes.

Figure 14 reports the percentage of total costs funded by match funding, by scheme. CMDC1 to 4 and ZEVI had similar levels of match funding, at around 30% of total project funding. The Hub had substantially higher levels of match funding, coming from research organisations and leveraged funding and in-kind contributions from industry, academia and civic organisations over the course of the project. TRIG had no match funding by design, as the grants were allocated to very early-stage research projects.

Figure 14   Percentage of project cost funded via match funding
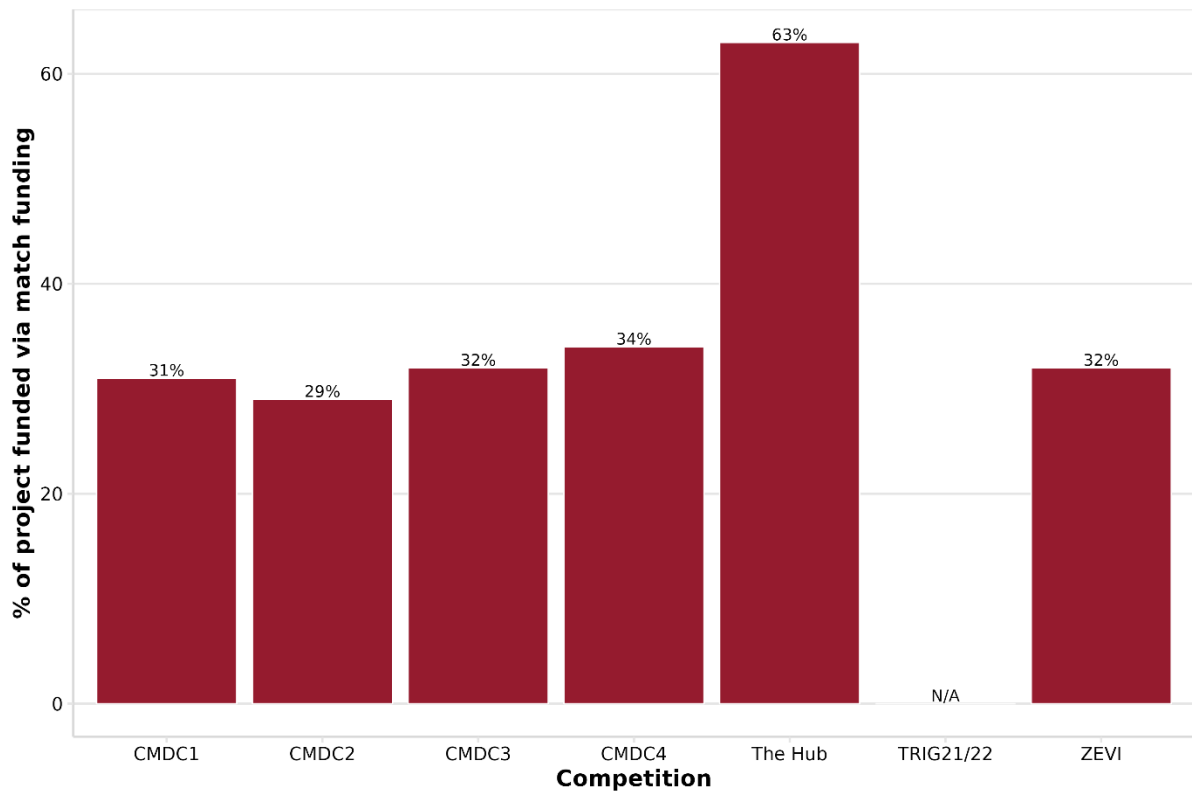
Source: *UK SHORE administrative data.*
Note: *Hub match funding figures are based on early indications.*

Figure 15 presents related information on funding by scheme, highlighting that ZEVI and CMDC3 were the largest schemes overall, and produced the largest levels of match funding.

Figure 15   Funding split by scheme
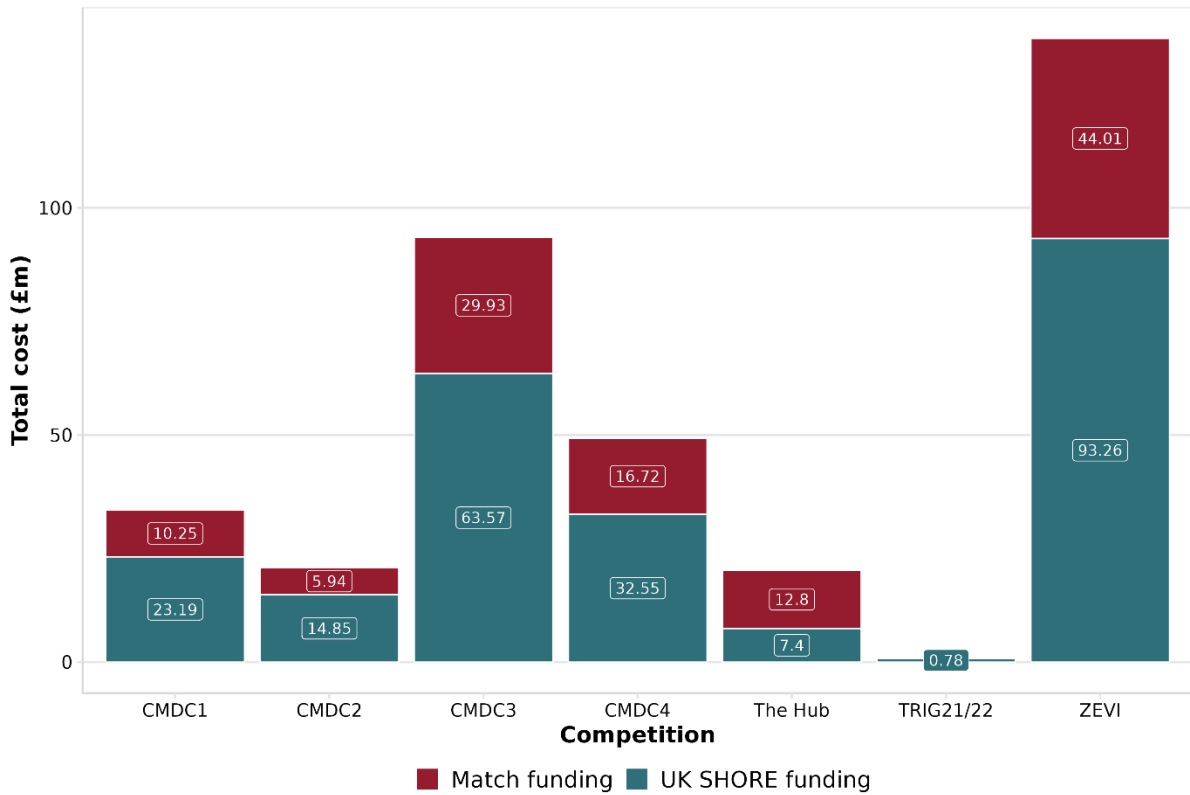
Source: UK SHORE administrative data.

Within a project, different organisations receive different levels of grant funding as a percentage of the total cost of delivery: some organisations may receive no grant funding, while other organisations may receive a significant amount of grant funding, up to 100% of the total project cost. This reflects the match funding rules, which differ across organisations, and UK SHORE must comply with subsidy control, which is outside the policy remit of DfT and IUK. Figure 16 represents the number of organisations that generated match funding at different levels across schemes: the width of the bar horizontally represents the number of organisations at each match funding percentage.

For the majority of organisations, around 25 and 50% of project funding was match funding. Firms were more likely to use 100% match funding (meaning they did not receive any grant funding from UK SHORE) in ZEVI than any other scheme. Academic organisations were the type of organisation most likely to receive 100% grant funding. Those who received no grant funding at all were typically large businesses (17 out of 39).

Figure 16   Match funding percentage across organisations
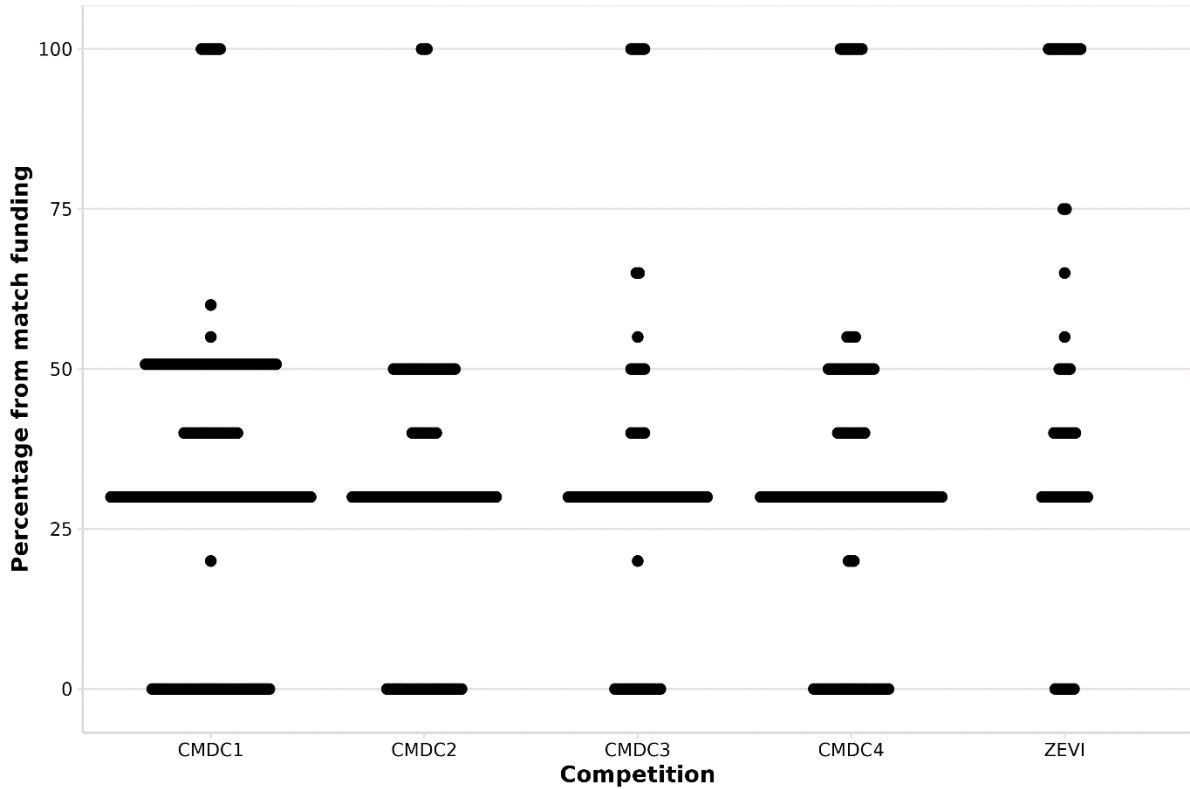
3.5   Type and application of technology

UK SHORE funding is split between TRL by schemes: some schemes focus on low TRLs (such as TRIG and the Hub), while others focus on mid to high TRLs (such as ZEVI). Figure 17 shows how TRL is distributed across schemes (see Section 3.1 for the allocation of funding across schemes). Annex D presents a definition of TRL.

Figure 17   Illustration of target TRL distribution across schemes
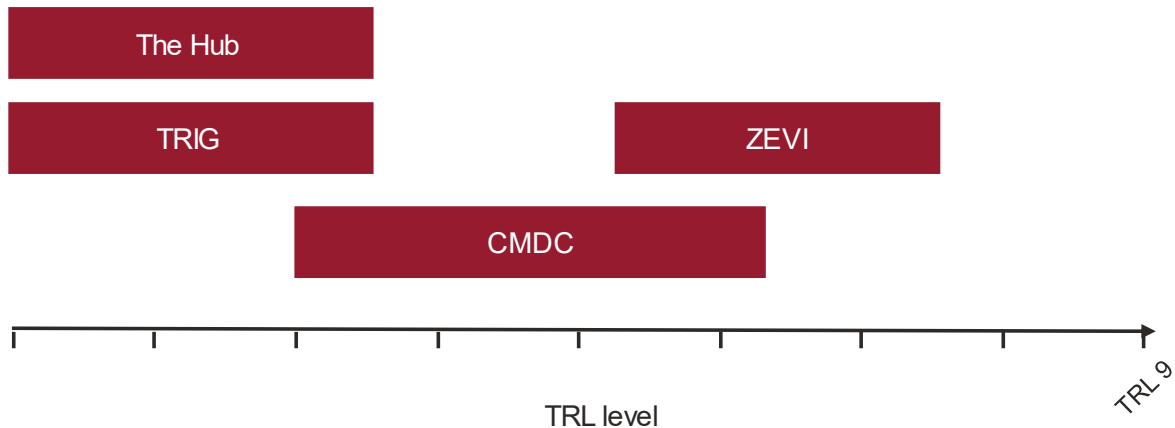
Source: *Frontier schematic.*

Note: *Illustrative, individual projects within portfolios may differ.*

Figure 18 presents the distribution of technology applications across projects in CMDC (data is not available for other schemes). CMDC1 and CMDC2 had more specific foci (smart shipping and green corridors, respectively).[11] Vessel projects were the most common type of projects in all rounds except CMDC3, where the largest tranche of projects focused on both vessel technology and infrastructure. CMDC3 also differed from earlier schemes as it focuses on slightly higher TRL projects and requires demonstration across some strands; these projects are longer and have a higher value (as shown in Figure 11). CMDC4 combined higher TRL projects (similar to CMDC3) with demonstration-level projects (like CMDC1 and CMDC2).

In addition, some more detailed information on technology studied in CMDC is available. The most common location for infrastructure projects was at ports (compared to Harbours and Offshore). Hydrogen was the most common fuel type studied (by at least 23 projects – because some products report 'multiple' fuel types and the exact fuels studied are unknown). Battery electric, fuel cell and ammonia were also commonly studied fuel types.[12]

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[11]   It is noted that future UK SHORE schemes (SSAT and the IGCF) will focus on smart shipping and green corridors, but these schemes are not included in the evaluation, as discussed at the beginning of these sectors. Projects focussing on these technologies were eligible for CMDC1 and CMDC2, respectively.

[12]   'Fuel cell' is not typically considered a type of fuel, but it has been included here as part of this analysis based on conversations with DfT.

Figure 18 Number of projects by application of technology
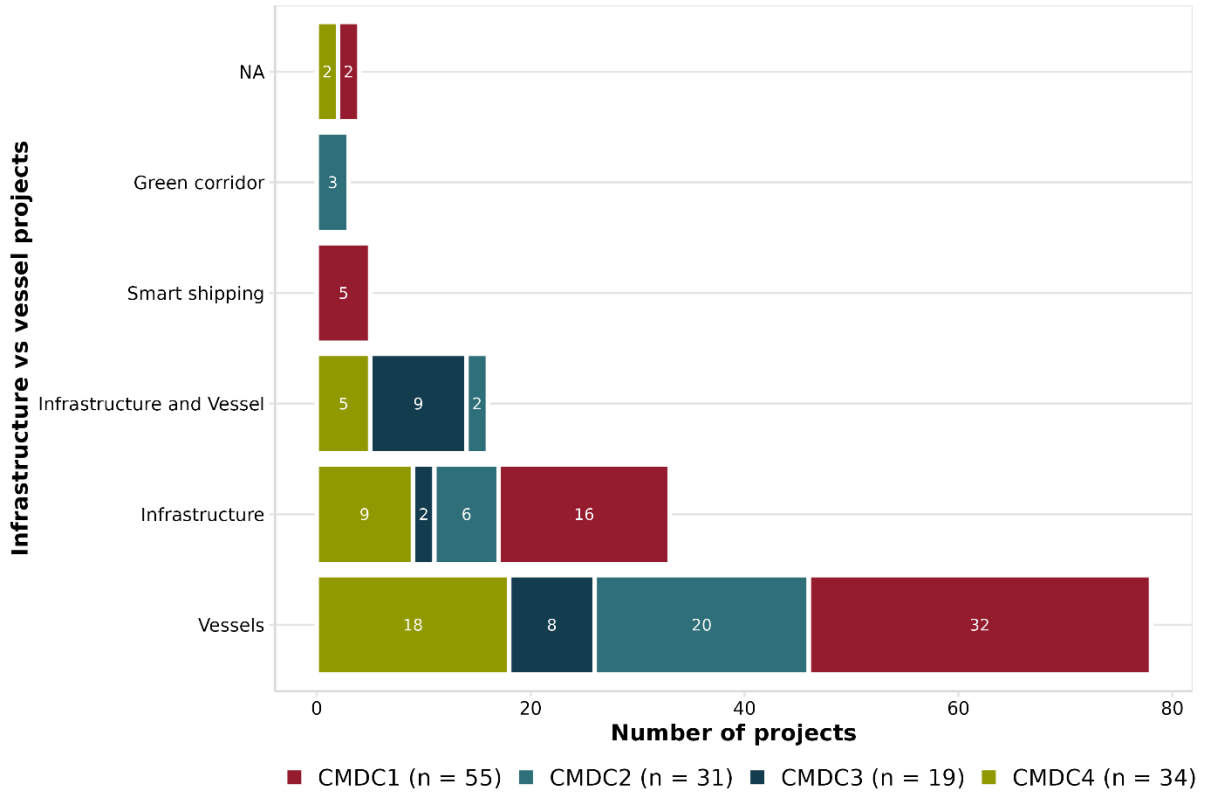
Source: Baseline monitoring data.

4   Evaluation approach

4.1   Approach and purpose of this report

This report covers both the process and impact evaluation of UK SHORE. While the process evaluation includes all UK SHORE schemes, the impact evaluation covers only a subset of schemes. At this early stage, the impact evaluation is focused on the experiences of CMDC1 and CMDC2 and TRIG 2021 and TRIG 2022 participants, as these schemes have concluded the delivery stage. The Hub is included, although evaluation primarily relates to understanding the outputs produced; given the early stage of the Hub, outcomes and impacts are not expected to have materialised to a significant extent. As the evaluation develops, as set out in the Evaluation Framework, in-depth research with wider delivery partners and scheme participants will be carried out, including additional indicators collected over longer timescales to build the evidence base over time and across the remaining UK SHORE schemes. The timeline of evaluation outputs is provided in Section 2.3.

4.1.1   Process evaluation

A process evaluation looks primarily at what worked and what could be improved in relation to the delivery of an intervention (HMT Magenta Book, 2020).

The process evaluation for UK SHORE considers the set-up of the competitions, working processes, and experiences of applicants. The evaluation provides evidence on lessons learnt for improving the design and delivery of UK SHORE and other similar schemes in the future and includes a focus on the core inputs, activities and outputs outlined in the logic models. The aims of this process evaluation are set out in Table 7.

Table 7   Aims of the process evaluation

	To understand:
1	to what extent interventions have been delivered as planned – what was changed and why
2	how far have delivery processes supported the realisation of intended activities and outputs
3	which elements of the scheme delivery are potentially transferable to other programmes
4	the barriers and enablers to delivery of the projects funded by UK SHORE
5	what elements of the schemes have worked well to date, and what could be improved
6	the experiences of applicants (successful and unsuccessful) in applying to the schemes

The process evaluation is supported by process maps, which set out the steps in the process from scheme design through to delivery, and the stakeholders involved in those steps.

One process map has been developed to reflect the UK SHORE portfolio as a whole, and an additional 4 have been created for each of the schemes: CMDC 1 to 4, ZEVI, the Hub and TRIG. These are contained in Annex A.

In addition, a matrix of sub-evaluation questions has been developed to better steer research materials. These evaluation questions (EQs) have been designed to cover all 4 schemes within the UK SHORE portfolio on which this evaluation is focusing, although research materials are designed in conjunction with the process maps to ensure the relevant questions are raised for the individual schemes. These are contained in Annex B.

4.1.2   Impact evaluation

The impact evaluation draws on best practice guidance for evaluation as outlined in the [Transport analysis guidance (TAG) unit E-1](#) and [the Magenta Book (HMT, 2020)](#). This evaluation will seek to provide lessons learnt for UK SHORE on the impact of its schemes, which can be taken forward to inform future schemes delivered by UK SHORE or future similar government schemes. The lessons can also have a wider influence on future government policy.

The focus of this report is on a shorter-term evaluation of UK SHORE. The focus on shorter-term evaluation imposes some limits on the evidence that can be gathered and the evaluation methods that can be used. In particular, given that many of the schemes delivered by UK SHORE are currently being implemented (eg CMDC 4) or are in their early phases (eg the Hub), and that the impacts of research and development programmes take a while to materialise, the degree to which outcomes and impacts will materialise by the end of 2025 is relatively limited. Much of the focus for the current evaluation period is, therefore, on understanding what inputs have been used (this was the focus of Section 3), what activities have been undertaken (discussed in the process evaluation in Section 5), what outputs have been delivered and the extent to which these outputs are in line with those intended as reflected in the UK SHORE business case (discussed in Section 6). The focus is also on what can be learnt about short-term outcomes through the quantitative data that is available or that can be collected through primary research, alongside qualitative data from delivery partners' own perceptions of the contribution and additionality of UK SHORE.

A further aim of this evaluation is to maximise learning while recognising a need to be proportionate and minimise burden on each of the participants in terms of data collection and other requests on their time and inputs.

For each scheme, the impact evaluation is organised around a set of EQs, as set out in Table 8.

Table 8 Impact EQs

EQ	Question
1	To what extent, and through what mechanisms, did UK SHORE help to accelerate and support the development of clean maritime technologies relative to what would have happened in the absence of UK SHORE?
2	To what extent, and through what mechanisms, can environmental benefits be attributed to UK SHORE?
3	To what extent, and through what mechanisms, did UK SHORE improve the commercial prospects and opportunities for clean maritime in the UK?
4	To what extent is there evidence that UK SHORE has generated positive spillover benefits?
5	To what extent has UK SHORE achieved wider social objectives?

Source: Frontier Economics.

The EQs and sub-questions are supported by the validated Theory of Change that was developed as a part of the UK SHORE Evaluation Framework in November 2023. The logic models summarising the Theory of Change are contained in Annex E.

4.1.3 Value for Money evaluation

The Evaluation Framework sets out 3 key questions to be answered as part of a VfM assessment:

1. to what extent have UK SHORE and its component schemes demonstrated strategic fit with government priorities
2. to what extent have UK SHORE and its component schemes been delivered in an economical and effective way
3. to what extent are the socioeconomic benefits (monetised and non-monetised) of UK SHORE and its component schemes likely to exceed the public costs of delivery

The first 2 EQs are addressed below in this interim evaluation. The third EQ cannot be addressed at this stage, given the need for a full impact evaluation to be conducted before assessing VfM. A more substantive VfM evaluation is expected in the final evaluation.

4.2 Evidence sources

4.2.1 Online Survey

During November and December 2023, all successful applicants, with the exception of the Research Hub, were invited to complete an online survey. The survey covered:

■ key information about roles, project and scheme, including its current TRL and commercial readiness level (CRL), geographical area of delivery, type of partner organisations and other funding streams utilised

■ satisfaction with and attitudes about different aspects of the competition and delivery process, including bid and delivery support, timescales, information and guidance, data and reporting requirements, and information sharing

■ barriers and opportunities around delivery

■ anticipated and early impacts and learnings, including employment, pace of delivery, commercialisation and if, and to what extent, the project may have progressed without UK SHORE funding

The data from this survey has been used to inform both the process evaluation and early findings of the impact evaluation. Table 9 shows the survey response rate.

Table 9   Survey Response Rate

Competition	Number of Responses	Successful Projects	Response Rate % (Successful Projects)
CMDC (1, 2 and 3)	38	105	36%
TRIG	7	26	27%
ZEVI	7	10	70%

Source: Online survey.
Note: No responses were collected from CMDC4 competition winners, as successful applicants were not known when the survey was sent out.

Although the number of responses from the CMDC competitions was fairly high (38, 36% response rate), the number of respondents from TRIG and ZEVI applicants was limited due to the small number of competition participants overall, with 7 responses from each of these 2 competitions, as shown in Table 9 above. Therefore, limited statistical analysis and conclusions can be made from this survey. All tables present results in absolute numbers rather than percentages to make the small sample sizes clear and caveat these initial findings accordingly.

Survey results show that, across the competitions, most survey respondents represented SMEs, with 28 out of 38 CMDC respondents, 6 of 7 ZEVI and 6 out of 7 TRIG respondents representing such private businesses. CMDC respondents were relatively evenly split between representing lead organisations (53%, or 20 respondents) and collaborator organisations (47%, or 18 respondents). All 7 TRIG respondents represented lead organisations, while 5 out of 7 ZEVI respondents represented lead organisations and the remaining 2 represented collaborator organisations. All CMDC and ZEVI applicants had

submitted their bids as part of consortiums, while 6 out of 7 TRIG applicants had submitted their bids independently.

The survey shows that project stage reached varies by competition. For CMDC applicants, 74% (28 applicants) of projects were complete, 24% (9) were being delivered and 3% (1) were in the mobilisation stage. All 7 TRIG projects were completed. Of the 6 ZEVI projects that responded to this question, 4 were in the delivery stage and 2 were in the mobilisation stage.

The survey method statement is provided in Annex C, with findings described in more detail in Sections 5 and 6 of the report.

4.2.2 In-depth Interviews

During December 2023, all successful and unsuccessful applicants for CMDC1 and CMDC2 were invited to participate in an in-depth interview with a SYSTRA researcher. In early summer 2024, this invite was extended to ZEVI, TRIG and the Research Hub. These competitions were selected as they progressed through the delivery stage; other competitions will be captured later in the evaluation programme. Those who opted into an interview were reviewed and, where opt-ins exceeded the interview slots available, were selected for interview based on a number of factors to ensure a range of projects were represented, including TRL and geography. It should be noted that those interviewed represented both lead organisations as well as collaborator organisations. Table 10 shows the applicant interviews that were undertaken.

Table 10   Distribution of in-depth interviews

Competition	Number of Interviews with Successful Applicants	Number of Interviews with Unsuccessful Applicants
CMDC1	2	1
CMDC2	3	2
TRIG	2	2
ZEVI	3	2
The Research Hub (Lead Organisation)	1	0

Source: Primary research.

The interview participants represented a range of project and organisation types, including commercial businesses and academic institutes.

Several of the participants had been involved in full projects, as well as with specific components as a collaborator; some were unable to bid without partner organisations as they

would not be eligible alone. One had been involved in both CMDC1 and CMDC2, 2 in both CMDC and TRIG and others had previously or subsequently applied for other projects or strands, which had been unsuccessful for a range, of reasons including timescales and eligibility criteria.

In addition, in the summer of 2024, interviews were carried out with delivery partners, including CPC, IUK and The Hub, and with stakeholder organisations: DfT (Policy and Delivery Teams) and the MCA.

Interviews were carried out over Teams, lasting around 1 hour each, with either lead or collaborator organisation representatives. A topic guide was designed to guide participants through each stage of the process, from competition to mobilisation and delivery, and outcomes, covering both impact and process elements.

4.2.3   Secondary Data

Alongside the primary research, data collated from secondary data sources was used to inform both the process and impact evaluations, as outlined in Table 11.

Table 11   Data sources used

Competition	Data used	
	Impact Evaluation	Process Evaluation
Winners data		
CMDC and ZEVI	Administrative data collected for the winning applicants of CMDC1, CMDC2, and ZEVI (eg project location, funding allocated, type and size of delivery partners). This is used to produce summary statistics in Section 3.	
Baseline data		
CMDC1 and CMDC2	39 CMDC1 projects (project leads only) and 21 CMDC2 projects. Provides comparison and benchmarks for success, including for TRL and CRL development.	Not applicable
TRIG21 and TRIG22	7 organisations involved in TRIG21 and 12 involved in TRIG22. A range of questions were used, including start TRL level, proposed measures of success, and number of employees.	Not applicable

Competition	Data used	
	More details on the data used are provided in each EQ in Section 7.	
The Hub	13 organisations are involved in the Hub. Provides a benchmark for TRL and CRL. More details on the data used are provided in each EQ in Section 8.	Not applicable
CMDC1 and CMDC2 (end of project)	A range of questions were used, including TRL, CRL, emissions benefits, financial impacts and job creation and retention. More details on the data used are provided in each EQ in Section 6.	403 responses (116 lead respondents and 262 collaborator respondents, covering 401 projects). Key questions used about collaboration, working with delivery partners, working with the MCA, and regulatory approvals.
TRIG21 and TRIG22 (end of project)	13 organisations were involved in TRIG21 and 11 in TRIG22. A range of questions were used, including TRL progress, investment or grant received and attributed to the programme, planned next steps, and job creation. More details on the data used are provided in each EQ in Section 7.	Not applicable
The Hub (end of year one)	13 organisations involved in the Hub. Provides organisation-level responses such as skills developed. More details on the data used are provided in each EQ in Section 8.	Not applicable
CMDC1 and CMDC2 (end of project)	Emissions data are extracted from a snapshot of reports; a review of select reports is done to try to rationalise certain survey, or monitoring, results.	Lessons learnt extracted from a snapshot of end-of-project reports (every n^{th} report selected within the timescale allocated to the task).
TRIG21 and TRIG22 (end of project)	Provides qualitative evidence on project views in several areas, including collaboration benefits, planned next steps, and projected future wider social benefits.	Not applicable

Competition	Data used	
	More details on the data used are provided in each EQ in Section 7.	
The Hub (end of year one)	Provides responses at a Hub level, such as papers published and policy engagement, plus a self-assessment against Key Performance Indicators (KPIs). More details on the data used are provided in each EQ in Section 8.	Not applicable

Cleaning processes for the CMDC1 and CMDC2 impact evaluation

For CMDC1 and CMDC2, the steps outlined below were used to clean the secondary data informing the impact evaluation findings. This created a dataset with 156 unique CMDC1 organisations across 51 unique CMDC1 projects, 86 unique CMDC2 organisations and 22 unique CMDC2 projects. Note that some questions were not presented to academic CMDC1 organisations, so the sample size is smaller for these questions; there are 18 academic organisations in the CMDC1 data.

Weighting of responses

There were instances where organisations responded multiple times to the survey. Responses were weighted so that weights were summed to 1 for each unique organisation[13] and project combination (noting that some organisations participated in multiple projects and so are expected to show up multiple times in the data). Each response by an organisation was weighted equally as there was no clear way to identify the 'correct' response. For example, where an organisation responded 3 times for the same project ID, each of their responses was given a weight of one-third.

This process has been used to prevent double-counting of numerical impacts and overweighting of responses in categories. It leads to cases where a fraction is recorded for the number of organisations. For example, it may be that 34.5 firms provide a specific response: the 0.5 may be due to the fact that a given organisation and project combination only provided this response in 1 of their 2 weightings. In this report, figures in the tables and charts have been rounded to the nearest integer for simplicity.

Where responses referred to project-level impacts, for example, the TRL or CRL of the project, only the responses from project leads were used. There were some instances where 2 different organisations reported being project leads. To deal with this, responses were

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[13] A manual process was used to identify cases where organisations reported their names slightly differently (for example, including 'limited' in one name but not another). One response was removed because the same organisation provided a response in which they marked their organisation name with 'revised submission'.

weighted at a project level (using project IDs) so that the weights summed to 1 for each unique project.

Outliers

In very few instances, projects reported responses that appeared to be in the wrong units (eg reporting £3 instead of £3 million). To deal with this, numerical responses, which had an order of magnitude more than 10^3 different than the other responses, were removed. Among the results included in this report, this cleaning process removed 1 observation when calculating job figures in Section 6.5. While it is possible that there are data entry errors remaining that could over or under-inflate the results, these errors are unlikely to bias the results since over-stating or under-stating figures seem equally likely.

Cleaning processes for the TRIG impact evaluation

For TRIG21 and TRIG22, the following points relating to the secondary data used for the impact evaluation findings are important to note:

■   Not all projects appear in both the baseline and end-of-project monitoring data. For TRIG22, we have both baseline and end-of-project monitoring data for 10 projects. For TRIG21, we have both baseline and end-of-project monitoring data for 7 projects.

■   The TRIG scheme funds projects under several different transport challenge areas, although only the maritime decarbonisation area is relevant to this evaluation. DfT provided Frontier Economics with only the survey responses from the relevant projects (or, in the case of the TRIG21 baseline data, the relevant responses highlighted) as well as a separate list of the relevant project IDs. Upon comparison of these 2 sources, 1 observation was removed from the TRIG22 baseline dataset, and 2 were removed from the TRIG22 end-of-project dataset. The project IDs of these observations were not included in the list of relevant IDs, so it was assumed they were not relevant to maritime decarbonisation projects.

■   The 2 surveys that were used to produce the datasets, 1 at the start and 1 at the end of the project, are not entirely consistent across years (ie for TRIG21 and TRIG22). For example, some questions were asked:

☐   in 1 year but not the other, meaning evidence for both TRIG21 and TRIG22 is not available

☐   in both years, but were worded slightly differently. In a few instances, there is a potential that this has led to differing responses from TRIG21 and TRIG22 projects (outlined in Section 7Interim impact evaluation findings – TRIG)

☐   in both years but offered different response options. Most significantly, some TRIG21 questions were open-ended (leading to qualitative evidence) when the equivalent TRIG22 questions were not. In some instances, both years were asked closed

questions, but the responses received indicate they may not have been presented with the same answer categories. Where this appears to be the case, the appropriate caveats are discussed in Section 7

This created a dataset of 7 (baseline) and 13 (end of the project) TRIG21 projects and 12 (baseline) and 11 (end of the project) TRIG22 projects.

5   Interim process evaluation findings

This section brings together findings from several evidence sources, structured against the core stages of the schemes, from competition through to delivery and outcomes. It brings together findings from:

■   the online survey (CMDC, TRIG and ZEVI)

■   project output data (CMDC1 and CMDC2)

■   the evaluation 'Lessons Learnt' log, which draws together insights from different sources, such as end-of-project reports (CMDC1 and CMDC2)

■   the qualitative findings from interviews with successful and unsuccessful applicants from all schemes (CMDC, TRIG, ZEVI and the Hub), and with delivery partners (IUK, CPC, DfT and MCA)

The following sections cover the different aspects of the process of designing and delivering the UK SHORE competitions CMDC, TRIG, ZEVI and the Hub. Research findings on the experiences and reflections of applicants, participants, fund designers and delivery partners are broken down by the different stages of process delivery: the competition phase, project mobilisation, and project delivery, and each phase is followed by a summary of which elements worked well and which could be improved upon.

5.1   UK SHORE awareness

The online survey, with successful applicants across CMDC, ZEVI and TRIG, asked about awareness of the wider set of competitions within the UK SHORE portfolio. The responses are shown in Table 12. This showed most respondents (over 90%) were aware of the 4 different CMDC competitions, while fewest were aware of the TRIG competitions and EPSRC Hub.

Table 12   Awareness and Involvement in UK SHORE Portfolio (Multiple response)

Competition (Number)	Not aware	Aware, not involved in	Aware, involved with related projects	Organisation successfully bid for funding	Organisation unsuccessfully bid for funding
CMDC1 (49)	4	13	8	24	0
CMDC2 (49)	2	7	8	25	7
CMDC3 (44)	3	16	6	14	5

CMDC4 (48)	1	18	22	5	2
TRIG 2021 (41)	23	15	1	1	1
TRIG 2022 (41)	23	10	1	6	1
TRIG 2023 (42)	24	14	3	1	0
ZEVI (48)	10	21	3	10	4
Research Hub (42)	18	11	7	5	1

Source: Online survey.

Note: *Multiple responses allowed. The competition about which the individual was responding, was excluded as an option.*

The survey also showed that 9 in 10 respondents were likely to participate in future similar competitions, as illustrated in Figure 19. For TRIG, participants were unanimous in saying they were likely to participate again in the future.

Figure 19   Following your participation in the project, how likely or unlikely are you to participate in future similar competitions?
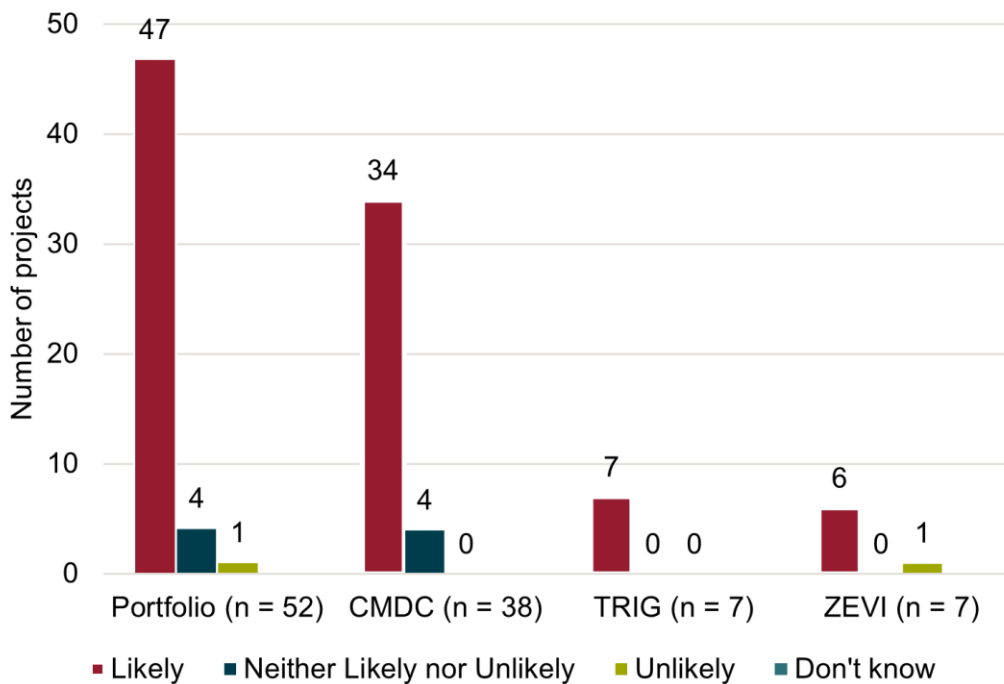
Source: Online survey.

Note: *'Likely' is comprised of those who have responded 'very likely' and 'likely', and 'unlikely' is comprised of those who have responded 'very unlikely' or 'unlikely'.*

Interviews conducted with unsuccessful applicants to the competitions showed varying degrees of familiarity with the various competitions within the UK SHORE portfolio. While all expressed familiarity with the UK SHORE portfolio, some were able to name specific

competitions within the portfolio and others were not able to do so. Those who were familiar with other UK SHORE competitions attributed this to either their own organisation, or their partner organisations, having applied to or been involved in 1 or more UK SHORE competitions previously.

5.2　Competition phase

Competition Design

Delivery partners and stakeholders briefly described their roles in the design of the competitions. Most stated the strategic objectives of the overall UK SHORE programme and its competitions were clear, and that this aided competition design. In addition, the design drew upon learnings from previous innovation competitions, for instance ones funded by the Office for Zero Emission Vessels (OZEV). Additionally, CMDC1 was described by stakeholders as a 'test bed' for future UK SHORE competitions and learnings generated from this were applied to the design of subsequent competitions:

> *"There was already a pool of expertise to pull from to do it … weren't starting from a blank sheet of paper."*

DfT

Likewise, stakeholder and delivery partners noted that all competitions in the portfolio had evolved and changed throughout the different rounds to accommodate learnings and identified improvement needs. This iterative approach to competition design can be considered a strength of the portfolio:

> *"Each competition, we continue to review, rewrite, review that and see what additional things we could potentially tweak or enhance as we go forward, for every competition."*

Delivery organisation

Knowledge about the bidding process

The survey conducted with successful applicants of the CMDC, ZEVI and TRIG competitions indicated that 42 out of 52 respondents were satisfied with the information and guidance provided by the organisation leading the competition. All competitions held a variety of briefing sessions during this phase, and comprehensive information about dates, eligibility, and scope was provided online on DfT's website or delivery partner websites. Examining responses for each competition separately, all 7 respondents representing the TRIG competition reported being satisfied. The same applied to 6 of the 7 ZEVI successful applicants who responded to this question. The low number of responses from the ZEVI and TRIG competition limits any conclusions that can be drawn. The results of this are shown in Figure 20.

Figure 20   To what extent were you satisfied or dissatisfied with the information and guidance provided by the organisation leading the competition?
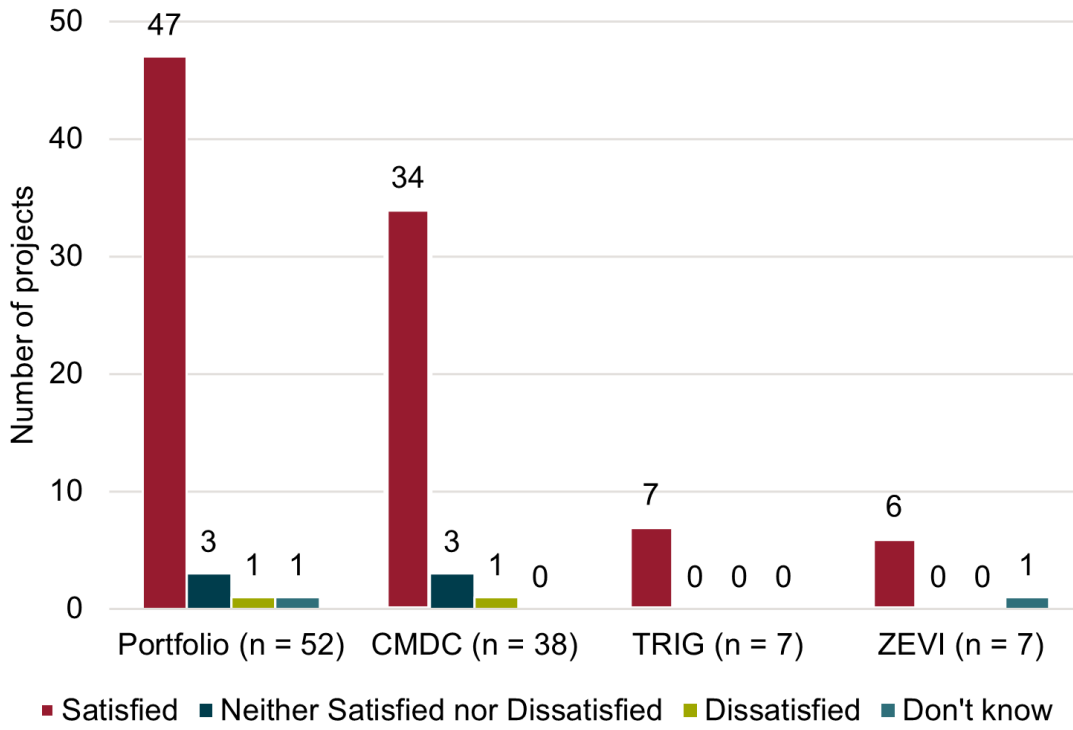
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

For successful CMDC competition applicants who responded to the survey, there were high levels of satisfaction with information and guidance provided by the organisation. Satisfaction was generally high across all CMDC competitions, and those participating in CMDC2 (Feasibility or Collaborative R&D) tended to be the most satisfied. Additionally, those representing lead organisations, rather than collaborators, tended to be more satisfied, although satisfaction was high overall regardless of role.

Similarly, in the interviews both successful and unsuccessful applicants across each competition were largely positive about the bidding process with most finding the requirements clear. However, there were mixed experiences with the timeliness and helpfulness of support from IUK, with some less positive feedback from ZEVI and TRIG applicants in particular:

"If we had a query, it was quite efficiently answered really."

CMDC2 successful applicant

> *"We had some questions for Innovate that it was quite difficult to get answers to. We had a specialist bid writer who was seconded to us by [company] … she told us that she had sent in requests for information that took a very long time to answer and wasn't accurately answered."*

<div align="right">

ZEVI unsuccessful applicant

</div>

Nevertheless, TRIG 2023 pre-programme questionnaire data showed that 5 out of the 7 successful applicants attended some form of pre-application webinar or other form of support for the application process, while 2 applicants did not attend any.

The majority of those interviewed, and across the competitions, specifically stated that the bidding requirements were clear and straightforward:

> *"I think the whole process is well thought out – compare this to the EU processes which we have, it's simpler."*

<div align="right">

TRIG unsuccessful applicant

</div>

However, applicants unfamiliar with the IUK application process felt they required additional guidance on expectations, and maritime businesses new to IUK need extra support on delivery and reporting expectations. Organisations who were unfamiliar with the bidding process found the level of guidance and support to be insufficient. Likewise, others, during interviews, noted that communication from the UK SHORE team could be improved to better support organisations in understanding the regulations and requirements of the bidding process.

Time and resources available for bid preparation

The survey conducted with successful UK SHORE applicants indicated lower satisfaction with the amount of time available to prepare bids compared to satisfaction with the information and guidance provided, as illustrated in Figure 21. Across CMDC, TRIG and ZEVI, 30 successful applicants who responded to the survey reported being satisfied with the amount of time, and around a fifth were dissatisfied. The percentage varied by competition, with around half of CMDC and ZEVI competition successful applicants reporting being satisfied and all TRIG competition applicants being satisfied (noting that for the latest TRIG competition, the application period was just 5 weeks; ZEVI was 7 weeks).

From survey responses from successful CMDC applicants, 27 were satisfied with the amount of time allowed to prepare bids. However, satisfaction decreased as the timescales decreased through the competition rounds. More CMDC1 candidates (6 out of 8, 75%) reported being satisfied with the amount of time allowed to prepare their bids (the application period was 11 weeks) than those who had won CMDC2 (11 out of 21, 52%; the application period was 7 weeks) or CMDC3 (3 out 6, 50%; the application period was 6 weeks). Additionally, while 18 of the 22 respondents representing a collaborator organisation were satisfied with the time allowed, the same only applied to 10 of the 30 respondents representing lead organisations.

Figure 21   To what extent were you satisfied or dissatisfied with the amount of time you had for preparing your bid?
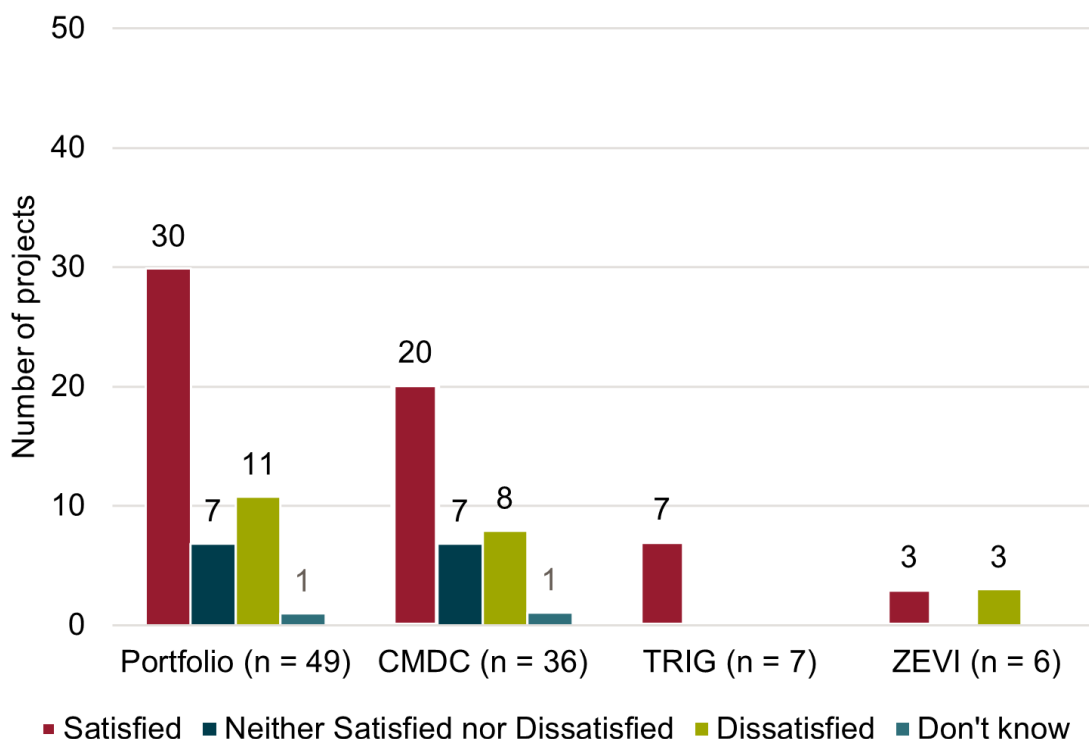
The in-depth interviews conducted in 2023 with CMDC applicants reflected the same mixed satisfaction with the time allowed for preparing bids. There was mixed feedback from both successful and unsuccessful applicants on the time and resources they had to prepare their bids. Three stated they had adequate time and resources, and 5 stated that the timescales were a barrier to them. Of those that stated time constraints were a challenge, all referenced the involvement of partner organisations as part of this; 1 having non-UK partners and not having enough time to gather the required team together, another requiring quotations from technical partners that could not be prepared in time, and generally the challenge of coordinating across a large team. In addition, 1 applicant stated that a delayed response from the MCA on queries delayed their submission.

In the interviews conducted in the summer of 2024 with applicants to the Hub, ZEVI and TRIG competitions, the applicants were divided in their opinion of whether there was sufficient time between the competition announcement and the deadline for bid submission. Two applicants found the time required sufficient, with 1 applicant noting their industry experience meant they were used to short turnarounds. Three of the five ZEVI applicants described the timescales

as very tight, as did the successful Hub applicant, primarily attributing this to the size of the consortium and the requirement for match funding:

"It's a poor commercial decision, especially for an SME, to spend that period of time without being paid on a completely speculative bid. It doesn't work, you know, and my feedback at Innovate at the time was … You need to have an expression of interest stage."

ZEVI unsuccessful applicant

All stakeholders and delivery organisations involved in delivery noted they would have preferred it if competitions were announced earlier, allowing a longer period of time for receipt of applications, although it was recognised this was not possible due to government processes. However, all also felt satisfied with the quantity and quality of bids received:

"If they [potential applicants] knew that these things were happening in advance, we'd probably get a lot more interest and even better-quality applications … we did get good-quality applications, but we could have had more."

Delivery organisation

It was also noted by both delivery partners and applicants that the length of time competitions are open for can affect the quality of consortia, not allowing sufficient time to get all suitable partners on board:

"It [the timescale] was tight and it was a bit hairy putting the consortium together, we ended up with a collaboration of 13 universities. At the time when we submitted, we had 72 project partners."

Delivery organisation

Despite this, delivery partners, stakeholders and applicants observed how the competitions were increasingly competitive and oversubscribed. One delivery organisation highlighted that reviewing the volume of applications for 1 of the competitions was a challenge:

"We had way, way too many applications for the number of technical reviewers that were lined up internally, which clearly didn't help, making the process much longer in terms of being able to sort of go through and review everything. So, everyone had quite a hefty workload."

Delivery organisation

Further to this, it was explained that in the most recent TRIG phase, 90 interviews were carried out, more than the planned 70, which reflected the quality and quantity of the bids received.

The DfT noted that the timing of competitions could result in some organisations bidding for the 'wrong' competition (not most appropriate for their project) and that they strived to provide an early indication to the industry if a more appropriate competition was coming.

A review of a random sample of 16 CMDC1 end-of-project reports highlighted a suggestion that extending the initiation period for larger projects would be appropriate, adhering to at least

a 3-month timeframe according to IUK standards. The current 8-week open competition window was reported to pose a risk to some organisations, especially considering the scale of innovation funding for the maritime sector. The reports suggested that fixed, short delivery timescales have deterred some potential bidders, especially those with larger projects; these anecdotal findings support the evidence from the survey and interviews, particularly with regard to smaller organisations.

Assessment and evaluation criteria

The survey of successful applicants shows overall high satisfaction (47 of 49 respondents answered 'satisfied') with the clarity of the eligibility criteria and scope of the competitions. Across all competitions, the relevant information was available online and shared through various webinars and events. Satisfaction on this point was consistently high, regardless of the UK SHORE competition, as illustrated in Figure 22. Similarly, participants of the in-depth interviews raised no particular concerns on this aspect of the competition.

Figure 22   To what extent were you satisfied or dissatisfied with the clarity of the eligibility criteria and scope of the competition?
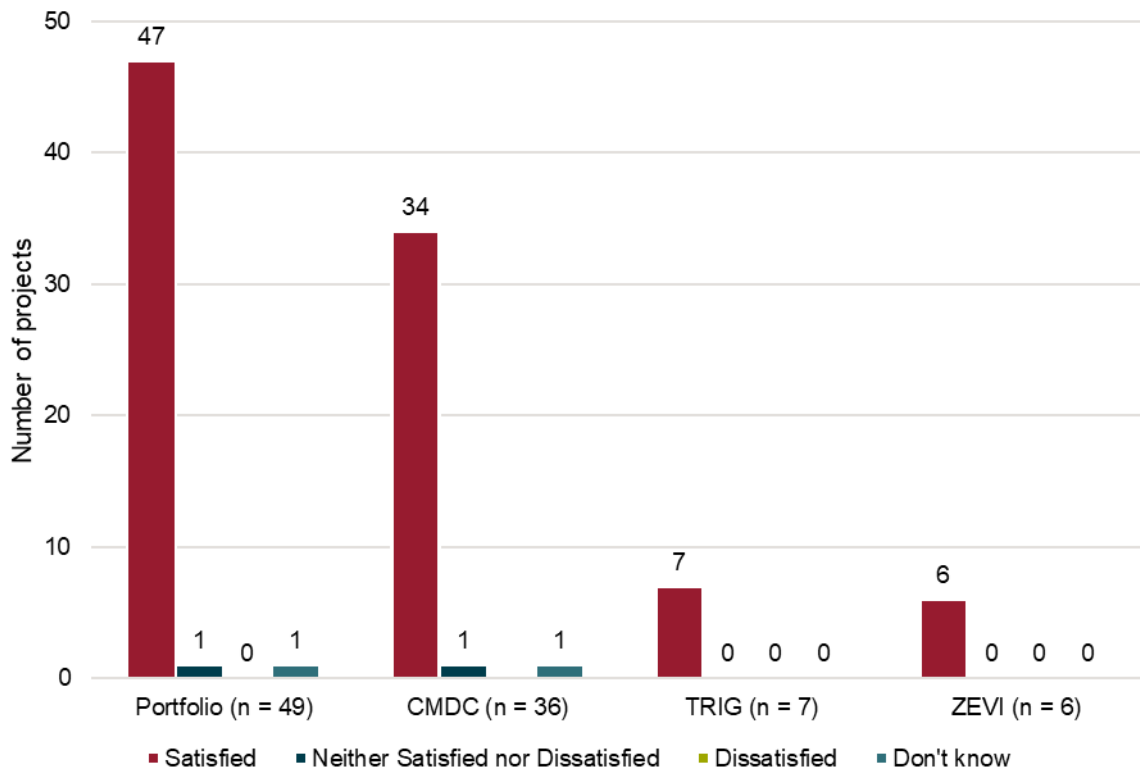
Source: Online survey.
Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

Although this was not raised as an issue during interviews conducted in 2023, the CMDC1 end-of-project reports found that organisations that were unfamiliar with or new to the bidding process reported a lack of awareness about the assessment and evaluation criteria. In addition, some respondent organisations praised the selection criteria, particularly the requirement for proposals to include clear collaboration plans, detailed problem identification and solution strategies, as well as quantifiable objectives and milestone setting.

Interviews conducted with applicants to the ZEVI and TRIG programmes in the summer of 2024 showed that they found the eligibility requirements and evaluation criteria for the competitions clear. However, delivery partners felt both the competitions would benefit from further clarity on scope, having received a high volume of queries. In particular, the 'capital' element of ZEVI was noted to have caused some confusion, and the 'challenge' scope for TRIG.

One delivery organisation noted that they felt the design of the competition may not be accessible to all and that it may be useful to provide reasonable adjustments to applicants. For instance, the organisation described how some applicants might prefer to give oral rather than written submissions or that longer timeframes could be provided for neurodivergent applicants. However, steps have been taken to address this. For example, questions in the earlier TRIG rounds that were perceived as too broad were refined for 2024:

> *"The one element that we've tried to incorporate specifically this year is to make the application questions more accessible and the whole process more accessible … based on feedback from last time. The questions, for instance, have been rephrased both for the application form and also for the interview questions."*

Delivery organisation

The reports highlighted anecdotally positive views about the large funding levels available. However, a randomly selected snapshot of 16 reporting organisations also expressed concerns that the level of commitment and reporting expectations were too high compared to the funds available. Further, they noted an inequality of fund distribution, with fewer awards being granted to underrepresented sectors such as fishing. Additionally, organisations felt that the government might view failures as inefficient use of funds, particularly for projects with low TRL but high potential for research and development.

Experiences with the assessment stage

In-depth interviews conducted with applicants to the ZEVI and TRIG competitions showed some dissatisfaction with the interview stage of the assessment. This dissatisfaction was particularly clear from the unsuccessful ZEVI applicants that were interviewed and 1 TRIG unsuccessful applicant, with the main points of contention being that the interview panel was perceived as having insufficient technical knowledge and industry experience and a perceived discrepancy between different stages of assessment. Regarding the stages of assessment, some applicants described being surprised at how differently their applications were scored at the interview, as compared to at the written application stage.

However, delivery organisations were aware of these perceived issues and looked to address them. Firstly, they noted that the pool of assessors is limited given the niche nature of the industry, but they have taken steps to increase the number of assessors. Secondly, delivery organisations described purposefully designing assessments to comprise both written and interview components, as they found this two-stage process enabled a more thorough assessment of projects' feasibility:

> *"We could always expand our pool of assessors ... in particular getting assessors that have a level of maritime regulation [knowledge] … the trouble is, maritime, although it seems like a huge sector, it's actually quite closed and small, a lot of the same people are involved in a lot of the same things. So, most of the people I want on my projects, assessing them, are somehow involved in a project, so they're conflicted out, so they can't assess it."*

Delivery organisation

Despite this, delivery partners and stakeholders were satisfied with the level of rigour used in assessing applications and that improvements are always being made to the assessment process, including additional levels of moderation and deliberation sessions:

> *"This year I've implemented having three technical reviewers per proposal. These allow us to have a better moderation of scoring and also better balance of ideas … I was very keen to introduce that and now it has happened because we've got the resources to do that."*

Delivery organisation

Likewise, DfT recognised the importance of the assessment being done independently:

> *"That [delegating assessment to delivery partners] was very much something we wanted to devolve to the organisations running it … [to remove any element of] political decision-making."*

DfT

Feedback and Outcomes

Of those who spoke about bid feedback in their interviews, most described having found the feedback relatively high level and not particularly informative. Aligned with this, delivery organisations did accept they do not have the resources to provide detailed feedback to all applicants:

> *"I'd like to say we can improve on the feedback we give applicants from the interview panel, but I just don't quite know what's possible with the time that's available."*

Delivery organisation

One TRIG applicant noted they would like greater transparency on the successful bids, an understanding of what criteria deemed it successful, and the panel's feedback, as they felt this would aid confidence in the process and help them shape future bids.

Some applicants, particularly unsuccessful ones across different competitions, noted that the same organisations were consistently successful (see Section 9.6 for more details). This was also observed by delivery organisations and DfT, but was not necessarily considered a negative outcome. Aligned with the UK SHORE programme objectives, DfT noted that the competitions are, to some extent, designed to 'ramp up' projects through different stages and TRLs and provide an 'innovation pipeline'. As such, some further consideration of transparency and messaging regarding successful bids may be beneficial:

> *"What I would say, is that throughout the CMDCs, you start to see the same faces come in. So, once people realise how to write their maritime application and, you know, what we're looking for, you'd get a lot of the same sort of people. … so I think one thing we can improve on next time is extending that reach out to people who aren't in the know about the maritime funding for whatever reason."*

Delivery organisation

Conversely, another delivery organisation specifically stated that they carry out a high volume of market outreach and 'scouting' of specific organisations, and in interviews, DfT explained that "a lot of energy was put into engaging with the sector to get them ready to bid for these kinds of funds," as grant funding was new to much of the sector.

One CMDC participant explained in an in-depth interview that for small companies, raising the private funds (match funding or private investors) in the timescales required for CMDC (2 months for that particular competition) was challenging, and later explained that the project would not be feasible without both CMDC funding and private funding. Similarly, the Hub noted that bringing together match funding in the short application window was challenging, particularly due to the governance processes required for academic institutions.

What worked well

In summary, both successful and unsuccessful applicants interviewed highlighted several things that worked well as part of the competition stage, which were also largely reflected in survey responses:

- a high level of awareness of the competitions within the UK SHORE portfolio

- straightforward and easy-to-understand bidding requirements, particularly for those experienced in bidding for such funding

- the information provided on the website was useful

- A recognition that 'sector readiness' was a key component to the success of the competitions, with good levels of market engagement and outreach activities taking place.

What could be improved

Although survey responses indicate overall satisfaction with timelines, some interview participants experienced barriers with the timescales, particularly where their bid involved

several partners or collaborator organisations, particularly for the ZEVI competition. Similarly, delivery partners and stakeholders agreed an earlier announcement and longer time frame would be preferable. **Overall, the competition phase timescales were considered appropriate. However, a 3-month application period is usual in the industry, so consideration could be made to align with that**.

A number of applicants noted that communication from the UK SHORE and delivery teams could be improved to better support organisations in understanding the regulations and requirements of the bidding process. Further, delivery partners agreed scopes could be clearer but noted this is reviewed and improved with every iteration. Similarly, it was felt that regulations and requirements could be better explained during the application process, particularly for newer applicants. **Early involvement from both DfT and the MCA would benefit applicants by expanding their knowledge and awareness of the wider portfolio and regulatory processes and requirements**.

In the end-of-project reports for CMDC1, respondent organisations suggested that to enhance future iterations of UK SHORE, consideration should be given to the inclusion of an interview stage within the assessment phase for future competitions; it was suggested an 'Expression of Interest' stage would help in the filtering process. Interview participants also noted that some of the feedback on their bids could have been addressed with the opportunity to engage with assessors, and others felt the feedback was not sufficient. Across TRIG and ZEVI, concerns were raised about the assessors' technical knowledge and experience. **A review of the assessment stage to ensure consistency across projects and efficient scrutiny may help enable 'near misses' to succeed and better support those less experienced in competition processes. Likewise, greater transparency and more publicity around which bids were successful, communicated to all applicants, would support the process**.

5.3   Project mobilisation

Next steps after finding out the bid was successful

Those who were successful were asked during in-depth interviews about the next steps with their project following notification of funding. Two noted that they had already started at risk prior to confirmation of funding, and another stated that they took out loans to support overheads and immediate costs. This is consistent with survey findings, which noted that a third of respondents used other sources, of which around half used their own funds to support their projects. Other activities that took place included early-stage data collection; kick-off of regular meetings led by project lead organisations; notifying partners; start of regulatory processes; set-up of steering groups; review and adjustments of project scope, plans and timelines; setting up agreements between collaborators; and setting up monitoring arrangements.

Timescales

In the survey of successful competition applicants, the vast majority expressed satisfaction with the timeliness of notification of the outcome of bids. In the survey of successful applicants across CMDC, TRIG and ZEVI, 50 of the 52 respondents said they were satisfied with this timeliness, as outlined in Figure 23. Looking at ZEVI respondents only, satisfaction appears lower, with 33% stating they were dissatisfied. However, as this reflects the opinion of 2 respondents out of a base of 6, it is difficult to draw conclusions from this.

Figure 23   To what extent were you satisfied or dissatisfied with the timeliness of notification of bid outcome?
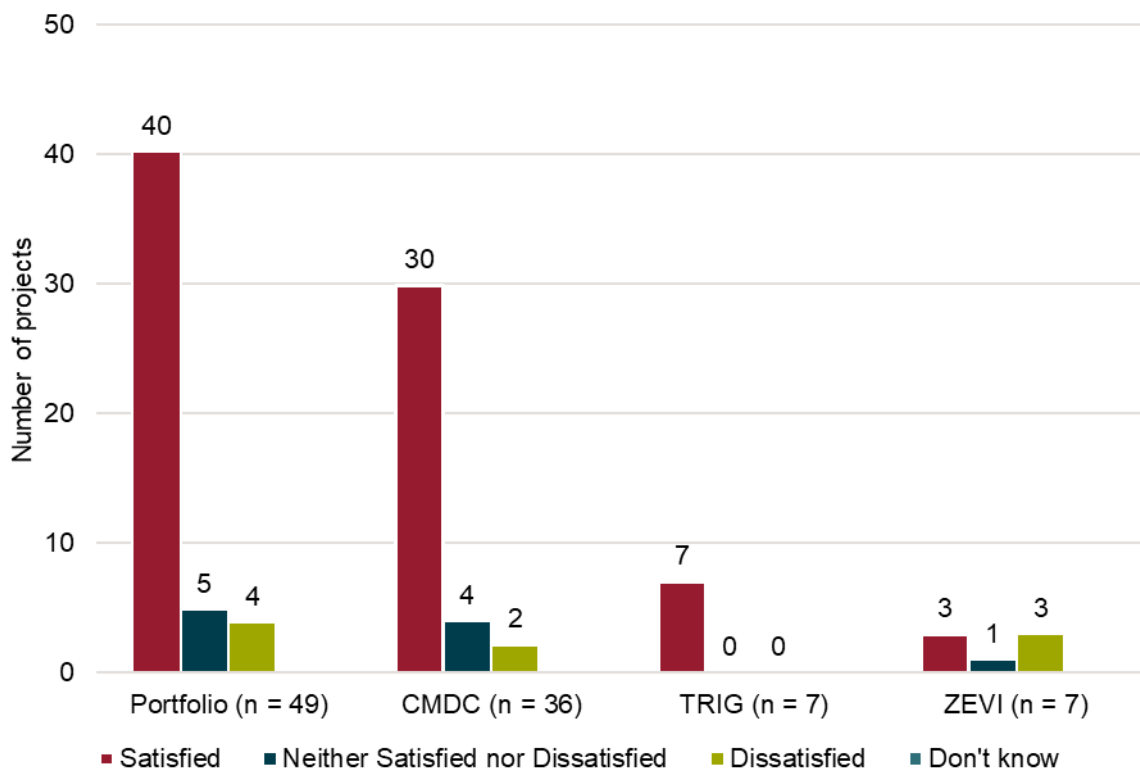
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

With regards to the survey responses from 36 successful CMDC applicants, those who had won CMDC1, all 9 respondents were satisfied with the time it took to be notified of the outcome of their bids, 17 of the 21 respondents who had won CMDC2 were satisfied, and of the 6 respondents who represented organisations who had won CMDC3 were satisfied. Additionally, 14 respondents representing collaborator organisations (out of a base of 16) were satisfied with response times compared to those representing lead organisations, of which 11 of the14 respondents were satisfied with this.

In support of this evidence, 2 applicants who participated in an in-depth interview felt the outcome was not communicated in a timely manner, whereas 3 participants specifically highlighted the prompt communication of outcomes, likewise with receipt of funding.

Despite this, a review of a random snapshot of 16 CMDC1 end-of-project reports highlighted time as being a significant barrier in the project mobilisation stage for some. Anecdotally, respondent organisations found that due to the short turnaround time between notification of successful outcome and project start, even minor setbacks in the project mobilisation could affect delivery times. The timescale between notification, and having to commence work for the Hub, was felt to be particularly short.

Compared to satisfaction with the time it took applicants to be notified of the outcome of their bids, survey results show that fewer applicants reported being satisfied with the timeliness of allocation of funding, as shown in Figure 24.

Figure 24   To what extent were you satisfied or dissatisfied with the timeliness of allocation of funding for the competition?
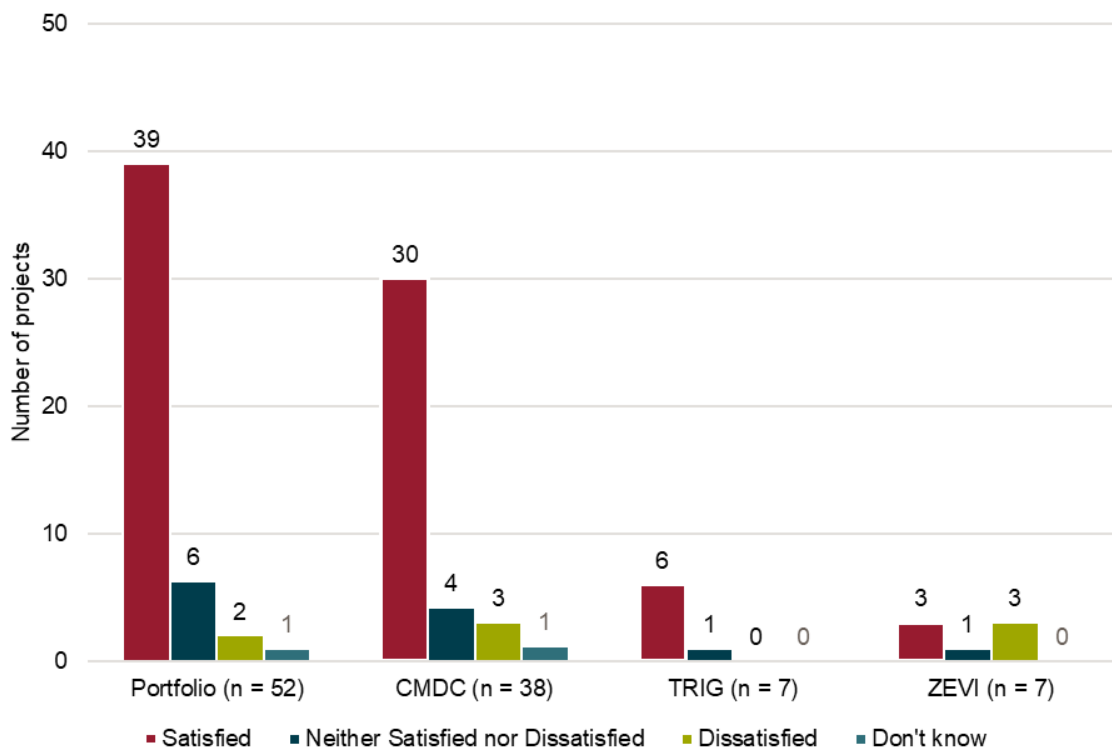
Source: Online survey.
Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

However, 3 in 4 (39) applicants across the 3 competitions (CMDC, TRIG and ZEVI) reported being satisfied with the time it took for funding to be allocated, and therefore, overall dissatisfaction was low. Although the number of respondents who had successfully received

ZEVI funding was low (7 responses) and therefore difficult to draw conclusions from, it is worth noting that equal numbers of these respondents were dissatisfied or satisfied with the time it took for funds to be allocated, with the period between competition close and notification being 7 weeks.

With regards to respondents who had won a CMDC competition, where the period between competition close and notification was 7 weeks, there were some differences in satisfaction with the timeliness of allocation of funding. Out of respondents whose projects had won CMDC1 or CMDC2, compared to those who had won CMDC3 funding, more were satisfied with the time it took for funding to be allocated (8 out of 9 CMDC1 successful applicants, 17 out of 21 CMDC2 successful applications and 5 out of 9 CMDC3 were satisfied with the timeliness of allocation of funding).

Among CMDC successful applicants who represented collaborator organisations (17), 16 were satisfied with the timeliness and 14 of the 20 respondents representing lead organisations reported being satisfied with how quickly the funding was allocated.

Further to this, 2 of the successful applicants participating in in-depth interviews felt the mobilisation phase was too short; and 1 of these noted a challenge to spend the required budget during this stage and felt they had to spend money at a quicker pace than they would have wished. However, none reported any significant difficulties in completing the mobilisation phase.

Change Control

Respondents to the survey of successful applicants across the CMDC, TRIG and ZEVI competitions were largely satisfied with how change requests were managed. Looking at all the competitions together, 30 of the 52 respondents indicated they were satisfied with this, as illustrated in Figure 25. However, levels of satisfaction were lower here than across other elements of the competition.

Figure 25   To what extent were you satisfied or dissatisfied with how change requests were managed?
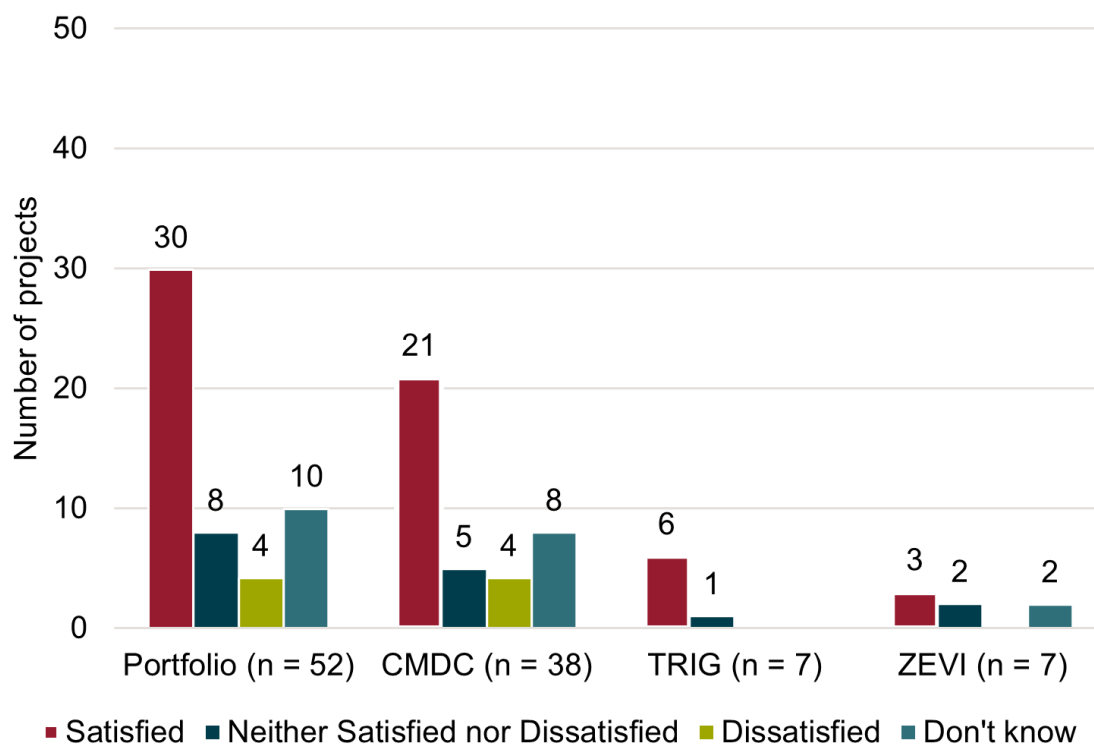
For successful TRIG applicants, 6 out of 7 reported being satisfied, 1 was neither satisfied nor dissatisfied, and none reported being dissatisfied with the way that requests for change were managed.

There was some variation in levels of satisfaction with change request management across the different CMDC strands. While all CMDC1 successful applicants who responded to this question (5) were satisfied, the percentage satisfied with the management of change requests dropped to 71% of CMDC2 winners (base of 17) and 50% of CMDC3 winners (base of 8).

To illustrate this, 1 interview participant, successful in CMDC, noted that during scope revision mid-project, they received a good level of support from Project Leads and the Monitoring Officer, especially in replanning the scope and reallocating resources with a tight deadline. However, another explained that the change control process was quite onerous and had potential to cause knock-on impacts with funding claims:

> " … the change process is quite involved … if you're not really on top of it and usually you're so busy doing the project, the project management side can lag

until it's time to start making a claim. That means that your claims get delayed which could be a bit frustrating if you've got your finance team asking why you haven't claimed yet."

CMDC2 successful applicant

Conversely, change control procedures were not flagged as an issue by TRIG, ZEVI or Hub applicants in in-depth interviews.

What worked well

Most successful participants interviewed were satisfied with the timeliness of notification of the outcome of their bids (on average, 7 weeks for each competition), and others noted useful feedback was received. Likewise, nearly all survey respondents were satisfied with the timeliness of allocation of funding, indicating processes are working well.

What could be improved

Participants did not specify anything that could be improved in the mobilisation phase in future. However, as detailed above, a small number of participants felt that the timescales for mobilisation were too short.

With regards to change control, across the portfolio just over half (30) were satisfied with this and a further 10 stated 'don't know', which suggests that around 80% of projects made a change. Across the portfolio, 8 were neutral about change control processes and 4 were dissatisfied. Qualitative data provided some mixed insights from CMDC applicants, with 1 participant stating they received a good level of support for change control processes, whereas another found it an onerous process, although no ZEVI, TRIG or Hub interviewees raised change control as an issue. **Given the lower level of satisfaction here compared to other process elements, there may be merit in reviewing the change control processes**.

5.4   Project delivery

Views on delivery period

Across the interviews with successful applicants, all reported meeting their planned objectives and outcomes to some extent, but all experienced some challenges with delivery or delivery timescales, which are further explored below.

Barriers and enablers to delivery

In the survey, respondents were asked to report on whether they had experienced a list of project barriers. As shown in Figure 26, the most frequently reported barriers were regulatory challenges and procurement or supplier challenges, both of which were experienced by 42 of the 52 survey respondents. Following this, 33 had experienced resourcing challenges to do with recruitment and expertise and 32 had experienced technological limitations.

More than half of survey respondents (28) across the CMDC, TRIG and ZEVI competitions, reported experiencing 'other' barriers. When asked to describe these challenges, those that provided examples included difficulties with multiple partners across different organisation types being required to fundraise simultaneously, and costs to do with Classification Societies.

Figure 26   To what extent did you experience any of the below barriers, in the delivery phase of your project? (multi-response)
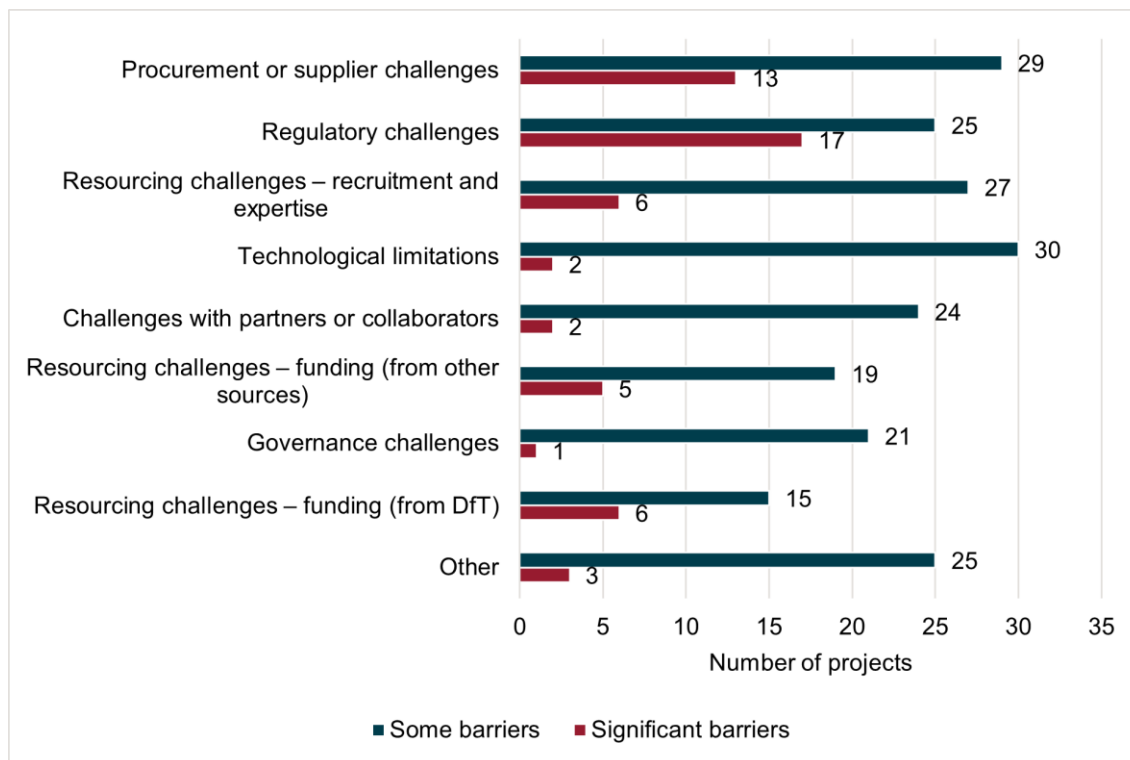
Source: Online survey.

Note: *From a base of 52 respondents across the CMDC, TRIG and ZEVI competitions. Number of projects which had experienced either significant or some barriers with different project elements.*

Survey respondents were also asked to describe the nature of any of the challenges they experienced. Written responses were provided by 34 respondents, across a number of themes. Thirteen respondents reported regulatory changes, such as struggling to obtain approval to test new technologies offshore, or projects being delayed as they were awaiting regulatory approval. Nine projects reported supply chain issues, such as disruption due to COVID-19 and impacting upon delivery of parts, samples, prototypes and services. Recruitment difficulties were noted by 6 firms, including a lack of UK-based technical talent post-Brexit; the impact of this is discussed further throughout the impact evaluation. Six projects felt they had insufficient time and required longer time to work on their projects, which were demanding and frequently delayed. Projects also noted difficulties with subcontractors, for example, due to recruitment difficulties or staff changes (4 respondents); partner organisations, for example, collaboration across different organisation types (4 respondents);

and, securing further funding (4 respondents). Underspending, wastage and technical challenges, such as safety or data privacy issues, were each noted by 2 respondents:

> *"Ports are highly regulated environments with very risk averse approaches to new technologies. Overcoming these barriers is a major challenge in addition to the capital-intensive nature of bringing in new technologies to such environments."*

<div align="right">

CMDC2 successful applicant

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A review of a random sample snapshot of 16 CMDC1 end-of-project reports also noted that some project teams felt existing regulations did not align with evolving technology, which is especially important for programmes such as UK SHORE, which emphasise new and innovative technology:

Challenges reported during in-depth interviews align with the survey finding. The allocation of funding was an issue raised, with 1 participant explaining that there was a lack of equal contribution among partners, and that the funding arrangements did not support this effectively:

> *" … It's quite demoralising for the other partners who are really committing and working hard when they see the other partners, they're not really doing very much."*

<div align="right">

CMDC2 successful applicant

</div>

One respondent experienced some technical challenges including: unexpected challenges with the testing partner included limited access to test laboratories, staffing problems at the university, health and safety issues, equipment failures, and difficulty completing testing for the project. The participant noted a lack of flexibility in the R&D programme and emphasised the importance of building flexibility into research programmes to reflect that "things can go wrong", especially with new developments.

One CMDC participant explained the importance of communication, which reflects similar sentiments from some others:

> *"We set up really regular meetings and we had a lot of communication which I think helped massively."*

<div align="right">

CMDC2 successful applicant

</div>

TRIG and Hub participants in particular flagged an issue of recruitment and retention; the funding was perceived as useful to hire early career researchers, but these contracts are generally short-term and there was a perception that graduates currently view academia as less lucrative than other career paths, making recruitment of early career researchers challenging. Similarly, recruiting from abroad and obtaining work visas is increasingly difficult. This is discussed further in the impact evaluation. In addition, 2 interview participants noted that recruiting and retaining a project manager for their project was a challenge for them:

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"It's primarily about not being able to recruit from the UK. We don't have people coming through with PhDs [..] and it's a real problem, and I don't know if that's to do with the status of, 'why do a PhD?', and also money … So we primarily recruit from abroad, the post-doctoral researchers, and then it's tied up with visas and all sorts of long HR processes. So, it's really quite tricky."

The Hub

Working as a consortium

Survey data showed that all CMDC (38) and ZEVI (7) applicants who responded to the survey had submitted their bids as part of consortiums, while 6 out of the 7 TRIG applicants who responded to the survey had submitted their bids independently.

A range of organisation types were involved in consortiums. For CMDC projects (38), the most common form of organisation to work with as part of a consortium was private business (SME), which 30 of the project respondents reported working with. 17 of the 38 CMDC projects also had an academic institution in their consortium, while 12 projects collaborated with a research and technology organisation (RTO) and 11 were in a consortium with a large private business. For ZEVI, the most common collaborator was a private business (SME), which 5 of the 7 projects collaborated with. Four ZEVI projects were partnered with an RTO, and 3 projects each collaborated with an academic institution or a large private business. Two ZEVI projects had a public sector organisation as part of their consortium. The detail of this is shown in Table 13.

Table 13   What other organisations form part of your consortium? (Multi-response)

Consortium organisation type	CMDC	TRIG	ZEVI	Total
Private Business (SME)	30	1	5	36
Academic Institution	17	0	3	20
Research and technology organisation (RTO)	12	0	4	16
Private Business (Large)	11	0	3	14
Public sector organisation	5	0	2	7
Charity	2	0	0	2

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Consortium organisation type	CMDC	TRIG	ZEVI	Total
Other	2	0	0	2
Other non-profit organisations	1	0	0	1
Private Business (SME)	30	1	5	36

Source: Online survey.

Note: From a base of 52 respondents across the CMDC, TRIG and ZEVI competitions.

In relation to working as a consortium, the self-reported project output data from CMDC1 and CMDC2 showed that out of 312 respondents (across both lead and collaborator responses) who responded to the relevant question, 86% (270) were very satisfied or satisfied with how effective the consortium was in terms of delivering the project. Of those that provided commentary on this, some noted that there was a high level of positive collaboration between partners and others noted that most issues related to delivery and project management were due to external reasons such as technical difficulties and lack of time. This aligns with the feedback provided in the applicant survey.

Support from Delivery Partners

In the survey with successful applicants, 47 of the 52 respondents were satisfied with the guidance provided by the CPC (TRIG) or IUK (ZEVI and CMDC), as illustrated in Figure 27.

Figure 27   To what extent were you satisfied or dissatisfied with the information and guidance provided by the CPC or IUK?
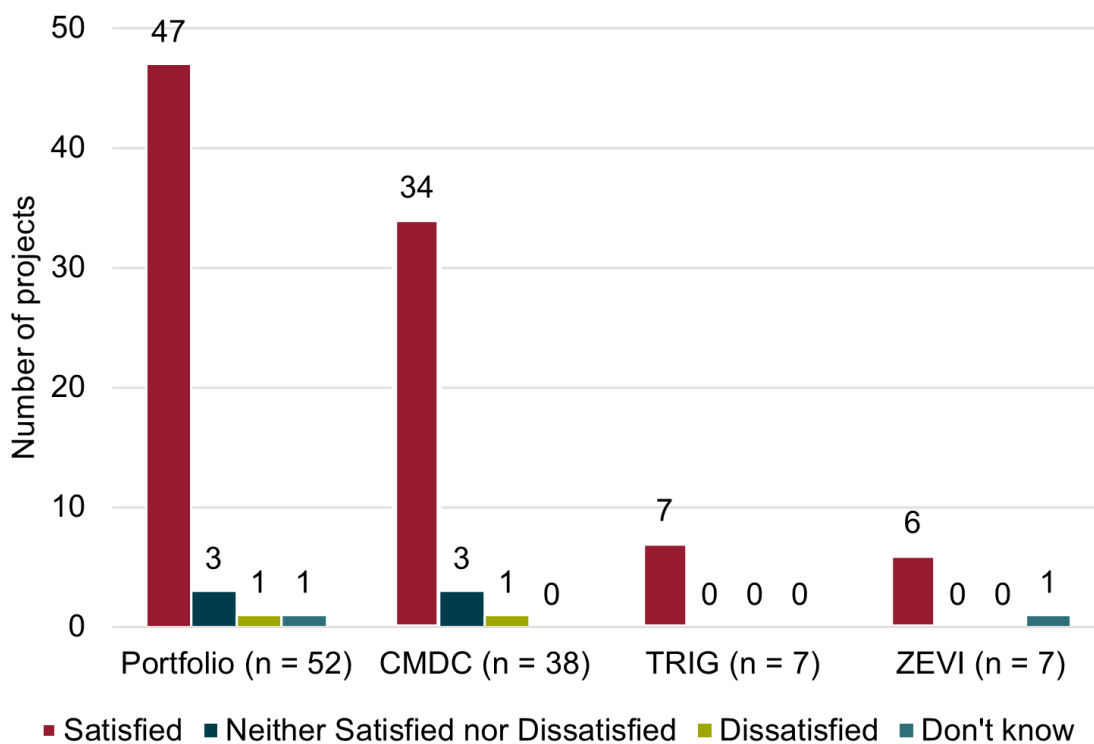
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

The interviews with CMDC applicants in 2023 provided some greater insight into the successes and challenges of working with the delivery partner. Two interview participants noted some challenges with IUK and Monitoring Officers, and there were delays in communications and response times, and both participants also felt the Monitoring Officers did not have sufficient technical knowledge to provide the support required:

> *"Our Monitoring Officer perhaps wasn't technically best suited to our project … the level of depth of requirement of project management seemed to be required from one end, wasn't necessarily in parallel or in agreement with how much we felt we had to do. So, there was an interesting tension there."*

CMDC2 successful applicant

Conversely, 2 of these participants felt they had a good level of engagement from their Monitoring Officer and queries were responded to promptly. One participant had an existing working relationship with IUK:

> *" … the Monitoring Officer was brilliant. He helped sort out that problem we had."*

CMDC2 successful applicant

One successful TRIG applicant was complementary about the support offered by CPC, "they're fantastic", although no other specific feedback on CPC was provided.

The project output data for CMDC was consistent with these survey findings, with 91% (280) of those that responded to the question about satisfaction with their delivery partner stating that they were very satisfied or satisfied with the level of CMDC1 and CMDC2 project monitoring provided by IUK. The level of satisfaction varied and of the 116 respondents who also stated their organisation size, those from micro or small organisations (63%) tended to be more satisfied than large and medium sized organisations. Responses are shown in Table 14.

From the delivery partner perspective, both felt adequate support was provided to successful projects, and also felt that DfT valued their role and any input they provided on competition design and delivery.

However, the 2 delivery organisations representing 3 of the competitions observed that they are not always able to provide sufficient general financial or investment advice, and 1 noted they have raised this with DfT with regards to any future competitions.

Table 14   Level of satisfaction with project monitoring provided by IUK

Level of satisfaction with project monitoring	Large (n = 42)	Medium (n = 20)	Micro or Small (n = 54)
Very satisfied	38%	60%	61%
Satisfied	57%	40%	31%
Neutral	5%	0%	8%
Dissatisfied	0%	0%	0%
Very dissatisfied	0%	0%	0%

Source: End-of-Project survey CMDC1 and CMDC2.

CMDC1 end-of-project reports also noted that officers were seen as having inadequate knowledge about the industry and the nature of work, and communication with regulatory bodies were often met with delayed responses, further affecting project management. To improve these aspects, the reports found that respondents suggest involving an advisory partner to support 'safety, permissions and regulations', working with external regulatory bodies to support the approval process.

Data reporting

Respondents to the survey across successful applicants were asked about their satisfaction with different elements of reporting. Respondents mostly reported being satisfied with elements of the monitoring and reporting requirement during project delivery, as shown in Table 15. In particular, 44 of 52 respondents agreed the nature of the data and information requested was appropriate; 43 agreed the timescale of the requests was appropriate. A slightly lower proportion (38) felt the format of templates and reports was clear and easy to understand. For each element, between 3 and 4 disagreed with the above statements.

Table 15   Data Reporting

Level of agreement	The nature of the data and information requested was appropriate	The timescale of the requests was appropriate	The format of the templates and reports was clear and easy to understand
Agree	44	43	38
Neither Agree nor Disagree	4	4	8
Disagree	3	4	4
Don't know	1	1	2
Total	**52**	**52**	**52**

Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'. From a base of 52 respondents across CMDC, TRIG and ZEVI competitions.

The in-depth interviews illustrate some of the reasons for dissatisfaction with templates for monitoring and reporting. Data reporting was raised by several participants during in-depth interviews with successful applicants, which appeared to create some challenges for project teams. One CMDC applicant explained that they were instructed to structure the final report according to a fixed template at a late stage, leading to additional time and resource allocation during a busy period in December. In addition, they were required to produce more documentation, reshape existing information, and generate specific data to meet reporting requirements. This sentiment was shared by another CMDC respondent, who felt "the information submitted was a bit repetitive", especially for the final review. They had difficulty understanding the requirements of the review, which were not communicated by their Monitoring Officer. In summary, they felt there was additional work involving reporting of the same content in a different format. A similar sentiment was expressed by 1 ZEVI successful applicant, who felt the reporting did not reflect the work being carried out. Another CMDC respondent described disagreeing with some of the metrics of reporting and measuring

programme success, finding it too focused on value for money in terms of pounds spent and generated:

> *"You're delivering something which people have pushed themselves on … And yes, people want value for money, but it should be about what we're delivering, not about whether we've overspent and we were on budget pretty much every single time."*

CMDC successful applicant

Likewise, reviewing a random sample of 16 end-of-project reports from CMDC1 and 2 showed that organisations also expressed concerns that the level of commitment and reporting expectations were too high compared to the funds available.

Similarly, another participant faced issues during final reporting and explained they felt it was difficult to convey the VfM in monetary terms at the stage their project was at.

Delivery partners feel they offer an adequate level of support to successful projects, and that monitoring processes are generally working well, noting that processes have been adapted to respond to feedback, and enable 'early warning' of issues and therefore mitigations to be put in place.

Some issues with data reporting are noted and discussed further throughout the impact evaluation, in particular binary indicators of success and peculiarities in TRL reporting.

Knowledge sharing activities

In the project output data for CMDC1 and CMDC2, 308 organisations involved in projects responded to whether they attended any Innovate UK events during the scoping, designing or implementation of their project. Of these, a majority (66%) of organisations stated that they had attended IUK events.

The survey of successful applicants to CMDC, TRIG and ZEVI showed relatively mixed results for satisfaction with the level of engagement and knowledge sharing with other projects in the competition. As shown in Figure 28, TRIG respondents were the group where the highest proportion reported satisfaction with engagement and knowledge sharing, with 5 out of 7 (71%) respondents stating they were satisfied with this. For the respondents who were successful CMDC applicants, around 1 in 4 (26%) were satisfied, and half stated they were neither satisfied nor dissatisfied.

Figure 28   To what extent were you satisfied or dissatisfied with the level of engagement and knowledge sharing you had with other projects within the competition?
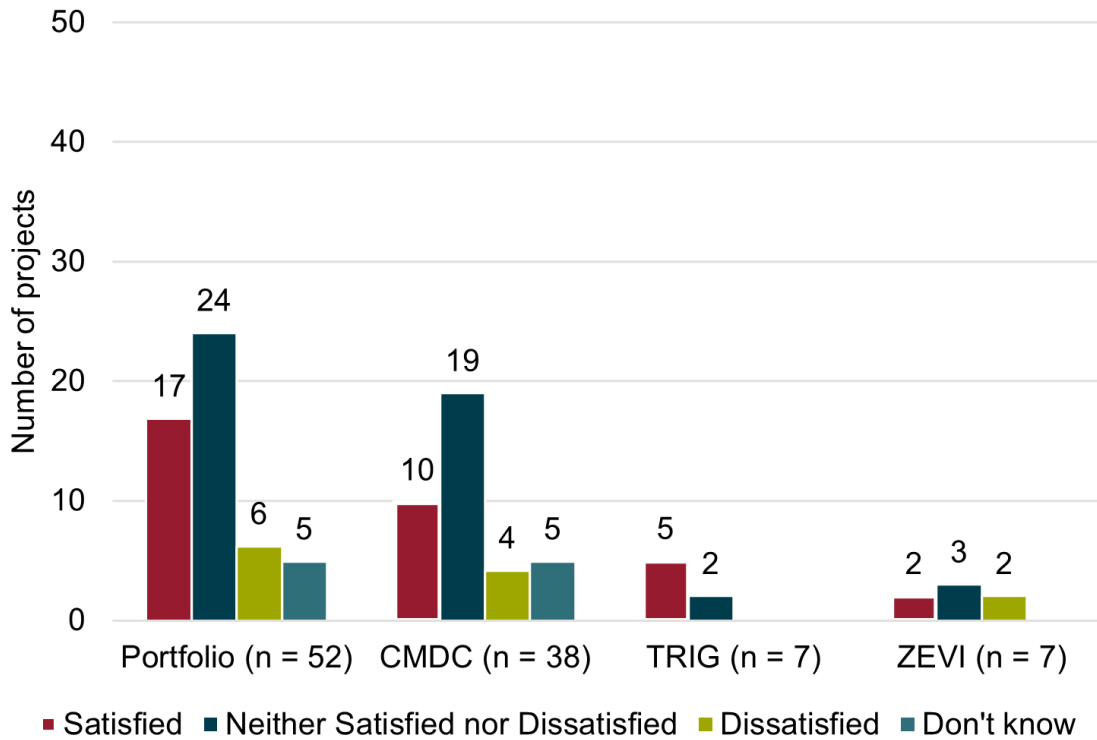
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

Looking at the survey responses from CMDC applicants only, satisfaction with engagement and knowledge sharing was highest for successful CMDC1 applicants, where 5 of 8 reported satisfaction, while the same applied for 5 of 17 of CMDC2 applicants whereas all 8 CMDC3 applicants that responded were neither satisfied nor dissatisfied with the engagement and knowledge sharing. Satisfaction also varied according to whether the survey respondent represented a lead organisation or a collaborator. While 2 respondents representing lead organisations were satisfied with engagement and knowledge sharing, 8 collaborator organisations reported being satisfied with this. Satisfaction was also higher in cases where the respondent represented a complete project, (9), rather than where they represented a project in its mobilisation phase (none reported satisfaction with engagement and knowledge sharing) and in the delivery phase (1 respondent was satisfied).

Most of the CMDC participants spoken to during in-depth interviews mentioned the UK SHORE events, with many having attended and having their own stand, although they did not give a strong opinion about the value of their participation. One stated there was not enough

opportunity to engage with other projects and another noted a lack of knowledge sharing activities at the end of the project.

Both delivery organisations, representing CMDC, TRIG and ZEVI, recognised there was room for improvement in this area. One expressed an ambition to agree knowledge sharing plans sooner, and another noted 'retention' as a challenge and an ambition to create an 'alumni network', recognising this is something they have not had resources to do in the past. However, the self-reported output data showed that out of those who attended IUK events, a majority (98%) of respondents found the events to be useful in the scoping, designing or implementation of their project. Of the 75 organisations who also stated their organisations' size, micro or small organisations (44%, 33) tended to find these events more useful, followed by large organisations (40%, 30) and medium sized organisations (15%, 11).

Engagement with MCA and Maritime UK

Overall, the survey across CMDC, TRIG and ZEVI successful applicants showed 21 of the 52 respondents were satisfied with the support they received regarding necessary regulatory approvals. Furthermore, 18 of these respondents stated they were neither satisfied nor dissatisfied, and 8 reported being unsatisfied. Looking at the survey responses of representatives of the 3 competitions separately, TRIG candidates had the most who were satisfied with this support, with 5 out of 7 respondents being satisfied. The CMDC candidates had the lowest percentage who were satisfied, with 18 stating this, and 8 indicating they were dissatisfied with the support they received with regulatory approvals, as shown in Figure 29. However, many CMDC applicants (16) reported being neither satisfied nor dissatisfied with this.

Figure 29   To what extent were you satisfied or dissatisfied with the support you received regarding necessary regulatory approvals?
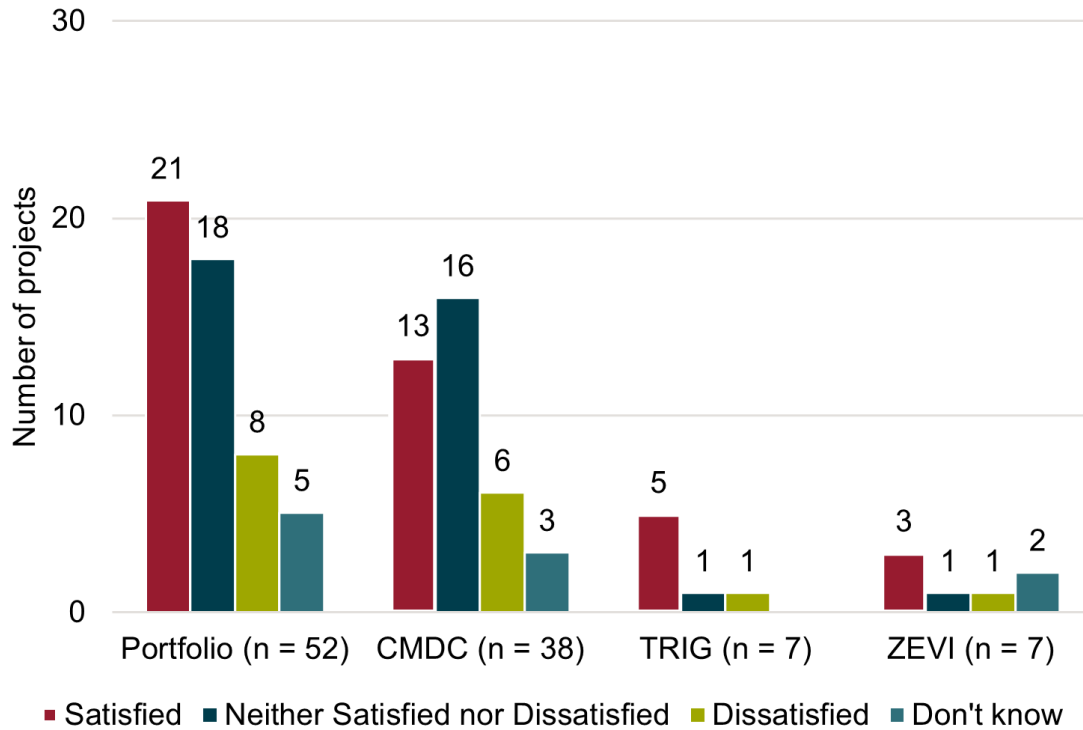
Source: Online survey.

Note: 'Satisfied' is comprised of those who have responded 'very satisfied' and 'satisfied', and 'dissatisfied' is comprised of those who have responded 'very dissatisfied' and 'dissatisfied'.

In the end-of-project data for CMDC1 and CMDC2, a majority of respondents self-reported that they engaged with regulators, including the MCA. The cost associated with getting regulatory approval for projects ranged from £0 (mainly for feasibility studies and studies awaiting approval) to £50,000. One interview participant described not having funding to pay for the regulatory advice they required.

Responses in the end-of-project data were typically positive about the engagement with regulators. Most respondents (73 out of 78) agreed or strongly agreed they were able to identify the applicable marine regulations without issues in delivering their projects. This was also true of micro or small organisations (25), who tended to agree or strongly agree that they did not encounter issues while identifying marine regulations during project delivery. In addition, 70 out of 74 respondents agreed or strongly agreed that their project team received adequate support from specialised organisations and subject matter experts on delivering their projects. Out of 49 respondents, 37 agreed or strongly agreed that their project team had the opportunity to meet in a timely manner with the MCA for early engagement.

Participants that were interviewed had limited involvement with the MCA or other agencies during their projects, or the engagement did not form a significant part of their delivery

processes. Some noted that as it was only a feasibility stage project, this was not required. In addition, 2 of the successful applicants' interviews gave opposing views on the role of the MCA. One stated they provided a good level of communication, and another noted that, as the MCA's relationship and communication channels with UK SHORE was not fully set up until CMDC3, queries took time to be clarified. This was also highlighted by one participant of CMDC and TRIG, who noted that the role of the MCA was historically 'distant' due to government direction, but now they are becoming more involved in 'novel' projects:

> *"They need to keep up with an environment which is very dynamic. I think they were much more static for a couple of decades now, hopefully they will pick up."*

TRIG Unsuccessful and CMDC Successful

Similarly, the delivery organisations and stakeholders noted that the regulatory side is becoming increasingly 'at the forefront' of minds, and DfT explained that the MCA was specifically engaged for CMDC 3 and 4 due to the 'higher risk' nature of the projects. MCA echoed this statement and welcomed becoming more involved as the UK SHORE competitions have progressed:

> *"I would argue that the early rounds of the CMDC, we were not sufficiently involved in the appropriate fashion. We were involved, but we were involved as a recipient of the project, not as a designer of the programme. That's a failing from both the UK SHORE and an MCA point of view, because corporately, neither group really understood what would be needed, and I think we've collectively learned and fixed that as we've moved forward … We are taking a much more active role now."*

MCA

As mentioned previously, other applicants would have liked more involvement from DfT, MCA and Maritime UK, but none highlighted this as a barrier to delivery. In addition, in a review of a snapshot of CMDC1 end-of-project reports, a number of delivery partners and bidders stated that they had a good existing level of knowledge about regulations and permits. The reports highlighted that more post-competition support could be provided for organisations to secure additional funding and explore different commercial routes.

What worked well

Survey respondents across successful applicants of CMDC, TRIG and ZEVI mostly reported being satisfied with elements of the monitoring and reporting requirement during project delivery, with the majority (44 of the 52 respondents) agreeing that the nature of the data and information requested was appropriate; that the timescale of the requests was appropriate (43); and that the format of templates and reports was clear and easy to understand (38).

In interviews, delivery partners expressed having developed a closer working relationship with MCA over time, including having MCA provide guidance to applicants and projects, as well as

helping with assessing applications. This increased engagement from MCA was welcomed by all parties.

What could be improved

The majority of survey respondents experienced barriers to delivery, with 42 of the 52 respondents experienced 'some' or 'significant' barriers with regards to 'regulatory challenges' or 'procurement or supplier challenges'. **As such, DfT may wish to review how engagement with regulators can be best facilitated throughout the lifecycle of the projects.**

Qualitative feedback noted that not all projects felt that their Monitoring Officer had the technical or industry knowledge to support them but were able to support them on a project management level. **DfT should consider ensuring the remit of the Monitoring Officer is made clear to project teams at the outset and communications channels to regulatory bodies are also clearly defined.**

There were mixed levels of satisfaction with the engagement and knowledge sharing with other projects in the competition. Maximising the opportunities for knowledge sharing and engagement between project teams, delivery partners, **DfT and other core stakeholders should remain a priority for the UK SHORE programme, as well as exploring new ways to increase opportunities and participation.**

5.5   Overall findings and recommendations

Competition

Participants showed good awareness of the range of competitions across the portfolio and 90% would participate in such a competition again, suggesting it was an overall positive experience for participants. Delivery partner organisations undertook a number of engagement and outreach activities but did note that some organisations are more experienced at bid writing than others and applicants perceived that the same organisations tended to successfully apply for funding. Stakeholders explained that competitions are designed in such a way to provide an 'innovation pipeline' allowing projects to 'ramp up' TRL levels over time. **However, UK SHORE may wish to consider the messaging around this, to provide confidence to new or previously unsuccessful applicants.** This is discussed further in the portfolio-wide impact evaluation (Section 9.6).

Some participants highlighted that gathering funding and funding the overheads can be a challenge for smaller organisations. A small number of interview participants further illustrated this, stating they self-funded until the competition funds were made available. **DfT should continue to provide as much advance warning of competitions as feasible, and continue to provide information and networking opportunities to support organisations.**

The survey conducted with successful applicants of the CMDC, ZEVI and TRIG competitions indicates 42 out of 49 respondents were satisfied (very satisfied or satisfied) with the information and guidance provided by the organisation leading the competition at bidding stage. Some would have liked to see more engagement from DfT and the MCA at an earlier stage. In future, **early involvement from both DfT and MCA would further benefit applicants, in terms of widening their knowledge and awareness of the wider portfolio and of regulatory processes and requirements**. Encouragingly, delivery partner organisations noted that the awareness of the role of regulatory processes is increasing both among projects and in delivery organisations.

Most applicants were satisfied with the competition timescales (30 out of 49) and clarity of requirements (47 out of 49). However, qualitative findings indicated that some organisations less experienced in bidding for such funding needed additional support to understand the scope, eligibility and requirements. This is further supported by the finding that smaller organisations found UK SHORE knowledge-sharing events more useful than others. Most respondents stated that delivery partners responded to queries quickly, and most found the requirements clear and straightforward. However, delivery organisations noted further refinement of scope would reduce the number of queries arising, and that they would like to see competitions announced sooner and open for longer, which was also stated by DfT. Despite this, delivery partners and stakeholders were generally happy with the quantity and quality of bids received. It was noted that the timescales were shorter than the usual industry standards, which caused a barrier to some, particularly with establishing consortia and gathering match funding.

Alignment with the standard 3-month application period would be beneficial to applicants. In addition, a review of the support offered and application stages to ensure consistency in the level of contact organisations have with assessors, may help enable 'near misses' to succeed and better support those less experienced in competition processes.

Qualitative interviews with successful and, particularly, unsuccessful applicants showed some dissatisfaction with the assessment panel or interview processes. Some perceived that the assessors did not have the right level of industry knowledge or experience to satisfactorily assess the bids from a technical perspective, or that the assessors were not diverse enough. Others noted a discrepancy between scoring at different stages. Delivery organisations and stakeholders recognised the challenge of finding suitable assessors in a relatively small, niche industry, but noted measures were in place to increase this and they were satisfied that the assessment approaches were robust and provided examples of where improvements had been made. Similarly, delivery organisations recognised that discrepancies in scoring often arose when an organisation used a professional bid writer, emphasising the importance of the interview stage.

Delivery partners should continue to be mindful of this challenge, and where possible, provide transparency on successful bids and consider if there are ways to increase the quality and quantity of feedback to aid future bidding. Transparency on outcomes and assessment of successful bids would aid confidence in the processes for applicants, and likewise, delivery

organisations should regularly 'check and challenge' their pool of assessors to ensure representation from a range of perspectives (technical and management) and demographics.

Mobilisation

Nearly all respondents across the portfolio were satisfied with the timely notification of the outcome of their bid.

Likewise, nearly all survey respondents were satisfied with the timeliness of allocation of funding, indicating processes are working well, and this was also reflected in qualitative evidence.

With regards to change control, across the portfolio just over half (30) were satisfied and a further 10 stated 'don't know'. Across the portfolio, 8 were neutral and 4 dissatisfied. Qualitative data provided some mixed insights from CMDC interviewees, whereas change control was not raised as a theme by ZEVI or TRIG participants. **Given the lower level of satisfaction here compared to other process elements, consideration should be given to reviewing the change control processes.**

Delivery

In terms of barriers to delivery, 42 of the 52 survey respondents experience 'some' or 'significant' barriers with regards to 'regulatory challenges' or 'procurement or supplier challenges'. Despite this, qualitative evidence shows that most achieved their planned objectives for their projects. Examples of barriers were provided in in-depth interviews. One respondent described problems with accessing testing facilities through a partner, causing delays and difficulties in progress. Qualitative evidence also emphasises the **need for greater involvement from regulators at an early stage**, with the level of innovation of these projects and the highly regulated maritime environment creating a challenge.

Nearly two-thirds experienced 'some' or 'significant' barriers with recruitment or technology. Likewise, up to half experienced 'some' or 'significant' barriers with other aspects, including challenges with partners or collaborators (42), funding (21 from DfT, 24 from other funding sources) and governance (22).

In the survey conducted across successful applicants of CMDC, TRIG and ZEVI, 47 of 52 respondents were satisfied with the guidance provided by the CPC or IUK during delivery. Delivery organisations were generally satisfied with the level of support they could offer but would like to be able to provide more support on financial and investment matters in future.

Qualitative feedback from some interview participants and within the end-of-project reports noted that not all felt that their Monitoring Officer had the technical or industry knowledge to support them, but was able to support them on a project management level. **Consideration should be given to how to improve the process of supporting project teams from a technical point of view throughout the lifecycle of the projects, covering wider issues such as health and safety and finance and investment. It should be ensured that the**

remit of the Monitoring Officer is made clear to project teams at the outset and communications channels to regulatory bodies are also defined clearly.

Likewise, some had mixed experiences in the support and engagement with the MCA, with survey results showing that just 21 of 52 respondents stated they were satisfied with the support they received regarding necessary regulatory approvals, with 18 neither satisfied nor dissatisfied, and 8 stating they were dissatisfied. Despite this, nearly all CMDC applicants reported in the end-of-project data that they were able to identify "the applicable marine regulations without issues". Delivery partners, and some applicants, did observe their role and awareness of regulatory issues as increasing over time. **As noted previously, qualitative feedback indicated earlier engagement from the MCA would be beneficial, as well as timely responses to queries, perhaps with an agreed response time. In future, further consideration could be given to how this is facilitated.**

Survey respondents mostly reported being satisfied with elements of the monitoring and reporting requirement during project delivery. Qualitative feedback highlighted some challenges that arose, with the structure of reporting being defined at a late stage, and information requirements felt repetitive. It should be ensured that **reporting requirements are set out at an early stage and communicated consistently to project teams.**

Across the survey responses, there was mixed satisfaction with the level of engagement and knowledge sharing with other projects in the competition. TRIG respondents had the highest proportion reporting satisfaction with engagement and knowledge sharing, with 5 out of 7 respondents stating they were satisfied with this. For the respondents who were successful CMDC applicants, 1 in 4 were satisfied, and 19 out of 38 stated they were neither satisfied nor dissatisfied. Qualitative feedback was relatively neutral on knowledge sharing activities from participants, and delivery partners noted there was room for improvement in this area. **Maximising the opportunities for knowledge sharing and engagement between project teams, delivery partners, DfT and other core stakeholders should remain a priority for the UK SHORE programme, as well as exploring new ways to increase opportunities and participation. This should encompass both project 'alumni' and unsuccessful organisations.**

6 Interim impact evaluation findings – CMDC

This section brings together several sources of evidence (including baseline and end-of-project monitoring data, survey data, and interviews) to present initial findings on CMDC1 and CMDC2, organised by EQ. Data sources are highlighted at the start of each section, with overall findings discussed at the end of the section.

As discussed in Section 4.2.3, the monitoring data used to inform this analysis included multiple responses from the same organisation for the same project. All charts and tables in this section are calculated from weighted responses, where each response for each unique organisation and project combination is weighted equally. This leads to cases where a fraction is recorded for the number of organisations but figures have been rounded to the nearest integer in this section for presential simplicity.

6.1 Development of clean maritime technologies

This section presents initial findings on EQ 1: to what extent, and through what mechanisms, did UK SHORE help to accelerate and support the development of clean maritime technologies relative to what would have happened in the absence of UK SHORE? The relevant data and data sources for each sub-question under EQ 1 are reported in Table 16.

Table 16   EQ 1 data sources

Sub-question	Data	Data source
To what extent did the projects funded through UK SHORE schemes deliver the outputs as anticipated in the business cases (eg feasibility studies, pre-deployment trials, demonstrations, deployment trials in operational settings and market-readiness plans)?	Number of projects and outputs delivered for CMDC1 and CMDC2	Monitoring data
	Number of projects reporting success for CMDC1 and CMDC2	Monitoring data
To what extent did the overall portfolio support technologies through the TRL scale?	Change in TRL for CMDC1 and CMDC2	Monitoring data
	Expected end of project TRL for CMDC1 and CMDC2	Monitoring data

Sub-question	Data	Data source
	Stakeholder views on change in project scopes for CMDC1 and CMDC2	Survey data
What role did UK SHORE play in facilitating parties to come together to advance the development of clean maritime technologies?	Number of stakeholders satisfied with their consortia	Monitoring data
	Number of stakeholders expecting to continue working with their collaborators	Monitoring data
	Number of stakeholders who experienced challenges with collaborators	Survey data
	Extent of skill development in collaboration through UK SHORE	Monitoring data
	Number of stakeholders who gained the benefit of new partnerships	Survey data
What factors or investments played a role in enhancing the influence of UK SHORE in meeting its aims for accelerating UK clean maritime?	Stakeholder views on remaining barriers to project development	Monitoring data, interviews
	Stakeholder views on the impact on their projects if they did not receive UK SHORE funding	Monitoring data, interviews

Source: Frontier Economics.

6.1.1 Evaluation evidence

Projects and outputs delivered

Out of 55 successful CMDC1 applicants, 50 submitted end-of-project reports, which was a requirement for all projects. Out of 31 successful CMDC2 applicants, 29 submitted end-of-project reports. Project outcomes are described in more detail below.

Most projects reported successful achievement of intended outcomes

Figure 30 shows the distribution of project leads' self-assessment of whether they achieved their intended project outcomes.

Figure 30   Has the intended project result been successfully achieved?

All respondents reported at least partial success. A larger share of CMDC2 respondents than CMDC1 reported full success (85% compared with 77%). No project indicated project failure.

Respondents also explained the reasons for their answers. Time constraint was a recurrent reason for only partial success. Some projects felt that the project timescales were too short, while others noted that external difficulties (such as supply chain issues) caused delays. One project answered that they were over-ambitious with their expectations in the time scale, while another highlighted the significant time taken to approve relevant paperwork. Additionally, projects noted failure to meet some of the initial objectives, for example a failure to demonstrate the technology in certain conditions, and the role of external circumstances such as lingering effects of COVID-19. Similarly, applicant interviews all reported successful delivery of intended outcomes (although interviewees may not be representative of all

participants, as those agreeing to be interviewed may have disproportionately positive outcomes).

Self-reported 'success' is a subjective measure, and organisations likely had different interpretations of 'success'. For example, 1 CMDC2 participating organisation (supply chain manufacturer) who felt that their project was a success because they delivered on their part of the project also felt they did not achieve as much as they hoped:

> *"I must say that it was an ambitious project, but it didn't achieve quite as much as certainly, I'd have hoped."*

CMDC2 successful applicant

Technology readiness level

TRLs are a measure from 1 to 9, capturing the maturity of the technology being researched where lower TRLs indicate lower maturity levels (a detailed definition of TRLs is available in Annex D). Project leads were asked to report their TRL at the start and the end of project as part of DfT monitoring. Project leads reported TRL at the end of their project without seeing the TRL reported at the start of projects.

Improvement in TRL is typically a key measure of development for R&D projects, indicating that a project has been able to advance its technology, for example moving from the development of a proof of concept (TRL 3) to demonstrating this proof of concept in a test site. However, TRL stagnation or regression is not in itself an indicator of an unsuccessful project and has been built into scheme-level business case expectations for UK SHORE. Part of the purpose of R&D funding is to help unsuccessful projects 'fail faster', freeing up investment for other technologies which may ultimately be successful. This is discussed further in Section 10.

Fewer than half of the projects reported TRL improvement

Figure 31 presents the change in reported TRL from the start to the end of project. Reported TRL improvements were more common in CMDC2. Of the projects that responded in both the baseline and end-of-project monitoring data, 15 (out of 39) CMDC1 indicated an improvement in TRL, compared with 10 (out of 21) for CMDC2. Eleven CMDC1 projects and 7 CMDC2 projects reportedly experienced no change in TRL.

Interestingly, 11 CMDC1 respondents and 3 CMDC2 respondents reported a fall in TRL. As shown in Figure 32, almost all respondents who experienced a fall in TRL belonged to strand 1, which focused on feasibility studies. Feasibility studies can uncover unexpected technological barriers during the project. Evidence from the end-of-project reports also suggests that some respondents may have inconsistently interpreted the TRL typology. One CMDC1 respondent noted in its end-of-project report: "In this project, the partners targeted (and achieved) proof of concept – TRL3, specifically for maritime applications" adding "Before the project began, [the firm] had achieved TRL5 (i.e. successful operation of a component in a commercially relevant environment)" when considering "stationary applications." However,

the respondent reported TRL4 in the baseline monitoring data and TRL3 in the end-of-project monitoring data. Similarly, another CMDC1 respondent stated: "The project has advanced the technology readiness level," in its end-of-project report but reported TRL6 during baseline monitoring and TRL4 during end-of-project monitoring.

Figure 31   Changes in TRL
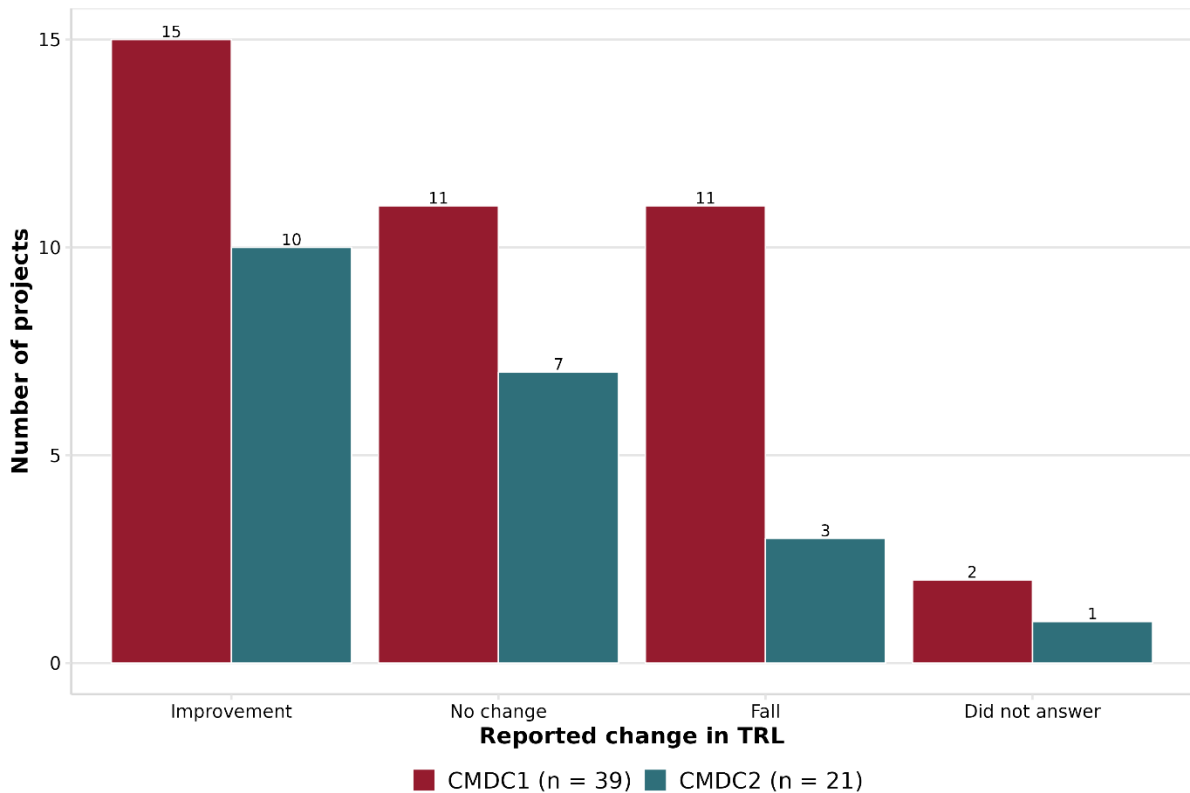
Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: *Compared answers to the question 'now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)', asked at the start and end of projects. Some project leads responded multiple times to the survey, so responses were weighted such that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.*

Figure 32   Changes in TRL by strand

Source: *Frontier analysis of baseline and end-of-project monitoring data.*

Note: *Compared answers to the question: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)', asked at the start and end of projects. Some project leads responded multiple times to the survey, so responses were weighted so that weights were summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.*

Figure 33 and Figure 34 cross-tabulate the start and end TRL. The numbers in the cells refer to the number of projects. Cells below the red line indicate a fall in CRL, and above the blue line indicate a growth in CRL.

For CMDC1, the majority of projects reported TRL 3 or TRL 4 at the start (23). Among those who started at TRL 3, 4 projects progressed to TRL 4 and 4 more progressed to TRL 5: this is the largest tranche of TRL improvement. Projects who reported a fall in TRL typically fell by 1 level, with 5 projects moving from TRL 4 to TRL 3. However, 2 projects fell by 2 levels (from TRL 5 to TRL 3 and from TRL 6 to TRL 4). Both these projects expected an improvement by 1 level and reported successful achievement of intended project results by the end. Thus, the monitoring data does not provide a clear explanation for the TRL fall. One project reported a drastic fall from TRL 6 to TRL 2. However, it expected TRL 1 and reported success. The project developed a lifecycle emissions analysis, so it is reasonable to speculate that the project may have been mistaken with the starting TRL.

Figure 33   Start and end TRL – CMDC1

		TRL at the end of the project						
		1	2	3	4	5	6	7
TRL at the start of the project	1	-	Increase in TRL		-	-	-	-
	2	-	1	1	2	-	1	-
	3	-	2	5	4	4	-	-
	4	-	Decrease in TRL	5	3	-	1	-
	5	-	-	1	2	3	1	-
	6	-	1	-	1	-	1	1
	7	-	-	-	-	-	-	-

Source: *End-of-project monitoring data and baseline monitoring data*

Note: *n = 37. Compared answers to the question: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)', asked at the start and end of projects. Numbers do not sum to total due to rounding where responses were weighted due to duplicates as discussed in Section 4.2.3. In CMDC1, 10 projects reported twice, 3 projects reported 3 times, 2 projects reported 4 times, and 1 project reported 6 times. In CMDC2, 5 projects reported 2 times and 1 project reported 3 times. Among projects who reported repeatedly, some reported different starting and ending TRL each time. For instance, 1 project reported TRL 2 and 4 for project start and end in 1 submission and TRL 4 and 5 in another.*

For CMDC2, the majority of projects reported TRL 2 and TRL 3 at the start. Seven projects improved to TRL 4 by the end of project (3 from TRL 2 and 4 from TRL 3). Only 4 projects reported a fall in TRL. Compared to CMDC1, CMDC2 participants appear more cautious with TRL estimates at project start, with a significantly lower proportion reporting fall in TRL by project end. This might also be an indication of an overall better understanding of TRL typology by CMDC2 respondents. It would be useful for UK SHORE to reflect on whether there were changes in how TRL typology was communicated between CMDC1 and CMDC2 that could have contributed to these differences.

Figure 34 Start and end TRL – CMDC2

Source: *End-of-project monitoring data and baseline monitoring data*

Note: *n = 20. Compared answers to the question: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)?" asked at the start and end of projects. Numbers do not sum to total due to rounding where responses were weighted due to duplicates as discussed in Section 4.2.3. In CMDC1, 10 projects reported twice, 3 projects reported 3 times, 2 projects reported 4 times, and 1 project reported 6 times. In CMDC2, 5 projects reported 2 times and 1 project reported 3 times. Among projects who reported repeatedly, some reported different starting or ending TRL each time. For instance, 1 project reported TRL 2 and 4 for project start and end in 1 submission and TRL 4 and 5 in another.*

Early indications suggest TRL progression differs across technologies and their applications

Monitoring data includes some detail on the technology being developed, including its application to infrastructures or vessels or the type of fuel it is investigating. Based on discussions with DfT, projects have been grouped based on their technology and application and the TRL progression across these groups are examined below. A key caveat of this analysis is that necessary project data is often incomplete and sample size is small when looking at the granular breakdown of projects. As more projects become available to analyse, the final evaluation will assess these in more detail.

For each grouping analysed, this section sets out a table showing the average TRL progression and the number of firms reporting an improvement, no change or fall in their TRL level across categories. The sample size is too small to present meaningful comparisons, but it is possible to consider early evidence across different technology types.

For CMDC1, Table 17 shows the split between vessel, infrastructure and smart shipping projects. Projects with technology applied to vessels were equally likely to see improvement, no change or fall in their TRL, although they saw a TRL regression on average (since projects that regressed did so by a larger amount than those that improved). Infrastructure and smart shipping projects both saw average progression. For CMDC2, the majority of projects

reporting application (16 out of 21) fall into the 'vessels' group and so it is not meaningful to categorise projects at in this way. Presenting them together with CMDC1 would skew the results.

Table 17   CMDC1 – Average TRL progression by application type

Type	Sample size	Average TRL progression	Number of firms		
			Improvement	No change	Fall
Infrastructure	9	0.69	5	2	2
Smart shipping	4	1.75	3	0	1
Vessels	24	-0.15	8	8	8

Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: n = 37. Compared answers to the question: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)', asked at the start and end of projects. Numbers do not sum to total due to rounding where responses were weighted due to duplicates as discussed in Section 4.2.3. In CMDC1, 10 projects reported twice, 3 projects reported 3 times, 2 projects reported 4 times, and 1 project reported 6 times. In CMDC2, 5 projects reported 2 times and 1 project reported 3 times. Among projects who reported repeatedly, some reported different starting or ending TRL each time. For instance, 1 project reported TRL 2 and 4 for project start and end in 1 submission and TRL 4 and 5 in another.

At a fuel-type level, it is more meaningful to assess TRL development when combining both CMDC1 and CMDC2 together. Results are shown in Table 18. No fuel cell projects saw an improvement in TRL progression, and hydrogen projects also saw a regression on average. Other fuel types saw average progression (this includes projects assessing multiple fuels, such as wingsails). Both options analysis and other projects saw no projects regressing in TRL.

Table 18   CMD1 and CMDC2 – Average TRL progression by fuel type

Type	Sample size	Average TRL progression	Number of firms		
			Improvement	No change	Fall
Ammonia	3	0.33	1	1	1
Battery electric	7	0.14	3	2	2
Fuel cell	3*	-0.83	0	2	2
Hydrogen	14	-0.07	6	2	6
Analysis of multiple fuel types	4	0.5	1	3	0

Type	Sample size	Average TRL progression	Number of firms		
			Improvement	No change	Fall
Other	8	0.73	5	3	0

Source: *Frontier analysis of baseline and end-of-project monitoring data.*

Note: *n = 37. Compared answers to the question: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)', asked at the start and end of projects.*

Numbers do not sum to total due to rounding where responses were weighted due to duplicates discussed in Section 4.2.3. In CMDC1, 10 projects reported twice, 3 projects reported 3 times, 2 projects reported 4 times, and 1 project reported 6 times. In CMDC2, 5 projects reported 2 times and 1 project reported 3 times. Among projects who reported repeatedly, some reported different starting or ending TRL each time. For instance, 1 project reported TRL 2 and 4 for project start and end in 1 submission and TRL 4 and 5 in another.

End-of-project TRL was roughly aligned with projects' expectations

At the start of project, project leads reported their expectations for TRL by the end of project. Figure 35 shows the number of CMDC1 and CMDC2 projects expecting to see either an improvement, no change or fall in their TRL level. The majority of both CMDC1 and CMDC2 respondents expected an improvement in TRL (54% and 88% respectively). It is surprising that some projects expected to see a fall in their TRL during a CMDC project, again highlighting likely issues with the TRL data.
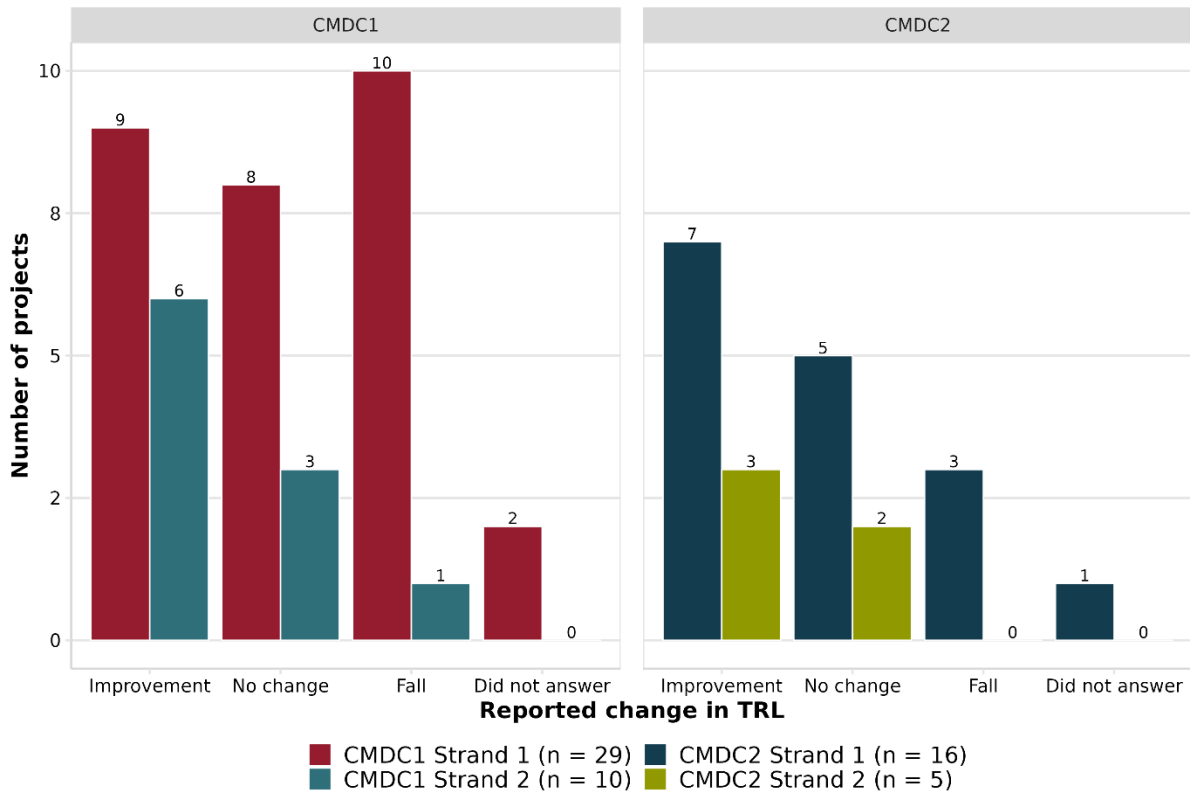
Figure 35 Number of organisations expecting a change in TRL
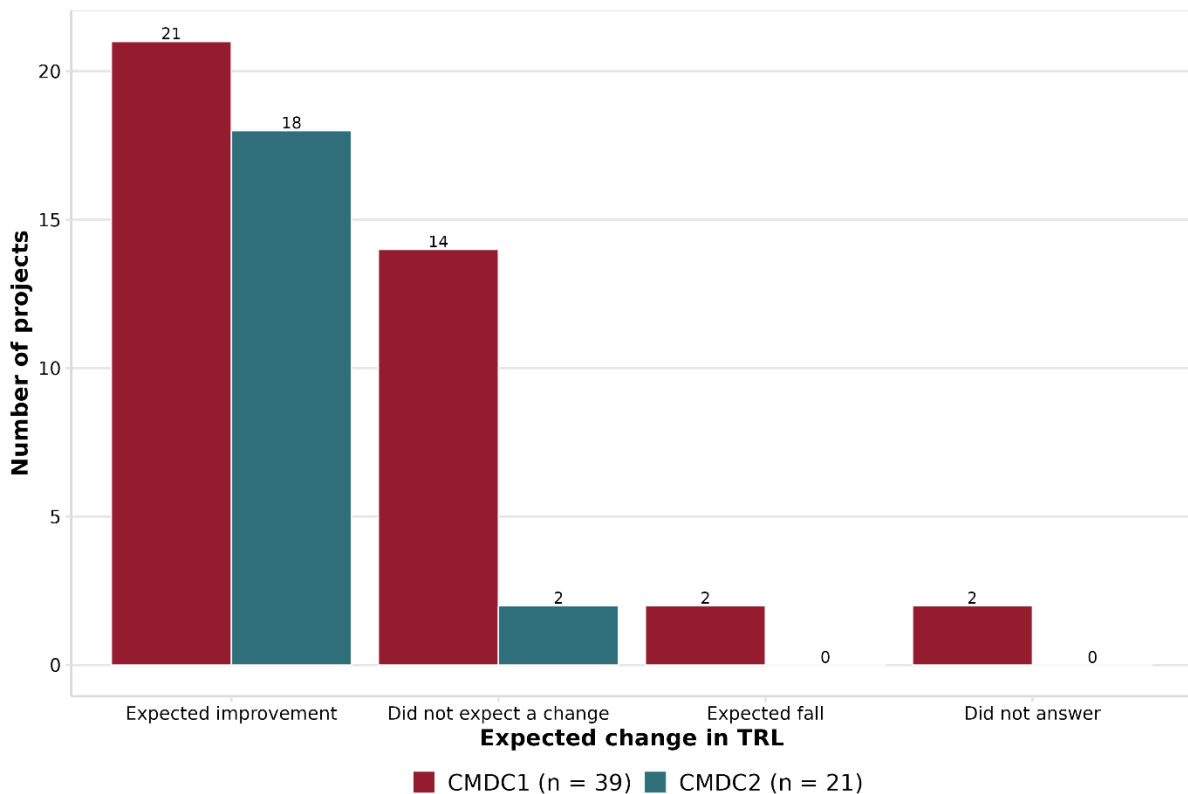
Source: Frontier analysis of baseline monitoring data.

Note: Compared answers to the questions: 'Now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its TRL' and 'where do you expect to be, in terms of TRL, by the end of the project'. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more detail. Rounded numbers are reported.

Figure 36 shows the expected and realised distribution of TRL at the end of the project. The comparison of these distributions suggests a small optimism bias at the start of the project. For CMDC1, slightly more projects finished at TRLs 1-4 than expected, and conversely slightly fewer projects finished with TRLs 5+ than expected. For CMDC2, several projects expected to achieve TRL 6 or beyond but none managed to in reality. Three projects concluded at TRL 2, although none expected to.

Figure 36   Expected compared to actual TRL at the end of the project
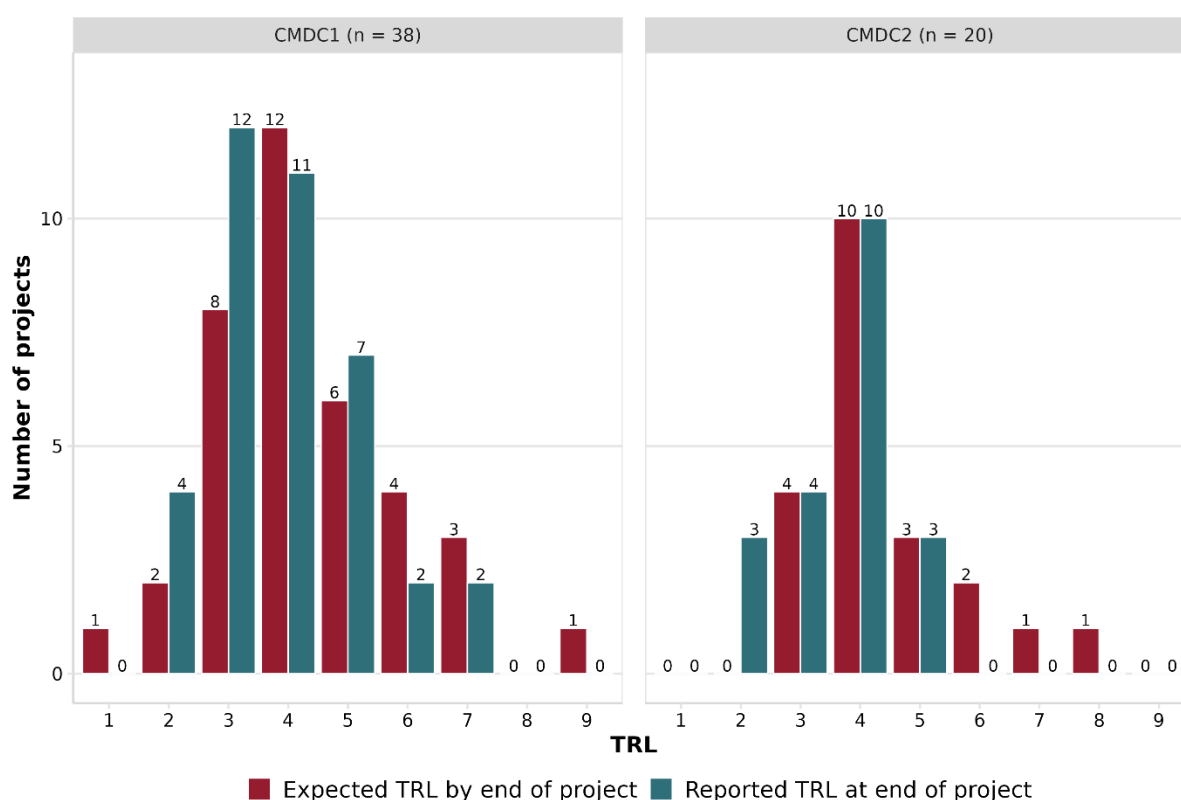
Source: End-of-project monitoring data and baseline monitoring data.

Note: Compared answers to the question 'now thinking about the primary innovation associated with the project, which of the following best describes the technical proximity of it to the market in terms of its technology readiness (TRL)' asked at the end of projects, and 'where do you expect to be, in terms of TRL, by the end of the project' asked at the start of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more detail. Rounded numbers are reported.

Survey data provided some insights into possible reasons for the optimism bias. Twenty-three organisations provided reasons for material changes in project scope and recurrent reasons included, skills shortage, delayed funding approval, unexpected test results and lingering effects of COVID-19.

Collaboration

Most organisations had positive experiences with their consortium

End-of-project monitoring asked respondents about the degree of satisfaction with their consortia's effectiveness in delivering the project, ranging from very unsatisfied to very satisfied.[14] Figure 37 shows the distribution of responses. Most respondents were either satisfied or very satisfied with their consortia. Over three-quarters of CMDC1 and CMDC2 firms were satisfied or very satisfied with their consortia. Only 8% of CMDC2 and 5% of CMDC1 organisations were unsatisfied or very unsatisfied.

Figure 37   How satisfied were you with the effectiveness of the consortium in delivering the project?
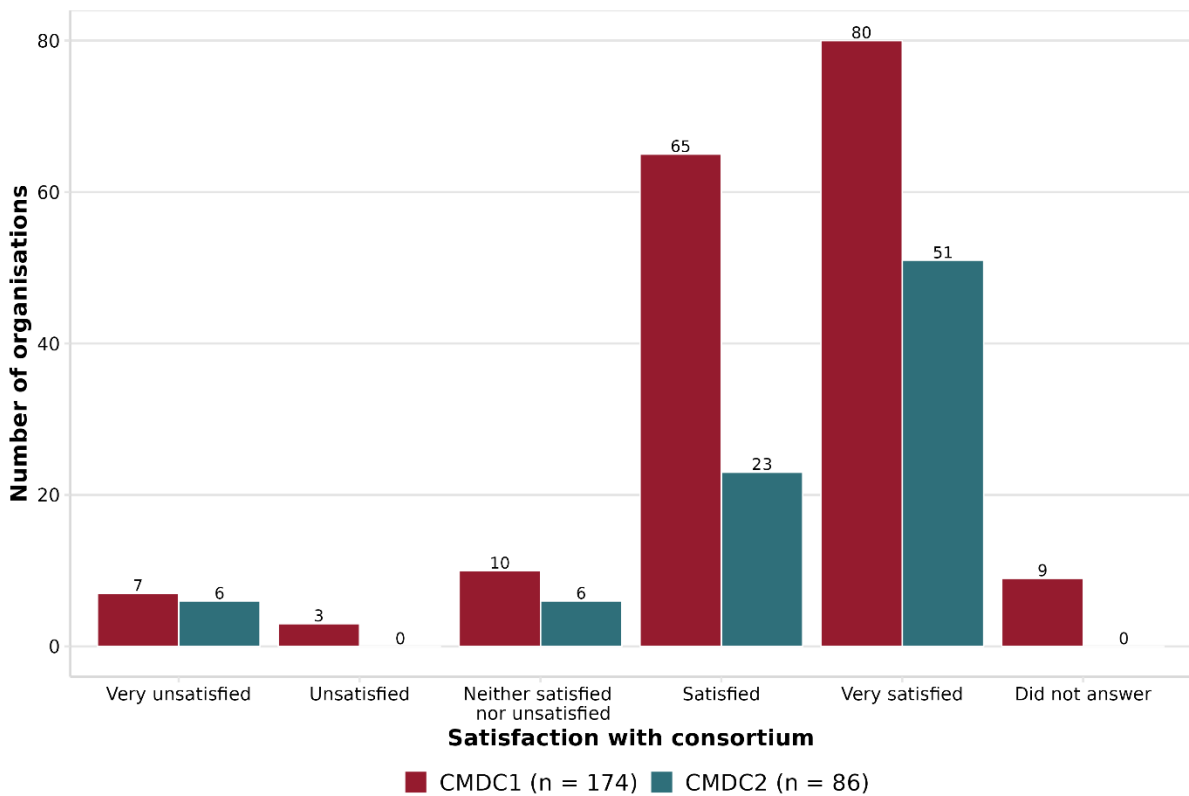
Source: End-of-project monitoring data.

Note: How satisfied were you with the effectiveness of the consortium in delivering the project? Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more detail. Rounded numbers are reported.

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14   How satisfied were you with the effectiveness of the consortium in delivering the project? CMDC1 n = 174, CMDC2 n = 86

Most respondents also expected to continue working with at least some of their current collaborators in the future.[15] For both CMDC1 and CMDC2, the majority of respondents expected to continue working with all current collaborators (half [87] of CMDC1 respondents, and two-thirds [53] of CMDC2 respondents). An additional 42% (74) of CMDC1 respondents and 37% (32) of CMDC2 respondents expected to work with some of their current collaborators in the future.

In addition, survey data asked organisations to what extent they experienced challenges with collaborators in the delivery phase of their projects.[16] This presents evidence on the extent of challenges respondents experienced with their consortia. Of the 9 CMDC1 respondents, 4 reported no barrier while 5 reported some barriers. Of the 21 CMDC2 respondents, 11 reported no barrier, 8 reported some barriers, and 2 reported significant barriers.

Experiencing barriers with collaborators did not appear to significantly impact respondent satisfaction with them. For both CMDC1 and CMDC2, most survey respondents who indicated some barriers with collaborators said they were satisfied or very satisfied with their consortia in the monitoring data (4 and 6 respondents respectively). This may reflect organisations' understanding of the volatile nature of pilot projects.

Most organisations gained long-term benefits associated with collaboration

As part of project monitoring, DfT asked each participant if funding for the project resulted in development of new skills or improvement of existing skills for their work force in collaborating and partnering.[17] For CMDC1, 24% (43) of respondents reported development in collaborating as a new skill, while 69% (120) reported improvement in collaborating as an existing skill. For CMDC2, 10% (9) respondents reported development and 76% (65) reported improvement.

Similarly, survey data indicated that building new networks and partnerships was a frequent benefit. Reporting benefits from the scheme,[18] the most common benefit selected was building new networks and partnerships, selected by almost all respondents (8 CMDC1 respondents and 21 CMDC2 respondents).

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[15] For those you worked with on the current project, do you expect to continue working with these organisations in the future? CMDC1 n = 174, CMDC2 n = 86

[16] To what extent did you experience any of the below barriers, in the delivery phase of your project? Challenges with partners/collaborators. CMDC1 n = 9, CMDC2 n = 21

[17] Did funding for this project result in the development of new skills or improvement of existing skills for your work force in any of the following areas? Collaborating and partnership. CMDC1 n = 174, CMDC2 n = 86

[18] Which of the following benefits, if any, have you gained from being involved in the scheme? CMDC1 n = 9, CMDC2 n = 21

Future barriers

The most prevalent barriers to future R&D were technical, financial, and regulatory

In the end-of-project monitoring data, DfT asked private organisations what barriers remain for the ultimate exploitation of the product, service or process being developed. Figure 38 shows the number of organisations reporting each barrier (organisations could report multiple barriers).

The top 3 anticipated barriers were similar across CMDC1 and CMDC2:

1. further technical, scientific or engineering challenges (61% [107] for CMDC1 and 68% [50] for CMDC2)
2. availability of finance (44% [78] for CMDC1 and 58% [50] for CMDC2)
3. UK government regulations (40% [70] for CMDC1 and 39% [33] for CMDC2)

For CMDC1, respondents also selected 'lack of or inappropriate industry standards' more commonly than 'UK government regulations'.

Figure 38   What barriers to exploitation of the product or service being developed remain?
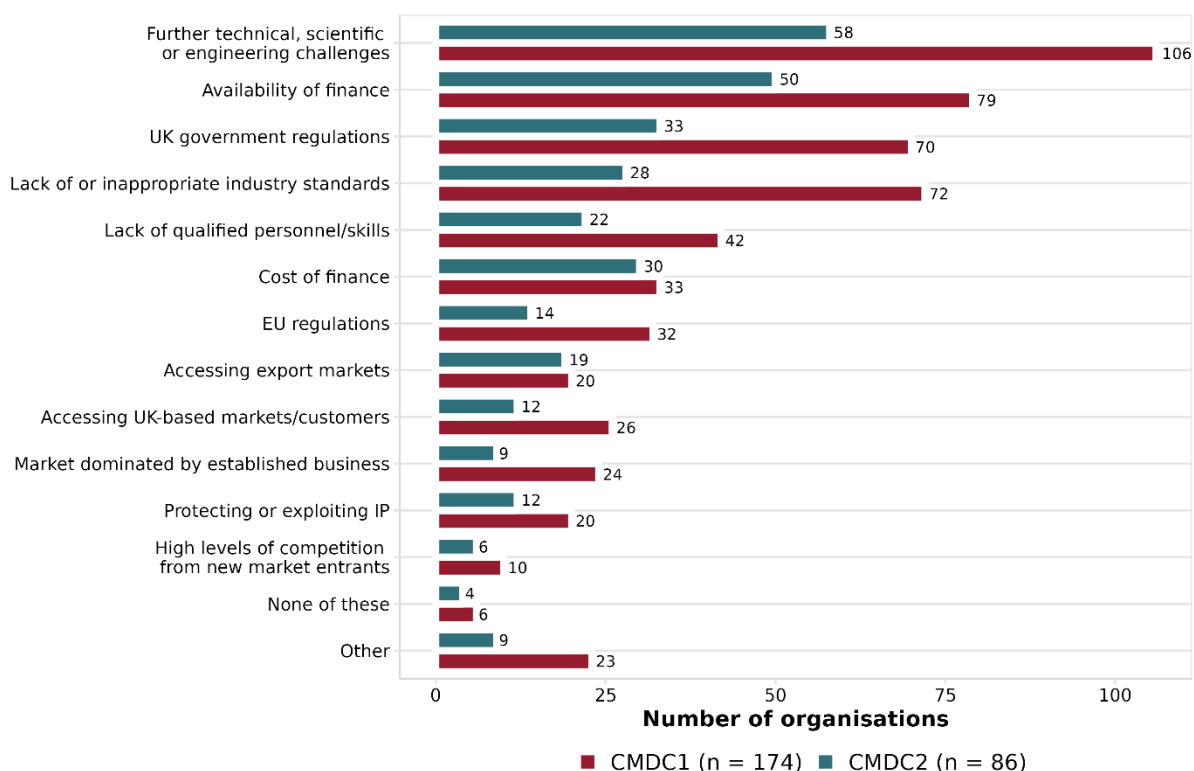
Source: End-of-project monitoring data.

Note: Respondents selected all that apply. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more detail. Rounded numbers are reported.

Applicant interviews also commonly identified availability of finance as a barrier to project development outside of UK SHORE. One collaborator organisation in CMDC1 (an environmental non-profit), expressed that although they successfully designed a pilot study for the duration of the scheme, they have not been able to meet other delivery objectives due to lack of funding. Similarly, a collaborator organisation in CMDC2 (engineering organisation), said that the project is currently at a standstill without further funding.

Project development without UK SHORE

The majority of projects would not have gone ahead without UK SHORE funding

At the end-of-project monitoring, respondents were asked what they think would have happened if their projects had not received IUK funding. Figure 39 shows the number of organisations reporting each impact.

Figure 39   What do you think would have happened if the project had not received IUK funding?
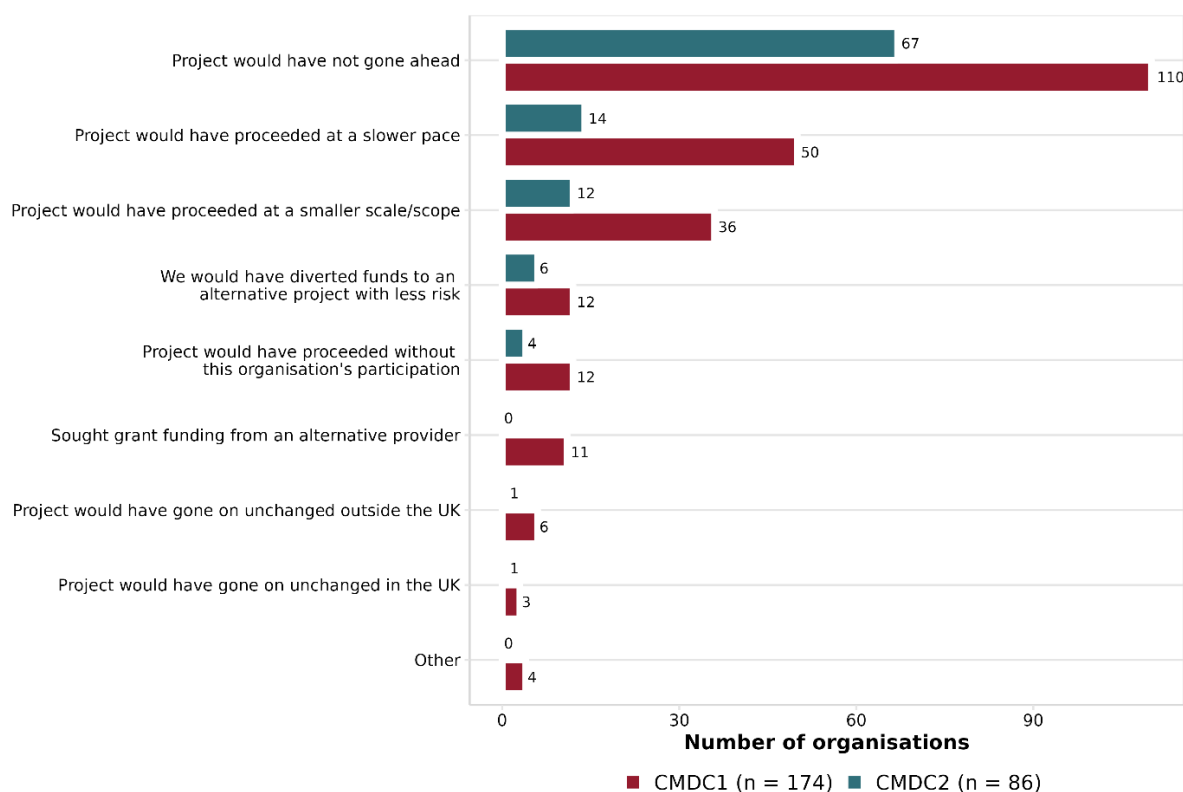
Source: End-of-project monitoring data.

Note: *Thinking about your organisation's participation in this project, what do you think would have happened if the project had not received IUK funding? Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more detail. Rounded numbers are reported.*

The majority of respondents in both CMDC1 and CMDC2 (63% [110 organisations] and 78% [67]) reported their 'project would not have gone ahead' if not for the UK SHORE funding, suggesting a relatively high degree of additionality. For CMDC1, an additional 29% (50) of

respondents said 'project would have proceeded at a slower pace', while 21% (36) said 'project would have proceeded at a smaller scale or scope'. Similarly, for CMDC2, 16% (14) of respondents indicated slower pace and 14% (12) indicated smaller scale or scope. Fifteen CMDC1 participants and 7 CMDC2 participants expected both slower pace and smaller scale. No participant reported that the project would have continued unchanged.

Figure 39 shows that some organisations reported that their project would go ahead unchanged in or outside the UK. However, no respondents provided this answer without also selecting another, sometimes contradictory, option. Only 3 CMDC1 respondents and 1 CMDC2 respondent reported that their projects would have gone on unchanged in the UK, and 7 CMDC1 respondents and 1 CMDC2 respondent reported that their projects would have gone on unchanged outside the UK.

Despite UK SHORE funding, a significant minority of organisations still faced financial constraints. In the monitoring data, respondents were asked if they had to divert resources away from other activities in order to complete the projects. 37% (64) of CMDC1 respondents and 24% (21) of CMDC2 respondents reported that they did divert funding. Of these respondents, around two-thirds diverted from R&D funding in both CMDC1 and CMDC2 (41 and 14 respondents respectively). This suggests that although the projects supported by CMDC1 and CMDC2 exhibit a high degree of additionality at the project level, the degree of additionality in terms of overall additional R&D investment is smaller, as at least some private R&D was diverted from alternative uses.

In line with monitoring data, CMDC1 and CMDC2 successful applicants who were interviewed either expressed that their projects would not have gone ahead or said that their projects would have developed at a slower pace. Those who expressed the former typically stressed the importance of UK SHORE funding in lessening the barrier of entry into the marine sectors. A research and consultancy project collaborator, who applied to CMDC1 unsuccessfully but later received ZEVI funding, said that CMDC1 allowed them to focus innovative efforts on the marine sectors, which they had long intended to but lacked the opportunity prior to UK SHORE. Similarly, an environmental non-profit participant noted the importance of UK SHORE support for certain projects which can support environmental benefits:

> *"Projects like these which target a small part of the market are not seen as traditionally commercially viable but are important because they work towards zero carbon efforts."*

CMDC participant (environmental non-profit)

Interviewed applicants who said UK SHORE sped up the pace of project development tend to be small organisations already present in the sector prior to UK SHORE. These participants typically appreciated the increased recognition from participation in UK SHORE. A project lead who participated in CMDC1 and CMDC2 (engineering SME), said that UK SHORE "has helped the company come up at par with other big names in the industry despite being a smaller company." As a result, they have felt benefits beyond direct funding such as expanded clientele.

"I think one of the main things that I found really helpful … was … [UK SHORE] was a public programme with the partners we had, it's been very helpful for effectively helping us establish our credentials, particularly now in the eyes of potential investors as a … means of helping us to raise further funds to keep doing our work."

CMDC2 collaborator (engineering organisation)

6.2 Environmental benefits

Initial findings on EQ 2 are presented below: To what extent, and through what mechanisms, can environmental benefits be attributed to UK SHORE? The relevant data and data sources for each sub-question under EQ 2 are reported in Table 19.

Table 19 EQ 2 data sources

Sub-question	Data	Data source
To what extent has UK SHORE facilitated emissions of CO_2e or air pollutants to be reduced from UK maritime?[19]	Scope and scale of carbon savings expected. Carbon savings already identified.	Survey data Qualitative interviews End-of-project reports
What factors enabled or hindered the ability for UK SHORE to contribute towards changes in emissions in CO_2e or air pollutants from UK maritime?	Technological barriers are discussed in Section 6.1.1.	Not applicable
Did changes in CO_2 emissions facilitated by UK SHORE vary by sub-sector or technology type?	A discussion of potential emissions reporting requirements for UK SHORE that would enable addressing this sub-question	Not applicable

Source: Frontier Economics.

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[19] Carbon dioxide equivalent (CO2e) is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO2e signifies the amount of CO2 which would have the equivalent global warming impact.

6.2.1   Evaluation evidence

Scope and scale of expected environmental benefits

Many projects aimed to have sector-wide and 'paradigm-shifting' environmental benefits

As shown in Figure 40, the projects in CMDC1 and CMDC2 have a range of expected scopes for environmental benefits. In both schemes, many projects focused on sector-wide or regional benefits (33 across both strands), but several focused on benefits that would impact the whole energy system (22 across both strands). The emphasis on sector-wide and whole-system benefits was present both at the start and at the end of CMDC1 and CMDC2 projects. Very few projects in CMDC1 (only 1 at the start and 2 at the end), and none in CMDC2, felt the scope of environmental benefits was limited to an organisation-level, suggesting the perceived potential for wider environmental impacts.

Figure 40   What do you think is going to be the scope of environmental benefit of your project?
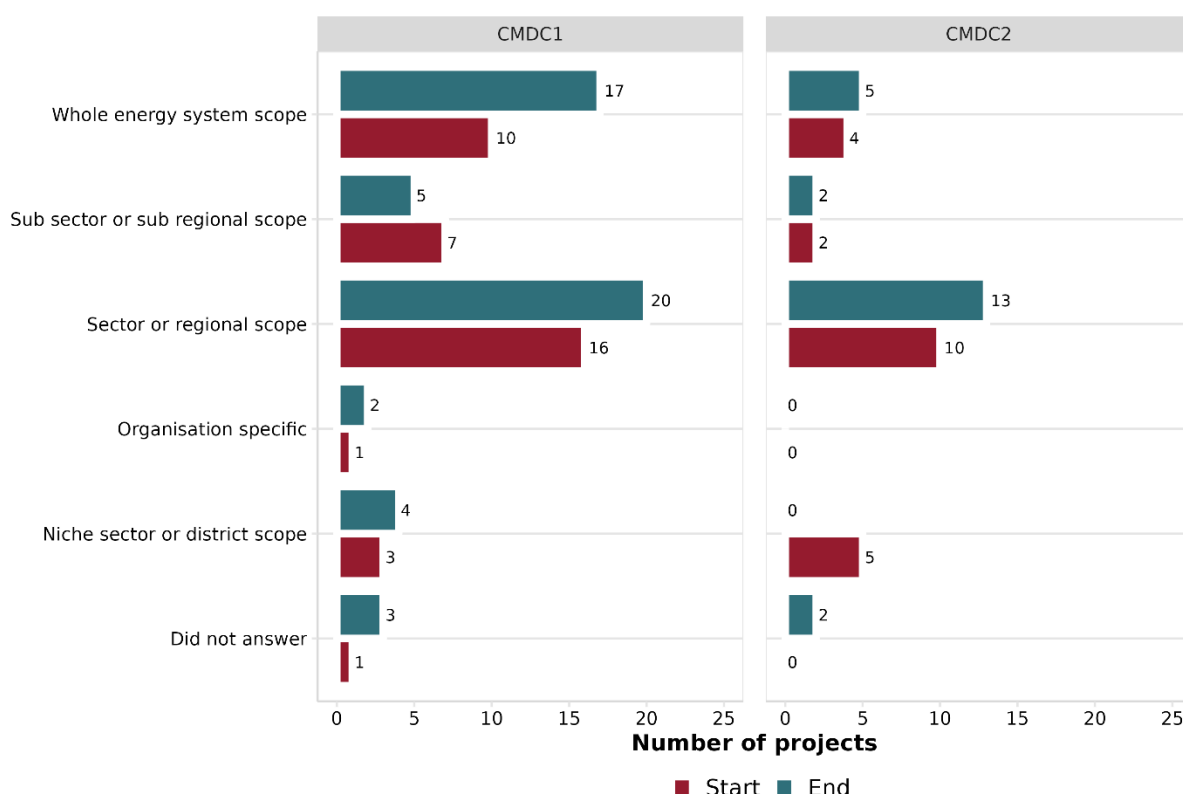
Source: Frontier analysis of end-of-project data.

Note: For start: CMDC1 n = 39, CMDC2 n =21. For end: CMDC1 n = 51, CMDC2 n = 22. 'Based on your expectations at the end of the project, what do you think is going to be the scope of environmental benefit – in terms of Net Zero: reducing carbon and other GHG emissions – of your project?' Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.

Figure 41 shows the self-reported scale of expected environmental benefits from monitoring data. The responses should be interpreted with the caveats that this is a qualitative and subjective measure that combines elements of scale, additionality, and scope. The distribution of responses within CMDC1 at the start and the end of projects is roughly similar, and the same is true of CMDC2.

Figure 41   Please state the level of impact this level of emission reduction is expected or intended to have
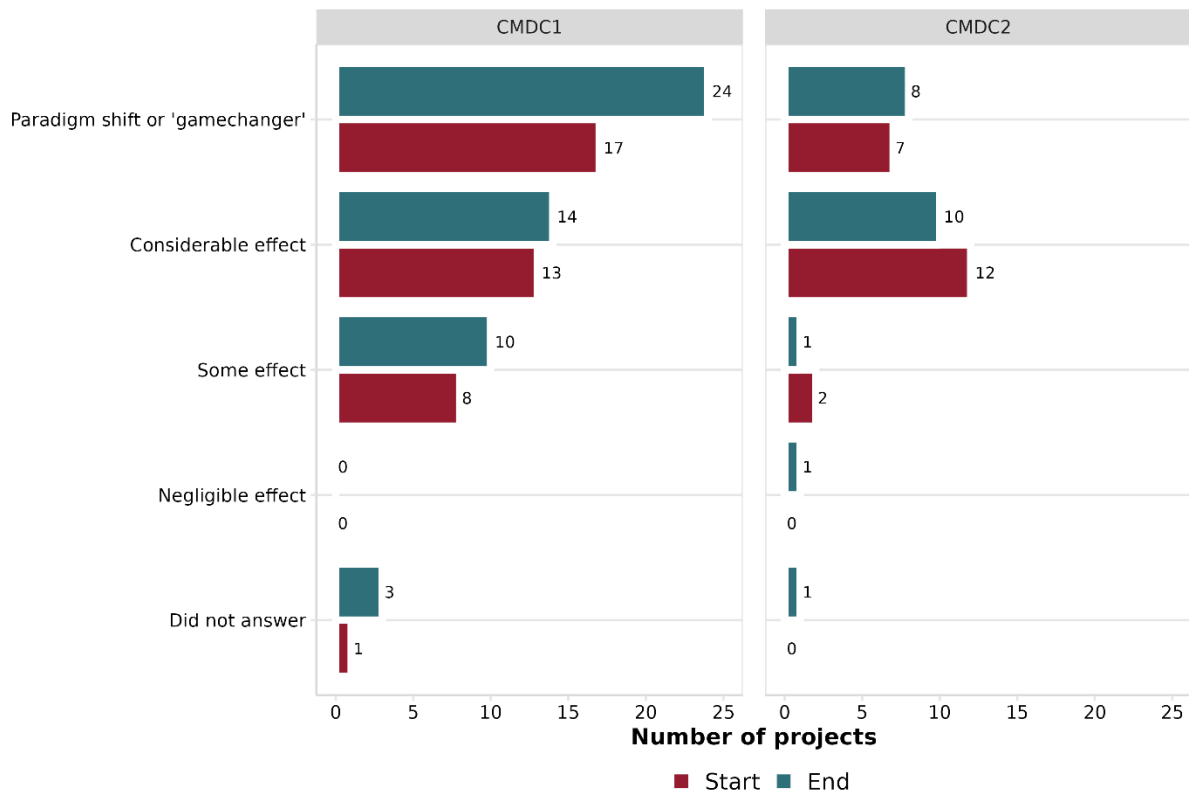
Source: *Frontier analysis of end-of-project data.*

Note: *CMDC1 n = 39, CMDC2 n =21 'Now thinking about the Scale (how much effect is expected) of that Environmental Benefit, please state the level of impact this level of emission reduction is expected or intended to have?' Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.*

Several respondents reported that they were working on a paradigm shift or 'gamechanger' project. One interviewed CMDC1 participant commented on the emphasis on high impact projects, and that CMDC1 required projects to be relatively high cost, high innovation, and high potential emissions impact. This participant felt that these types of projects only represent a subset of types of initiatives that can usefully contribute to carbon savings. They thought that there are material carbon savings that could be generated by solutions that did not qualify to apply for CMDC because the solutions were not aligned with CMDC's objectives, either because the level of funding required was too low or the technology was not sufficiently new. The participant felt that there is a trade-off between funding these different types of projects,

but that it is important for funding to be available to smaller cost innovations to ensure these carbon savings can be realised.

Carbon dioxide emissions

Most projects reported that they had not identified carbon savings

Survey respondents reported on carbon savings during their project, shown in Figure 42. In both CMDC1 and CMDC2, the majority of respondents did not report estimated carbon savings. This was largely due to projects that were feasibility studies or projects that did not include carbon savings estimation within scope.

Of those projects that reported estimating carbon savings, some reported specific statistics, such as: "We estimate that for an 8-metre boat operating 50 hours a year, the carbon saving would be in the order of 2.5 to 3 tonnes per annum per boat. Assuming 20 to 30 boats being supported by this infrastructure would imply 50 to 100 tonnes of CO_2 per annum." Others reported more simply that the technology under development would eliminate operational emissions, for example: "As this is an engine running on green hydrogen, it would eliminate CO_2 emissions in anything to which it is applied."

Figure 42   Carbon savings identified to date
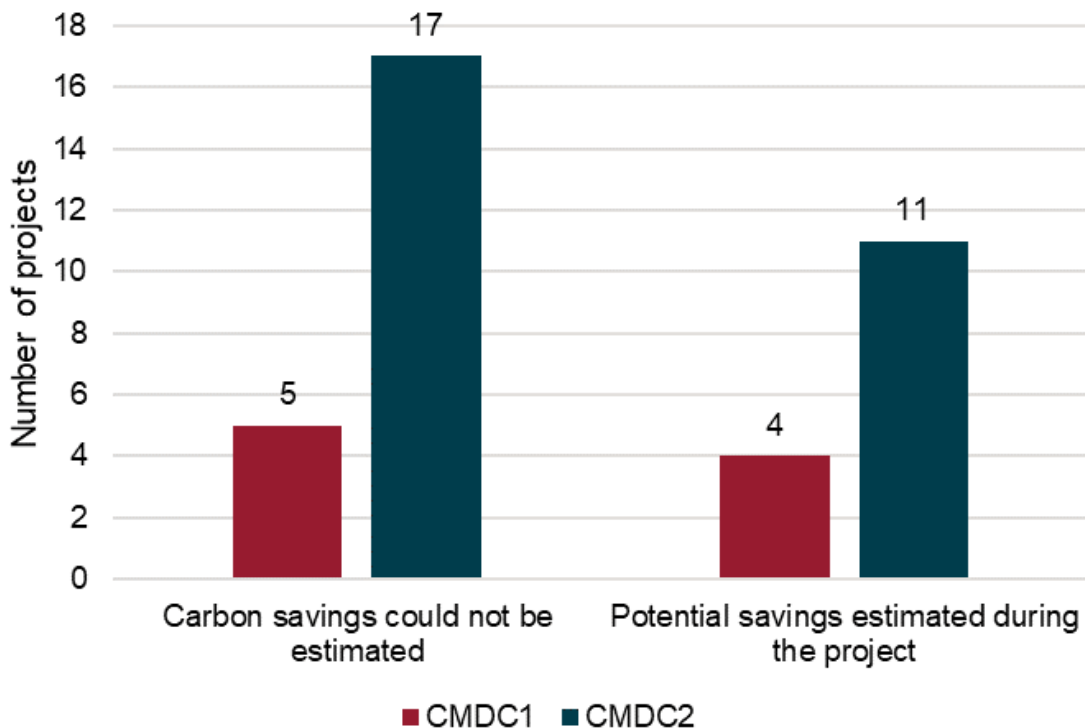
Source: Survey, n = 37

Note: 'Carbon savings could not be estimated' includes answers reporting no carbon savings, uncertainty about carbon savings, and blank answers (no carbon savings reported).

In end-of-project reports, CMDC1 and CMDC2 projects reported estimated carbon savings in a range of ways. Table 20 reports carbon savings estimates for CMDC1, Strand 2.

Several key issues emerge from the reported statistics, which result from the intrinsic difficulty of comparing projects within the UK SHORE portfolio that have different technologies, TRLs and CRLs, and environmental effects. Projects reported emissions savings in a variety of different units, both in terms of the numerator (CO_2, CO_2e, NOx and Diesel fuel) and the denominator (per vessel, per day, per year, % reduction). Moreover, the emissions savings may have been calculated using different sets of assumptions that complicate comparisons, and are reported for a range of different timescales (or without any clear timescale at all). Based on expert views, it is not possible to aggregate or compare the available emissions end-of-project estimates for CMDC1 and CMDC2, without further information from projects. The following sections discuss options for how UK SHORE could collect future monitoring and evaluation data on emissions to be able to better compare project outcomes.

Table 20   Reported carbon savings statistics, CMDC1 Strand 2

ID	Emissions reduction	Emissions intensity change
1	Not reported	Innovation would save 60% CO_2 on a daily usage pattern cycle
2	Not reported	30-year projection: 23 vessels will cumulatively reduce CO_2 emissions by 50% compared to conventional charter vessels
3	1) CO_2 savings per year (kg): 1,045,497 2) By 2026 if 150 sold (t): 162,575 3) 30-year projection (t): 3,717,905	Not reported
4	Not reported	Not reported
5	Not reported	If electrification of port achieved, 96% emissions reduction
6	CO_2 savings per year (t): 344	97.4% emissions reduction from technology
7	1) CO_2 saving per year per vessel switching from marine gas oil to battery electric propulsion (t): 1278[3]	Not reported

ID	Emissions reduction	Emissions intensity change
	2) CO_2 savings per year if adopted by 50% of the UK Crew Transfer Vessels fleet (t): 131,100	
8	1) 12-metre x-class Unmanned surface vehicles (USVs): 280kg CO_2 saved per day of usage per vessel 2) 18-metre xl class USVs: 1300kg CO_2 saved per day of usage per vessel 3) CO_2 savings per year with 50% utilisation: 50,000kg for x-class and 230,000kg for xl-class	Not reported
9	CO_2e savings per year (t): 85,919	Not reported
10	CO_2e savings per day (kg): 40 in 2030 and 130 in 2040	Not reported
11	1) CO_2 savings per year (t): 20,069 by year 5 if 450 units sold 2) CO_2 savings for 5 years (t): 50,000	Not reported
12	CO_2 savings per year (kg): 104,350 from a 10-vessel fleet	Up to 67% reduction in CO_2
13	1) Nitrogen oxides (NOx) savings per year per vehicle (kg): 30 2) Diesel fuel consumption reduction per year per vehicle (l): 13,000	Not reported

Source: CMDC end-of-project reports.

6.2.2   Options for carbon savings reporting

In the context of monitoring and evaluation, carbon savings estimates can be used to:

■ forecast the reduction in emissions due to the activity, and to measure the progress against emissions targets

■ understand how and why the emissions reduction occurred, or is forecast to occur, to inform future interventions

These objectives are discussed below.

Measuring progress against emissions targets

Table 21 are key emissions targets that are relevant for benchmarking UK SHORE activity, which suggest a potential set of emissions reporting units.

Table 21   Units used in emissions targets

Emissions target	Examples of emissions units
[2050 Net Zero commitment](#) (UK government) Ambition to reach Net Zero close to 2050 and indicative checkpoints at 2030 and 2040 ([IMO GHG Strategy July 2023](#))[20]	Sector-level reduction in tCO_2e per year
Commitment to ensure an uptake of alternative zero and near-zero GHG fuels, to represent at least 5% (striving for 10%) of the energy used by international shipping, by 2030 (IMO GHG Strategy July 2023)	Reduction in energy (eg kWh) from the use of zero and near-zero GHG fuels
Target to reduce emissions by transport work[21] by 40% by 2030 (IMO GHG Strategy July 2023)	Reduction in CO_2e emissions per transport work
NOx,[22] SOx and PM[23] regulations	Reduction in grams per kilowatt hour (NOx) and reduction in mg/m^3 (SOx and PM)[24]

Source: Frontier Economics.
Note: These emissions units are examples that would align with policy and regulation. Other units would also align.

These policy and regulatory targets could be used to formulate a set of options for UK SHORE projects' high-level project emissions reporting. Because of the range of projects, it will be important to verify that each project will be able to find at least 1 reporting option that is appropriate for their work.

It is important to note that the resulting estimates will not necessarily be able to be aggregated across projects, as projects may be working on complementary and mutually dependent technologies (eg green hydrogen engines and green hydrogen infrastructure, which are needed in combination to realise carbon reduction).

Moreover, certain mitigation approaches depend on the availability of a low-emissions version of the energy source (eg green hydrogen versus grey hydrogen; successful grid decarbonisation), which is subject to uncertainty.

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[20]   IMO (2023), '[IMO's work to cut GHG emissions from ships](#)', IMO.

[21]   An example of unit of transport work is '[tonnes-km](#)': a measurement unit corresponding to the transport of one ton over a distance of one kilometre.

[22]   IMO. '[Nitrogen oxides (NOx) – regulation 13](#)', IMO.

[23]   IMO. '[Sulphur oxides (SOx) and Particulate Matter (PM) – regulation 14](#)', IMO.

[24]   A unit measuring the % content of the fuel mass.

Understanding why and how emissions reductions would occur

An advantage of the above approach is that it requires relatively little technical specification from DfT. In order to generate additional insight, DfT could develop clear guidelines for emissions reporting, including aspects like counterfactuals, assumptions, utilisation levels, preferred units of measurement, and calculation methodologies.[25] This would enhance the quality and consistency of data collected.

One potential approach would be to collect information from projects on displaced fuel. Displaced fuel can be declared by various technologies, independent of the alternative fuel, including electric connections (cold-ironing), and energy conversion technologies (alternative fuel engines, batteries and fuel cells). An advantage of this approach is that it could provide a common basis for reporting net change in CO_2e, NOx, SOx, and PM. However, this approach would require DfT considers how projects report emissions associated with the alternative technology, which would be dependent on grid emissions intensity, fuel pathway or fuel cycle emissions.

The specifications of emissions reduction measures are an area of active development. The IMO 2023 GHG Strategy proposed: "A basket of candidate measure(s), delivering on the reduction targets, should be developed and finalized comprised of both:

1. "a technical element, namely a goal-based marine fuel standard regulating the phased reduction of the marine fuel's GHG intensity; and

2. "an economic element, on the basis of a maritime GHG emissions pricing mechanism."

The strategy also notes: "the potential synergies with other existing measures such as the Carbon Intensity Indicator (CII) will be considered, in particular regarding incentives for energy efficiency and for the adoption of better operational practices in the shipping value chain or other technologies to reduce emissions from ships."[26] It may be useful to align UK SHORE reporting with international standards as appropriate.

6.3 Commercial opportunities

This section presents initial findings on EQ 3: To what extent, and through what mechanisms, did UK SHORE improve the commercial prospects and opportunities for clean maritime in the UK? The relevant data and data sources for each sub-question under EQ 3 are reported in Table 22.

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[25] For example, see IMO 'Guidelines on Life Cycle GHG Intensity of Marine Fuels (LCA Guidelines)', IMO.

[26] The Carbon Intensity Indicator (CII) is a measure of emissions intensity measured in CO2 emitted per cargo-carrying capacity and nautical mile, with variants for segments where the cargo is weight-critical and volume-critical. This reporting standard was developed based on the data elements that are supported through the IMO DCS system, which does not collect the cargo data required to calculate emission per tonne-mile (Energy Efficiency Operational Indicator [EEOI]). The IMO previously published guidelines for reporting EEOI, which is defined as the mass of emissions per unit of transport work.

Table 22   EQ 3 data sources

Sub-question	Data	Data source
To what extent was additional private investment crowded in for developing clean maritime technologies?	Match funding for UK SHORE projects	Monitoring data
	Additional funding received for CMDC1 and CMDC2	Monitoring data
	Follow-on funding for CMDC1 and CMDC2 projects	Survey data
How far have commercial benefits for UK businesses been realised or are expected to be realised in the future, for clean maritime technologies?	Change in CRL for CMDC1 and CMDC2	Monitoring data
	Financial benefits realised by organisations involved in CMDC1 and CMDC2	Monitoring data and stakeholder engagement
	Improvements in commercial opportunities by organisations involved in CMDC1 and CMDC2	Monitoring data and stakeholder engagement
	Plans to take CMDC1 and CMDC2 projects further towards commercialisation	Survey data
	Plans to exploit findings from CMDC1 and CMDC2 projects	Monitoring data
To what extent did UK SHORE facilitate Intellectual property (IP) to be generated and retained in the UK for clean maritime technologies?	Number of organisations involved in CMDC1 and CMDC2 reporting intellectual property rights	Monitoring data

Source: Frontier Economics.

6.3.1   Evaluation evidence

Crowding in investment

Section 3.4 reports match funding across projects. A total of £103 million match funding has so far been raised across the entire UK SHORE portfolio, excluding CMDC4 for which match funding figures have not been confirmed. Of this, £10 million went into CMDC1 projects and £6 million into CMDC2 projects. Data has not allowed for the split of investment into public and private.

Beyond match funding, UK SHORE has directly crowded in additional investment, both public and private, through further funds raised to support projects during the delivery phase of the project, as well as follow-on funding for after the delivery phase. These amounts are measured as part of the evaluation from monitoring and survey data respectively. Investment figures should be considered in light of evidence of diverting R&D spend, as discussed in Section 6.1.

During the delivery phase of the project, most organisations did not raise additional funds beyond match funding

As part of project monitoring, respondents were asked whether they were able to raise further funding to support the delivery phase of their project, in addition to the match funding. Figure 43 shows the number of organisations who reported receiving this further funding.

Figure 43   Has your organisation been able to raise further funds, in addition to the match funding?
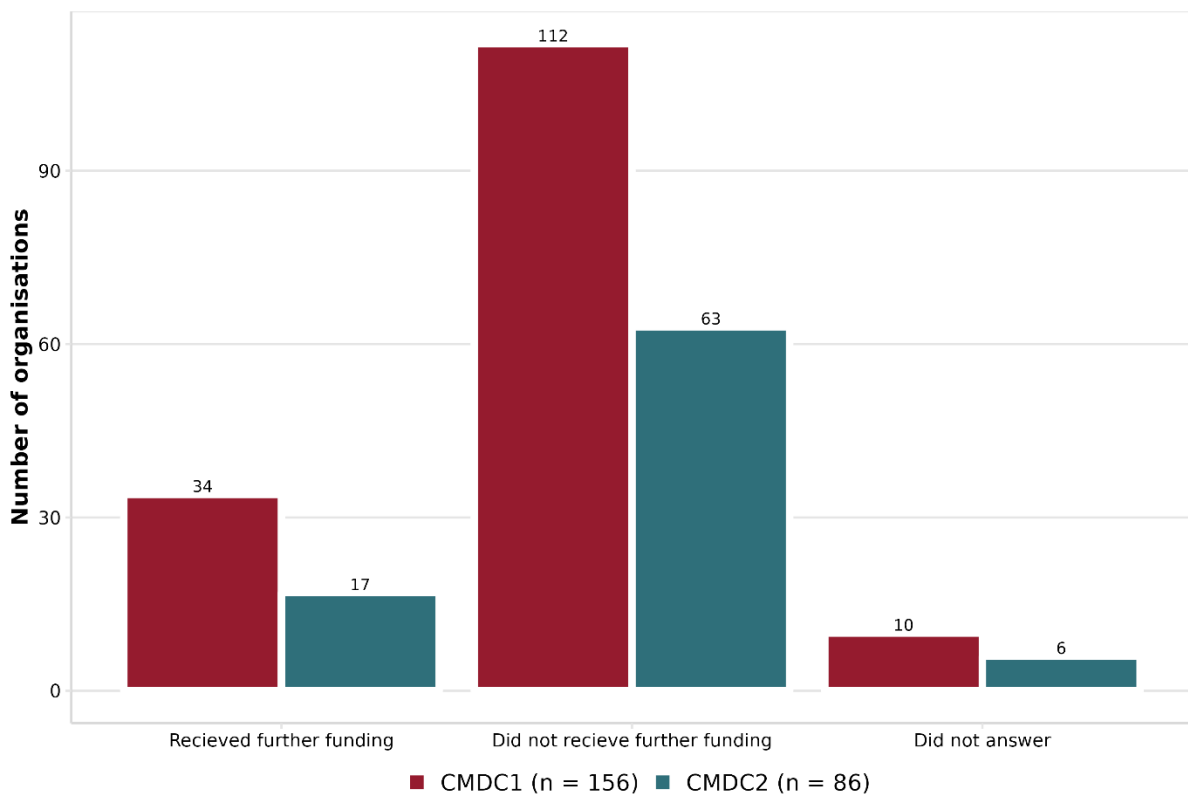
Source: Frontier analysis of end-of-project data.

Note: "As a result of your participation in this project, has your organisation been able to raise further funds, in addition to the match funding?" The question was presented to all CMDC2 organisations and private CMDC1 organisations (not academic organisations). Some organisations responded multiple times to the survey, so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.

Only a minority of organisations (around 20%) reported raising further funding as a result of participation in the scheme.

The most common source of further funding was from internal sources (reported by 12 CMDC1 organisations and 8 CMDC2 organisations). [27] Other common sources were existing investors (8 for CMDC1 and 2 for CMDC2), venture capital (8 for CMDC1 and 4 for CMDC2), and business angels (5 for CMDC1, 2 for CMDC2).

Organisations were also asked how they used the additional funding.[28] Funding was typically used for further R&D investment on the same project (17 CMDC1 projects and 4 CMDC2 organisations) and for general investment in the business (16 CMDC1 organisations and 5 CMDC2 organisations).

The proportion of organisations receiving further funding differed across regions

Table 23 shows, for CMDC1 and CMDC2 combined, the likelihood of an organisation in a given region receiving further funding (the number of organisations who received further funding in a region divided by all CMDC1 and CMDC2 organisations in that regions) with the number of organisations who received further funding by region. A higher proportion of CMDC1 and CMDC2 organisations in the West Midlands, Yorkshire and London secured further funding than other regions (with a third or more achieving further funding). The North East, Scotland and South East also saw relatively high levels (around a quarter of organisations). The North East stands out with less than 1 firm reporting further funding despite 15 CMDC1 and 2 organisations who responded to the survey.[29] More organisations in the South East received further funding than any other region, but this is not surprising given that more firms received funding from CMDC in the South East than any other region (see Section 6.5.1).

This data shows how outputs differ across regions but does not provide evidence about whether outcomes or impacts differ by region: in particular it does not suggest that funding should be concentrated in specific regions because the impact on further funding is larger.

Table 23 Has your organisation been able to raise further funds, in addition to the match funding? Regional distribution

Region	Likelihood of receiving further funding (% of organisations in that region)
East Midlands	17 (1)
East of England	12 (2)

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[27] CMDC1 n = 34 CMDC2 n = 17, "As a result of your participation in this project, has your organisation been able to raise further funds, in addition to the match funding? Please tick all that apply."

[28] CMDC1 n = 34 CMDC2 n = 17, "What was this further funding for?"

[29] As noted in Section 4, some firms responded multiple times and so responses are weighted such that each unique project-organisation combination sums to 1. We reported rounded numbers of firms, except for 'Less than 1' where a response with a weighting of 0.2 got further funding.

London	33 (9)
North East	3 (<1)
North West	22 (2)
Northern Ireland	17 (1)
Scotland	23 (8)
South East	24 (18)
South West	18 (2)
West Midlands	41 (4)
Yorkshire and The Humber	33 (1)

Source: Frontier analysis of end-of-project data.

Note: "As a result of your participation in this project, has your organisation been able to raise further funds, in addition to the match funding?" The question was presented to all CMDC2 organisations and private CMDC1 organisations (not academic organisations). Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.

A higher proportion of micro or small businesses received further funding than other firm sizes

Figure 44 shows the percentage of CMDC-funded organisations of each size who received further funding. Across both rounds, more than 50% of micro and small organisations (22 CMDC1 and 10 CMDC2 firms) received further funding, compared with around a quarter of large and 10% of medium sized organisations.

Figure 44   Has your organisation been able to raise further funds, in addition to the match funding? Distribution by organisation size
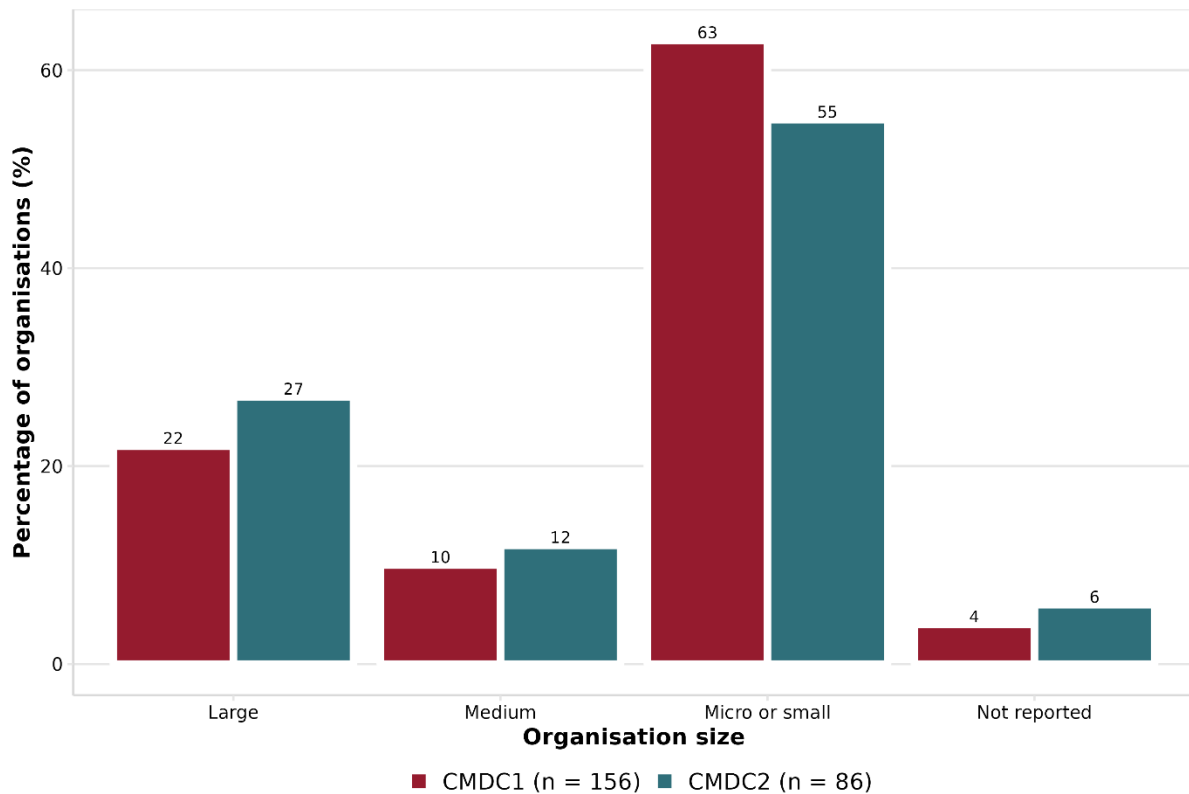
Source: Frontier analysis of end-of-project data.

Note: "As a result of your participation in this project, has your organisation been able to raise further funds, in addition to the match funding?" Question was asked to all CMDC2 organisations and all private CMDC1 organisations (ie not academic organisations). Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more detail. Rounded numbers reported.

Many organisations have secured, or are expecting to secure, follow-on funding for after the delivery phase of the project

Figure 45 presents survey results on the number of respondents who have secured, or expect to secure, funding compared to those who have not: overall 63% of respondents have or expect to have funding (16 CMDC2 and 6 CMDC1 projects). Among these respondents, 15 are expecting to secure further funding from private investors in the UK, 15 are expecting to secure from the public sector and 11 expecting to secure from private investors overseas. Of those who have already secured further funding, this is typically from the UK public sector.

In addition, survey respondents reported a median level of follow-on funding of £2 million per project. Survey response rate for CMDC projects was only 36% and so the total amount secured for follow-on funding is expected to be higher than this figure. Follow-on funding for after the delivery phase of the project reported in the survey data is much larger than further funding raised during the projects reported in the monitoring data.

Figure 45   Have you secured, or do you expect to secure within the next 2 years, any follow-on funding to further develop the technology after the delivery phase of this project?
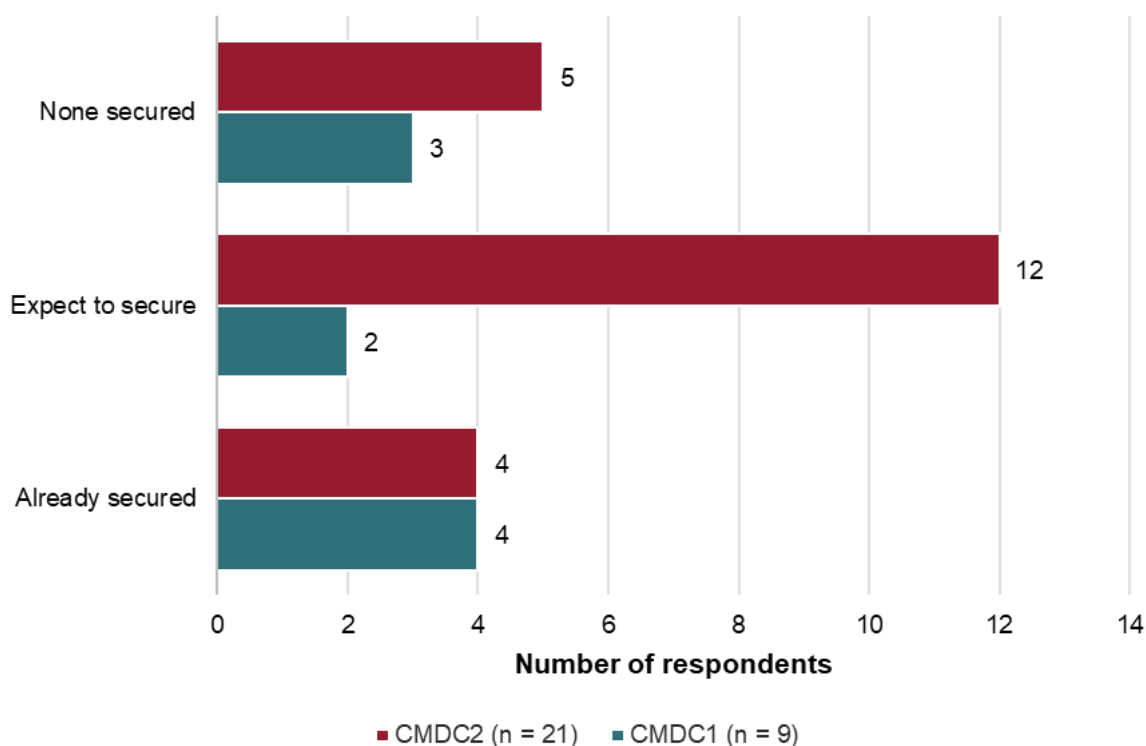
Source: Survey data.

Note: *Figures are calculated by allocating respondents who have secured any funding to 'Already secured', those without funding but expecting to secure to 'Expect to secure' and the remaining respondents to 'None secured'. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.*

Funding raised during and after CMDC projects is at a similar level to funding raised prior to CMDC projects

Funding achieved during and after CMDC projects can be compared to funding raised in the 12 months prior to UK SHORE, to provide a benchmark for the level of funding. Baseline project monitoring data asked organisations whether they received funding in the 12 months prior to the start of their project.

For CMDC1, this question was only asked to project leads, and so total figures are not comparable to CMDC2 figures nor CMDC1 end-of-project responses (which refer to all

organisations). Of those organisations who received funding, the median funding was around £700,000 with a total of £32m raised.[30]

All CMDC2 organisations were asked the question, with 63 organisations (65%) reported receiving funding. Of those organisations who received funding, the median funding was around £10,000 with a total of £47 million raised. Funding between CMDC1 and CMDC2 is markedly different, although potential outliers and small sample sizes reporting funding means significant conclusions should not be drawn from this finding.

Table 24 sets out the different types of funding received for CMDC1 and CMDC2 projects. Comparing funding during and after CMDC1 and CMDC2 projects suggests that funding is at a similar order of magnitude to funding before UK SHORE. It is not possible to draw a strong conclusion from these figures, particularly as the data do not come from the same organisations but rather from those who completed the monitoring questionnaires or evaluation survey. The fairly small sample size means that figures are sensitive to outliers where 1 or 2 organisations see particularly high levels of funding, and figures for funding secured or expected within 2 years of project completion comes from a small number of survey respondents.

Table 24   Total funding amounts

Time frame	Type of funding	CMDC1	CMDC2	Source
Prior to project	Funding raised by organisation 12 months prior to project	£392 million	£47 million	Baseline monitoring data
During project	UK SHORE funding	£23 million	£15 million	Baseline monitoring data
	Match funding	£10 million	£6 million	Baseline monitoring data
After project	Follow-on funding, secured or expected to secure with 2 years	£18 million	£357 million	Survey data

Source: *Various (as reported in table).*
Note: *'Prior to project' CMDC1 n = 26, CMDC2 n = 63. 'After project' CMDC1 n = 9, CDC2 n = 21.*

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[30]   This excludes one additional outlier of £360 million (on top of outliers excluded using the methodology in Section 4.2.3. This is excluded as it leads to a change in the total figure by an order of magnitude and it is not possible to verify the figure is correct.

Commercial readiness level

Most projects achieved improvements in CRL

CRL is a measure from 1 to 9 where a higher CRL indicates the product or technology is closer to being ready for market launch; a detailed definition of CRL is available in Annex D. Project leads were asked to report their CRL at the start and end of the project as part of DfT monitoring. Project leads reported CRL at the end of their project without seeing the CRL reported at the start of projects.

Figure 46 shows the number of projects reporting an improvement, no change or fall in their CRL level. Figure 47 and Figure 48 show the number of organisations for each combination of start and end CRL, for CMDC1 and CMDC2 respectively.

Figure 46   Changes in CRL
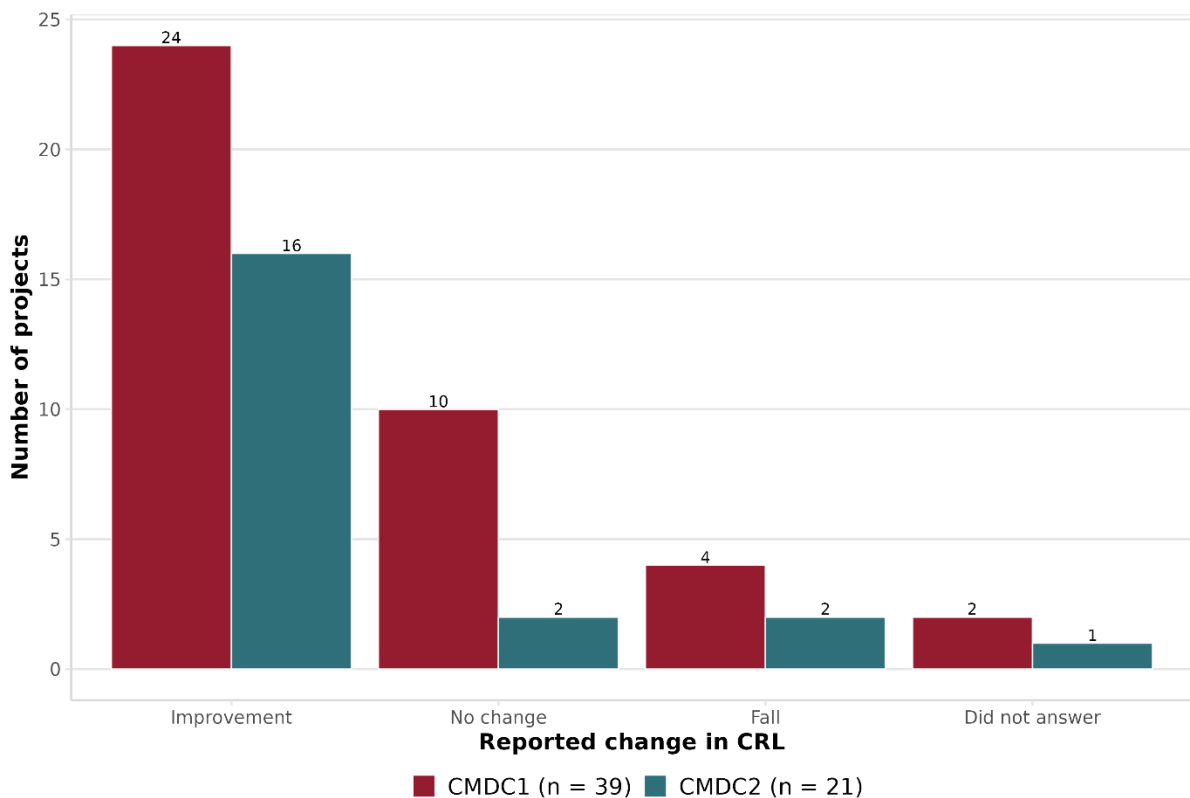
Source: *Frontier analysis of baseline and end-of-project monitoring data.*

Note: *Compares answers to the question: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness", asked at the start and end of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.*

The majority of projects (60% of CMDC1 projects, 77% of CMDC2 projects) reported an improvement in CRL between the start and end of the project.

As discussed in Section 6.1.1 with TRL responses, project leads reported CRL at the end of their project without seeing the CRL reported at the start of projects. Unexpectedly, some projects reported a fall in CRL. This could occur for a number of reasons, including 'genuine' changes in projects' understanding of change in the CRL level between the start and end of the project, misreporting of the CRL at the start or end, or differences in interpretation between those providing the information at different points in time. Based on the monitoring data available, it is not possible to determine the drivers of self-reported CRL decreases.

Figure 47 and Figure 48 cross-tabulate start and end CRL from project monitoring data. The number in the cell refers to the number of projects, where cells below the red line indicate a fall in CRL and above the blue line indicates a growth in CRL.

For CMDC1, the majority of projects were at CRL 4 by the end of the project and these projects typically started at CRL 2, 3 or 4. Only 4 projects reported a regression in CRL levels: 1 project started at CRL 4 and fell to CRL 3, while 3 started at CRL 5 and ended at CRL 3.

Figure 47   Start and end CRL – CMDC1

Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: n = 37 . Compares answers to the question: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness," asked at the start and end of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.

Like for CMDC1, CRL 4 was the most common CRL at the end of the project and it was common for organisations to start at either CRL 2 or 3 and grow to CRL 4. Projects typically saw a 1 or 2 CRL improvement. For CMDC2, 2 projects saw CRL regression, falling from CRL 5 to CRL 4.

Figure 48   Start and end CRL – CMDC2

		CRL at the end of the project					
		2	**3**	**4**	**5**	**6**	**7**
CRL at the start of the project	**2**	1	1 →	4	-	-	-
	3	-	-	4	3	-	-
	4	-	-	1	3	2	-
	5	-	-	2	-	-	-
	6	-	-	-	-	-	-
	7	-	-	-	-	-	-

Increase in CRL

Decrease in CRL
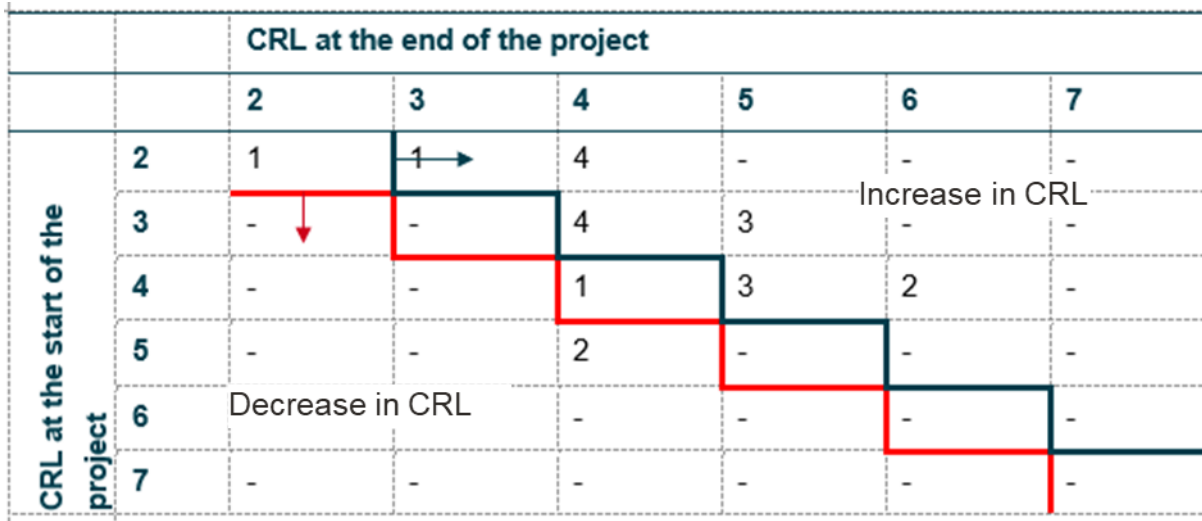
Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: n = 20 . Compares answers to the question: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness," asked at the start and end of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported

All technology applications saw CRL development

As discussed with TRL development in Section 6.1.1, the small sample size means it is not possible to make meaningful comparison across different project types but early indications can be discussed. This section presents the average CRL progression and the number of firms reporting an improvement, no change or fall in their CRL for each technology type and application.

Table 25 shows all technology applications saw improvements in CRL. Improvements were lowest for infrastructure projects and greatest for smart shipping projects, although the sample size for this group is the smallest (only 4 projects). As noted above when discussing TRL development across projects, it is not possible to analyse CMDC2 at the same level as CMDC1 because a significant proportion of projects are classified as 'vessels'.

Table 25   CMDC1 – Average CRL progression by technology application

Type	Sample size	Average CRL progression	Number of firms		
			Improvement	No change	Fall
Infrastructure	9	0.17	3	5	1
Smart shipping	4	1.5	3	1	0
Vessels	24	0.85	18	4	2

Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: Compares answers to the question: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness," asked at the start and end of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.

Table 26 shows that across CMDC1 and CMDC2 vessel projects, all fuel types saw CRL development. Hydrogen and Ammonia projects saw the largest development.

Table 26   CMDC1 and CMDC2 – Average CRL progression by fuel type

Type	Sample size	Average CRL progression	Number of firms		
			Improvement	No change	Fall
Ammonia	3	1.33	2	1	0
Battery electric	7	0.93	5	1	1
Fuel cell	3	1	3	0	0
Hydrogen	14	1.11	11	2	1
Analysis of multiple fuel types	4	0.5	3		1
Other	8	0.92	6	0	2

Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: Compares answers to the question: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness," asked at the start and end of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.

Improvements in CRL were slightly lower than expected

At the start of the project, project leads' expectations for CRL by the end of the project were recorded. Figure 49 is similar to Figure 46, but instead shows the number of CMDC1 and CMDC2 projects expecting to see an improvement, no change, or fall in their CRL level, by comparing current and expected CRL levels as reported in the baseline data.

Across both CMDC1 and CMDC2, most organisations expected to see an improvement in CRL. Comparing these graphs shows that more organisations expected an improvement in CRL than achieved an improvement (20 CMDC1 organisations achieved an improvement compared to 27 expecting an improvement; these figures are 16 and 20 for CMDC2 organisations, respectively).

Figure 49   Number of organisations expecting a change in CRL
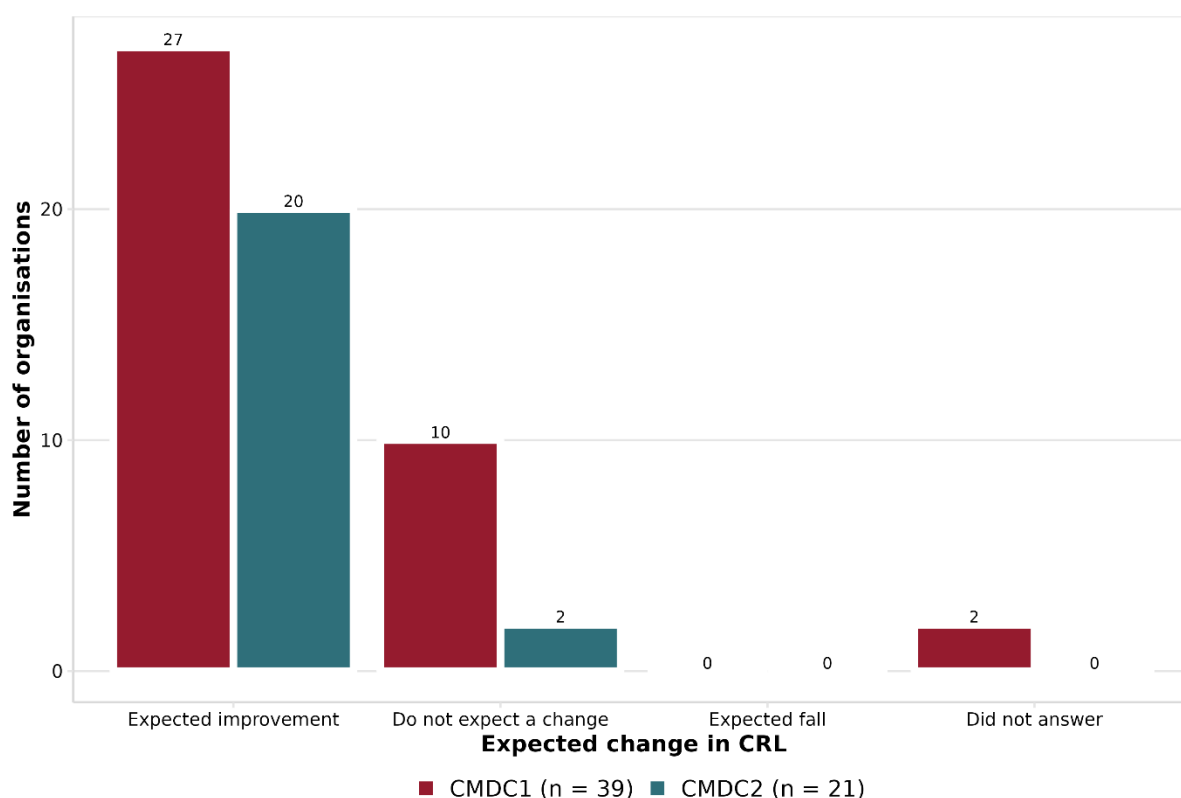
Source: Frontier analysis of baseline monitoring data.

Note: Compares answers to the questions: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness," and "In terms of its commercial readiness where do you expect or aspire to be by the end of the project." Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.

Figure 50 shows the actual distribution of CRL at the end of the project, compared with the expected distribution of CRL at the end of the project. For CMDC1, more projects finished with low CRLs than expected. For CMDC2, realised CRL does not appear to systematically deviate from expected CRL. As discussed above, these distributions may be affected by differences

in interpreting CRL for those reporting the expected CRL and those reporting the actual CRL, if the questions were answered by different people within an organisation.

Figure 50   Comparison of the distribution of expected and reported CRL
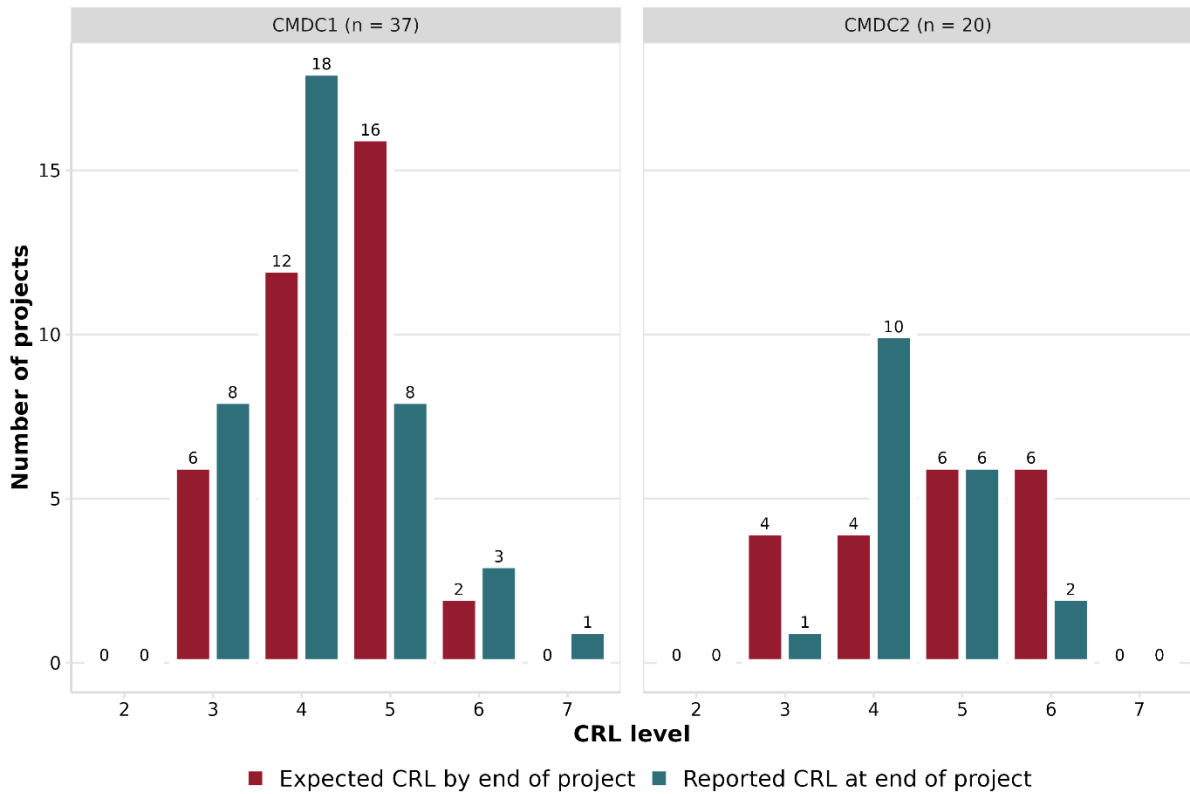
Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: Compares answers to the questions: "Thinking about the innovation at the heart of the project, which of the following best describes the proximity of it to the market in terms of its commercial readiness," asked at the end of projects and "In terms of its commercial readiness where do you expect or aspire to be by the end of the project," asked at the start of projects. Some project leads responded multiple times to the survey so responses were weighted so that weights summed to 1 for each project. See Section 4.2.3 for more details. Rounded numbers are reported.

Intellectual property (IP)

A minority of organisations have applied for or been granted IP rights

Intellectual property includes trademarks, registered design, copyright material, patents and other content rights, and is a useful leading indicator for commercial value. Organisations reported in monitoring data whether they had considered, applied for, or been granted IP rights, either solely or with another organisation involved in the project. Figure 51 shows the responses to this question, aggregating all types of intellectual property.

Eighteen CMDC1 and 7 CMDC2 organisations have been granted IP rights, with a further 6 CMDC1 and 3 CMDC2 organisations applying for rights. This was typically in the form of patents or trademarks, and was done by individual organisations (rather than being granted

or applying for IP with other organisations). Non-response rates were high for this question. At this stage, it is too early to understand the IP benefits of these projects, including the extent to which organisations considering IP rights will ultimately be granted IP rights.

Figure 51 What stage are you at regarding the protection of the IP used on this project?

Source: *Frontier analysis of monitoring data.*

Note: *"What stage are you at regarding the protection of the IP used on this project and are you considering protecting IP with any other organisations involved in the project?" Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.*

Financial benefits

Around half of organisations have reported financial benefits

End-of-project surveys asked organisations about the annual financial impact on sales revenue, licensing revenue, cost reduction, and other financial effects. Results are shown in Figure 52. Around half of all organisations (80 CMDC1 organisations and 35 CMDC2 organisations) reported a financial benefit of some kind.

Figure 52   What do you expect the future average annual financial impact in pound sterling to be? Number of organisations reporting positive impacts

Source: Frontier analysis of end-of-project monitoring data

Note: "Thinking of the likely impact of these new products, services and processes, what do you expect the future average annual financial impact in pound sterling (whether positive or negative), to be on the following? The figures provided should refer to income or cost savings generated specifically from your participation in this project." Academic organisations (of which there are 18) are not asked financial benefit questions in CMDC1, but they are in CMDC2. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details.

Financial benefits typically came from increased sales revenue

Figure 52 also identifies that an increase in sales revenue was the most common benefit reported, followed by an increase in licensing revenue. In interviews, 1 CMDC2 organisation identified increased exposure and publicity as the driver of increased sales revenue.

Another organisation identified that CMDC2 allowed them to realise other opportunities in the business to cut costs and create efficiencies:

> *"We've been doing it this way for so long, we've never questioned it. Maybe we should have questioned it and now we are questioning it. So that's been really positive and it's kind of shown a couple of other things that we could do to make the pull better generally."*

CMDC2 successful applicant

Size of the benefits

The total median gain (aggregated across all 4 financial benefits) reported by CMDC1 organisations was £700,000, compared with £1.1 million for CMDC2 organisations. The total financial benefit reported was over £635 million for CMDC1 and around £403 million for CMDC2. Table 27 reports the median and total benefits for CMDC1 and CMDC2, split across different types of benefits. It should be noted that academic organisations in CMDC1 were not asked this question.

Table 27   What do you expect the future average annual financial impact in pound sterling to be? Total and median benefits

	CMDC1		CMDC2	
Financial benefit	**Median**	**Total**	**Median**	**Total**
Sales revenue	£0.8m	£644.77m	£0.9m	£327.72m
Licensing revenue	£0.45m	£58.71m	£1m	£70.83m
Cost reduction	£0.02m	£11.43m	£0.08m	£4.77m
Other benefits	£0.08m	£0.08m	Not Applicable	Not Applicable
All financial benefits	£0.7m	£634.99m	£1.1m	£403.31m

Source: Frontier analysis of end-of-project monitoring data.

Note: "Thinking of the likely impact of these new products, services and processes, what do you expect the future average annual financial impact in pound sterling (whether positive or negative), to be on the following? The figures provided should refer to income or cost savings generated specifically from your participation in this project." Academic organisations (of which there are 18) are not asked financial benefit questions in CMDC1, but they are in CMDC2. For CMDC1, total does not sum to the individual benefits due to 1 organisation reporting a significant negative financial benefit. Academic organisations (of which there are 18) are not asked financial benefit questions in CMDC1, but they are in CMDC2. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details.

Figure 53 reports the distribution of benefits across firms. For CMDC2 organisations who saw financial benefits, these were typically reported between £1 million and £10 million. CMDC1 organisations saw benefits that were distributed more evenly across different levels of benefits. There were no extreme outliers as defined by the criteria in Section 4.2.3, but some organisations reported particularly high financial benefits such as sales revenues above £100 million.

Figure 53   What do you expect the future average annual financial impact in pound sterling to be? Distribution across organisations

Source: Frontier analysis of end-of-project monitoring data.

Note: "Thinking of the likely impact of these new products, services and processes, what do you expect the future average annual financial impact in pound sterling (whether positive or negative), to be on the following? The figures provided should refer to income or cost savings generated specifically from your participation in this project." Academic organisations (of which there are 18) are not asked financial benefit questions in CMDC1, but they are in CMDC2. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details.

The size of these benefits should be put into the context of the stage at which these questions were asked. It is likely too early to understand the complete financial benefits of these projects. However, the fact that 50% of projects are seeing benefits by the end of their 6- to 8-month long projects is likely to be a positive outcome.

Financial benefits are concentrated in the South East and North West

Table 28 shows the total and average financial benefit reported for each region across both CMDC1 and CMDC2. It is important to note that regions refer to where the organisation seeing the financial benefit is based, which may not correspond to the region where the financial benefits are realised. This analysis shows how benefits differ across regions and is not intended to imply that funding should be concentrated in a particular region to maximise financial benefits.

The South East and North West regions combined receive over two-thirds of all financial benefits that can be allocated a specific region; this is greater than the proportion CMDC1 and CMDC2 funding that went to these regions (around half of total funding). Average impacts are highest in the North West, followed by the North East and the East Midlands. Benefits are greatest in England: Scotland and Northern Ireland saw particularly low benefits, with no organisations seeing benefits in Wales.

Table 28   What do you expect the future average annual financial impact in pound sterling to be? Totals across regions (£m)

Region	Average benefits, for benefitting organisations	Total benefits
East Midlands	1.23	7.40
East of England	1.62	21.10
London	4.20	117.71
North East	1.75	26.20
North West	30.51	274.6
Northern Ireland	0.17	1.00
Scotland	0.25	8.73
South East	3.95	280.33
South West	2.40	26.40
Wales	0	0
West Midlands	6.07	66.80
Yorkshire and The Humber	9.20	27.60
Unknown	1.23	7.40

Source: *Frontier analysis of end-of-project monitoring data.*

Note: *"Thinking of the likely impact of these new products, services and processes, what do you expect the future average annual financial impact in pound sterling (whether positive or negative), to be on the following? The figures provided should refer to income or cost savings generated specifically from your participation in this project." Not all firms can be assigned a region so totals do not align with the total financial benefit reported. No financial benefits were reported in Wales. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more detail.*

A higher proportion of small firms received financial benefits than other firm sizes

Across both CMDC1 and CMDC2, smaller firms had the highest proportion of firms with positive annual financial impacts as shown in Figure 54. The chart shows the percentage of organisations of each size who reported positive financial impacts (the remaining

organisations reported no impact).[31] Large firms were least likely to report positive financial impacts, medium firms were more likely, and micro or small firms were most likely. It is not surprising that micro or small firms see the largest benefits: they are likely to have no or very low sales revenue and are expecting to break into a new market with their technology. In contrast, large firms will already have high revenues and are likely already involved in shipping.

Figure 54   What do you expect the future average annual financial impact in pound sterling to be? Distribution of organisations reporting positive impacts by organisation size

Source: Frontier analysis of end-of-project monitoring data.

Note: "Thinking of the likely impact of these new products, services and processes, what do you expect the future average annual financial impact in pound sterling (whether positive or negative), to be on the following? The figures provided should refer to income or cost savings generated specifically from your participation in this project." Not all firms can be assigned an organisation size so are excluded from this analysis. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.

The average size of financial benefit for organisations who reported benefits is shown in Table 29. For CMDC1, large farms reported the largest size of financial impact, which may be expected given these firms have a larger starting base of revenue and larger costs against

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[31]   All remaining organisations reported no financial impact, excluding one large firm which reported a negative 'other' financial impact.

which savings can be made. However, for CMDC2, micro and small businesses report the largest benefits by a significant margin. Revenue and cost data is not available against which to assess the size of these benefits.

Table 29   What do you expect the future average annual financial impact in pound sterling to be? Size of impacts by organisation size (the number of organisations reporting benefits appear in brackets)

	CMDC1	CMDC2
Large	£12.92m (14)	£1.18m (5)
Medium	£5.88m (13)	£0.44m (3)
Micro or small	£4.15m (42)	£2.39m (25)

Source: Frontier Economics.

Note: "Thinking of the likely impact of these new products, services and processes, what do you expect the future average annual financial impact in pound sterling (whether positive or negative), to be on the following? The figures provided should refer to income or cost savings generated specifically from your participation in this project." Not all firms can be assigned an organisation size so are excluded from this analysis. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.

Opportunities and market size

Organisations typically reported improved commercial opportunities as a result of UK SHORE

Around 80% of organisations reported improved commercial opportunities (124 CMDC1 organisations and 65 CMDC2 organisations) by the end of the project in monitoring data.[32] In qualitative responses to the survey, organisations identified improved technological understanding, a greater understand of the market and more exposure to clients, customers and investors as the drivers of improved financial benefits. A number of organisations who did not identify commercial benefits reported that their role in the project was not driven by commercial opportunities, for example because they were a not-for-profit organisation.

This suggests that, while tangible benefits such as patents and financial benefits had not yet been realised, organisations overall felt their commercial prospects improved due to UK SHORE and that these benefits might be felt in the future. This aligns with the findings from interviews: many projects are at a demonstrator phase so project participants typically framed the benefits as potential future benefits, if demonstrators were successful.

The nature of the monitoring question, which directly asks for changes as a result of this project, provides early indications of organisations' views on the additionality of UK SHORE.

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[32]   "How do you think your commercial opportunity has changed as a result of this project?" CMDC1 n = 156, CMDC2 n = 86.

Some organisations have seen protection of their current market position, but many more expect it will expand their position in the future

As part of the monitoring data collected at the end of the project, organisations reported on the extent to which they expected their project to affect their market position now or in the future.[33] Some organisations reported that the project helped to protect their current market position: 25% (39) of CMDC1 organisations and 35% (31) of CMDC2 organisations. Only a small proportion (around 15%) of CMDC1 and CMDC2 organisations reported their project expanding their current market position, while a much larger proportion of organisations (close to 70% across both schemes) expect it will in the future, suggesting that any commercial benefits may tend to be realised over longer timescales.

Some organisations have reported benefits from increased exposure and connections

In applicant interviews, 1 participant, an SME, noted that CMDC funding has helped their organisation within the industry, and more widely allowed them to be on a similar level to 'big names' in the industry and 2 stated it has helped them gain recognition in the market.

"*It's been very helpful for effectively helping us establish our credentials, particularly now in the eyes of potential investors as a way of means of helping us to raise further funds to keep doing our work.*"

CMDC2 successful applicant

Two others reported similar benefits, with another stating it has improved their connections within the industry and another that UK SHORE has helped them improve their awareness about opportunities in the industry.

Longer term plans for commercialisation

Most organisations expect to take their project forward towards commercialisation within 6 months

Survey data asked organisations whether they plan to take their project further towards commercialisation at the end of the project. Most responding organisations were planning to take their project forward within the next 6 months, using either private or government funding (or a combination of the 2), shown in Figure 55. None of the projects cited a lack of resources or expertise as a reason they were not expecting to further progress the commercialisation of the project, though 2 organisations (1 from CMDC1 and 1 from CMDC2) cited a lack of funding as a reason that progress was not expected beyond the project. Five CMDC2 projects are expected to be taken forward in a time horizon of more than 6 months, which may be due to

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[33] "Thinking about market impacts, do you expect this project to result in: protect current market position, expand current market position in the UK, expand current market position outside the UK? Now, expected, never." CMDC1 n = 158, CMDC2 n = 86.

the recent finish date of CMDC2 (August 2023). One 'other' respondent noted that the answer differed over different elements of their project, while another said it depended on receiving further DfT funding.

Figure 55   At this stage, do you expect to take your technology further towards commercialisation at the end of the project?
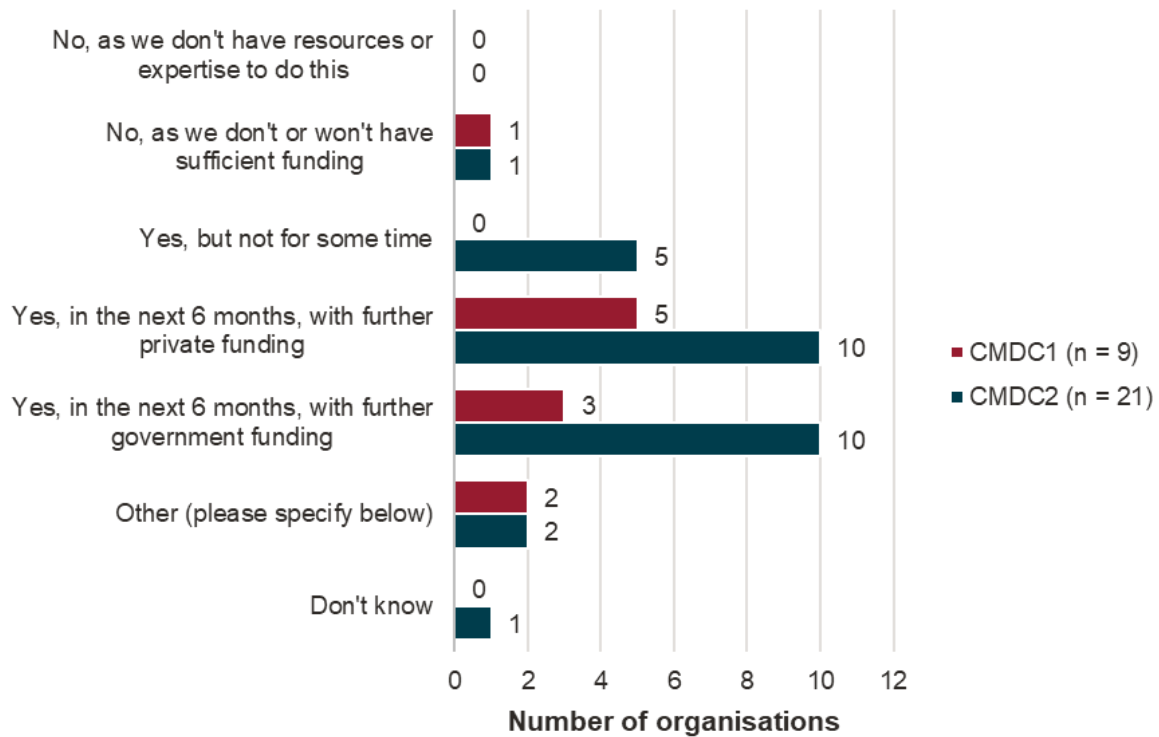
Source: Frontier analysis of survey data.

Organisations reported a range of plans to exploit their CMDC project outcomes

Organisations were asked in project monitoring how they planned to exploit their CMDC project outcomes. Figure 56 shows organisation responses to this question, with organisations able to choose multiple responses. The most common responses were 'provide services to customers' (64 CMDC1 organisations and 35 CMDC2 organisations), 'provide services to other businesses' (70 CMDC1 organisations and 48 CMDC2 organisations) and 'process innovating to improve their business offering' (52 CMDC1 organisations and 39 CMDC2 organisations). Many organisations also planned to produce the product or service using their own or contracted manufacturers. However, it was not possible from the monitoring data to understand the timeframe or scale of these expected ultimate outcomes.

Figure 56   How does your organisation plan to ultimately exploit the product, service or process being developed?

Source: Frontier analysis of end-of-project monitoring data.

Note: Academic organisations (of which there are 18) are not asked financial benefit questions in CMDC1, but they are in CMDC2. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to one for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.

6.4   Spillover benefits

EQ 4 asks: To what extent is there evidence that UK SHORE has generated positive spillover benefits?

While there is not enough evidence to include this EQ in detail at this stage of the evaluation, some early evidence has been recorded. Monitoring data records the scope of environmental benefit, as discussed in Section 6.2. At the end of the projects, 17 CMDC1 and 10 CMDC2 projects identified their project would have 'whole energy system' environmental benefits, suggesting that they expect their project to have impacts beyond the maritime sector. In addition, applicant interviews identified 1 organisation (a manufacturer of a specific component) who had not previously and did not usually work in the maritime sector, but were pleased to see their technology applied successful there.

In the next interim evaluation, it is expected that more extensive qualitative engagement, alongside the longer time frame for benefits to materialise, may allow for a more detailed (albeit early) assessment of this question.

6.5 Wider social objectives

This Section presents initial findings on EQ 5: To what extent has UK SHORE achieved wider social objectives? The relevant data and data sources for each sub-question under EQ 5 are reported in Table 30.

Table 30 EQ 5 data sources

Sub-question	Data	Data source
To what extent has UK SHORE contributed to sustaining or creating jobs in the UK in the clean maritime or related sectors?	Number of jobs created and retained by CMDC1 and CMDC2 projects	Monitoring data; stakeholder interviews
	Expectations of jobs created and retained	UK SHORE business case
	Green and highly skilled jobs	Monitoring data
	Impact on jobs in the broader sector	Survey data; stakeholder interviews
To what extent has UK SHORE contributed towards levelling up of coastal areas?	Number of projects in coastal areas	Survey data
	Regional split of UK SHORE funding	Monitoring data; survey data
Not Applicable	Other social benefits	Stakeholder interviews

Source: Frontier Economics.

6.5.1 Evaluation findings

Job creation and retention

The following findings based on monitoring data must be caveated because CMDC1 monitoring data did not ask job creation and retention questions to academic organisations, while CMDC2 monitoring data did not make this distinction. Only a small proportion (18 of 178) organisations in the CMDC1 data are classed as academic, so it is not expected this will make a significant difference to the findings. The ability of academic organisations to generate jobs

is constrained by many external factors (eg higher education funding policy and student intake) and non-academic organisations would be expected to be the material drivers of job creation.

Few organisations created or retained jobs during the delivery phase, but organisations expect job creation and retention to increase in the future

As part of end-of-project monitoring data, organisations were asked the number of full-time equivalent (FTE) jobs that were retained and created in their organisation as a result of the project, both during the project and expected within the next 2 to 10 years.

Figure 57 shows the number of organisations grouped by the number of jobs they reported retaining or creating as a result of their CMDC1 or CMDC2 project, over the course of the project. A large proportion of organisations (around 60%) did not create any jobs, and those that did typically created between 1 and 4 jobs. Organisations were more likely to retain, rather than create, jobs during the project delivery phase (30% and 23% report not retaining jobs, for CMDC1 and CMDC2 respectively), although job retention figures were still fairly low.

Figure 57 How many FTE jobs were retained or created in your organisation as a result of participation in this project?
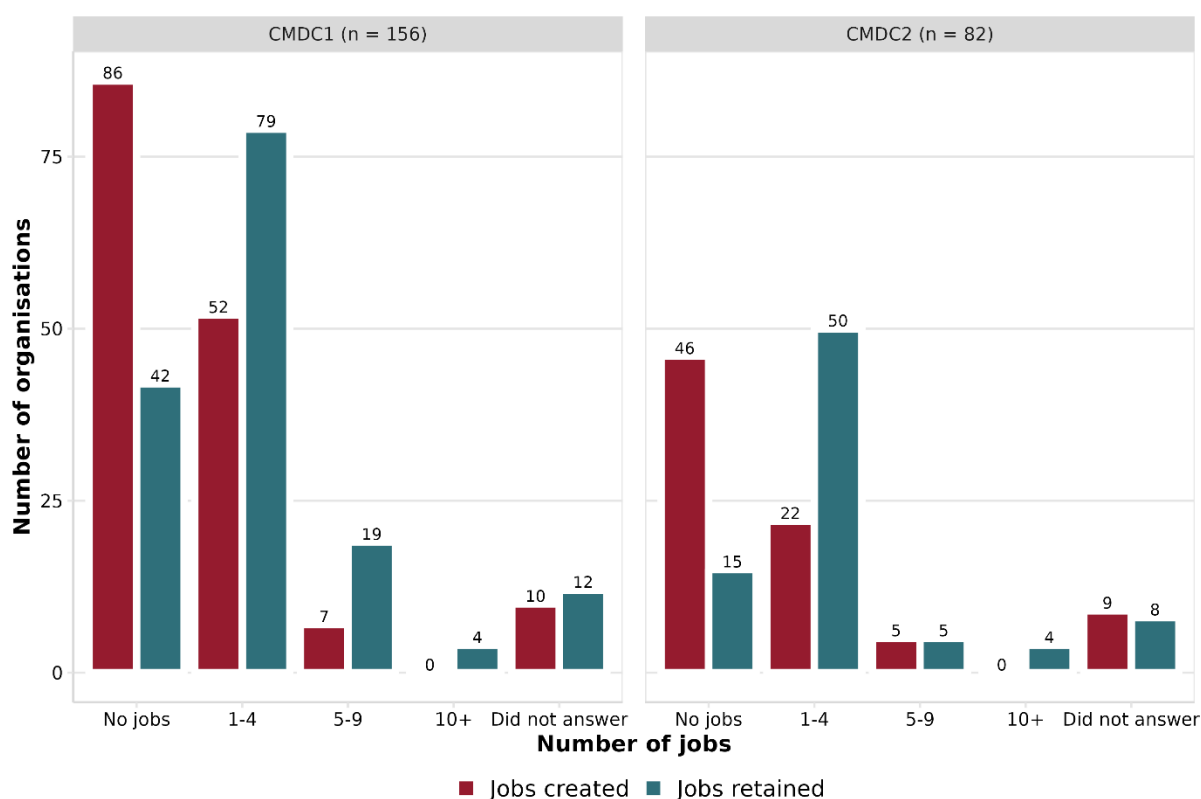
Source: *Frontier analysis of end-of-project monitoring data.*

Note: *"Please state how many FTE jobs were retained in your organisation as a result of participation in this project? Please repot jobs on a cumulative basis. Retained during the project. Expected retained in 2 years. Expected retained in 5 years. CMDC2 only: Expected retained in 10 years". Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.*

Figure 58 shows organisations' expectations for job creation and retention in the next 2, 5 and 10 years compared to their actual job creation and retention figures within the project, removing 1 very large outlier from CMDC2 organisations as set out in the process for data cleaning in Section 4.2.3.[34] For both CMDC1 and CMDC2, the total number of jobs created and retained is expected to increase over time. Job creation is expected to grow at a particularly high rate and exceed retention by 2 years after the project end. Even after accounting for the fact that there are fewer CMDC2 than CMDC1 projects, expected job creation in 2 and 5 years is much higher for CMDC1 than CMDC2. This may be driven in part by particularly high rates of forward-looking job creation and retention reported by 1 CMDC1 organisation (not large enough to be removed from the cleaning process).

Business case expectations are not available to benchmark CMDC1 job creation and retention. For CMDC2, business case expectations are based on levels of creation and retention for CMDC1. Therefore, similar levels of job creation and retention during the delivery phase of CMDC1 and CMDC2 (adjusted for the number of projects) put CMDC2 in line with expectations. However, longer-term forecasts of jobs (beyond 5 years) for CMDC2 are reasonably lower than CMDC1 and are, therefore, not in line with expectations. In this case, business case expectations do not necessarily present a suitable benchmark as they are based on self-reported data, and forecasting job expectations is difficult, particularly for these low- to mid-TRL projects where the extent to which the technology will scale up is unknown. A full discussion of business case expectations is outside the scope of this evaluation.

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[34] This organisation reported retaining and creating over 40,000 jobs at each timescale.

Figure 58   How many FTE jobs were retained or created in your organisation as a result of participation in this project? Totals
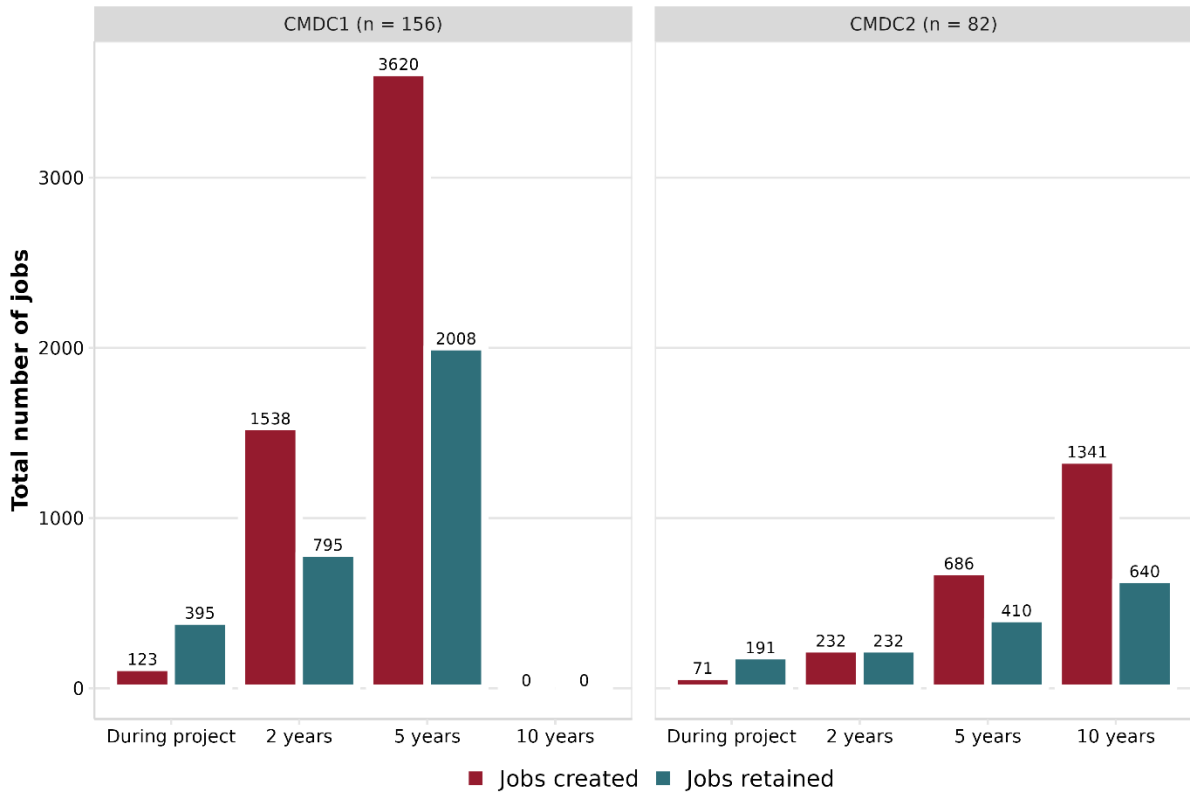
Source: Frontier analysis of end-of-project monitoring data.

Note: "Please state how many FTE jobs were retained in your organisation as a result of participation in this project? Please report jobs on a cumulative basis. Retained during the project. Expected retained in 2 years. Expected retained in 5 years. CMDC2 only: Expected retained in 10 years". One larger outlier from CMDC2 was removed. CMDC1 organisations were not asking about 10-year timescales. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Rounded numbers are reported.

Applicant interviews also identified that job creation was likely to scale up overtime:

> *"We're now gearing up for taking this to market and commercialising it. We're working on the next phases of it … We're recruiting and building a team around here."*

CMDC successful applicant

A high proportion of CMDC2 jobs created and retained are green jobs and highly skilled jobs

As part of the end-of-project monitoring data, CMDC2 organisations were asked how many of the jobs retained and created as a result of CMDC2 participation are 'highly skilled' or 'green' jobs.[35]

Comparing these results to the total number of jobs created and retained shows that a high proportion of jobs created and retained are likely to be both 'green' and 'highly skilled'. For example, 93% of jobs created and retained during the project delivery phases are 'green', and 97% are 'highly skilled'.

The future impact on employment in the wider maritime sector is unclear, but early indications suggest it will be positive

Considering employment in the sector as a whole (beyond the organisations directly involved in CMDC projects), survey respondents were asked whether the project has resulted, or will result, in increases in employment in the industry as a whole. Figure 59 shows the responses to this survey question.

CMDC2 survey respondents tended to find this question difficult to answer, with only 13 out of 21 organisations able to answer 'yes' or 'no' (instead of 'not sure' or 'too soon to say'). CMDC1 respondents were more likely to answer the question, and 5 out of 9 organisations expected recruitment to increase in the next 2 years. This may partially reflect timing issues, as CMDC1 projects concluded earlier than CMDC2 (CMDC1 projects ended in March 2022 compared to CMDC2 in August 2023).

The positive impact on employment identified by CMDC1 respondents is supported by interview findings. Three participants noted that CMDC has supported employment in the sector, with one highlighting opportunities in academia.

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[35] 'Highly skilled jobs' are jobs categorised within the Standard Occupation Classification (SOC 2020) codes 1-3. SOC 1-3 includes managers, directors, and senior officials, as well as professional occupations and associate professional occupations. 'Green jobs' are any role that includes duties and responsibilities, including the design, development, market commercialisation, or operation of any clean maritime technologies.

Figure 59 Other than anyone hired to deliver the project, do you expect any recruitment to the industry in the area in which the project is being delivered in the next 2 years?

Source: Frontier analysis of survey data.

However, it is difficult to put any magnitude on the size of recruitment in the industry. Survey respondents who reported that there will be additional industry employment were asked about the expected total number of jobs. The median number of jobs reported was 3 and the maximum figure reported was 10. This suggests that those that did answer may have answered at an organisation level, rather than the industry as a whole.

Coastal communities and levelling up effects

Section 3.2 sets out the funding allocation of UK SHORE schemes, across regions and types of locations (such as coastal, rural and inner city) as part of a general portfolio summary. The funding allocation is assessed in more detail below.

Forty-five percent of CMDC1 and CMDC2 funding was allocated to the Greater South East

Baseline monitoring data collects information about each organisation, their primary work region and the total grant funding allocated to that organisation (the split of total grant

funding for a given project between organisations).[36] Table 31 presents the distribution of this funding across the UK for CMDC1 and CMDC2.

Table 31   Regional split of CMDC1 and CMDC2 funding (£m)

Region	CMDC1	CMDC2
East Midlands	0.12	0.41
East of England	1.02	0.75
London	1.59	1.66
North East	2.9	1.01
North West	1.06	0.09
Northern Ireland	0.58	3.2
Scotland	2.49	1.73
South East	8.15	4.32
South West	1.82	0.7
Wales	0.05	0.27
West Midlands	0.59	0.66
Yorkshire and The Humber	0.35	0
Unknown	2.47	0.03

Source: Frontier analysis of monitoring data.

Note: Based on 'Primary work region' as reported in the monitoring data, which may not be a perfect representation of where work takes place. Some organisations responded multiple times to the survey so responses were weighted so that weights summed to 1 for each unique organisation and projection combination. See Section 4.2.3 for more details. Figures may not sum to the values reported elsewhere, as not all organisations reported their region.

The South East received the highest amount of funding in both schemes (£12.4 million in total), followed by Scotland for CMDC1 (£2.5 million) and Northern Ireland for CMDC2 (£3.2 million). This broadly aligns with the findings for other UK SHORE schemes.

Table 32 presents a possible benchmark for UK SHORE funding: public-funded spending on research and development by region in the financial year 2021, as reported by the ONS. Shading on the graph suggests funding for CMDC1 and CMDC2 is roughly in line with current government R&D spending. A key goal for the government is to move R&D investment beyond

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[36]   Survey respondents were also asked: "In which geographical region(s) is your project being delivered? Where are the activities of your project taking place? Select all that apply." Response rates are too low to draw meaningful conclusions from this data, given the number of possible regions, but the picture is broadly similar to monitoring data with the largest tranche of projects operating in the South East.

the Greater South East.[37] CMDC1 and CMDC2 funding in the Greater South East is 45% of the total funding in those schemes, and the total government R&D in the region is 52% of what it was in 2021.[38]

However, broad government targets are a blunt means of assessing UK SHORE, which is a targeted scheme where certain areas of the UK have regional competitive advantages and so should be expected to receive a large proportion of funding. Table 33 shows the regions expected to benefit from UK SHORE as set out in the business case; these areas are disproportionately in the North of England and Scotland. This suggests that more CMDC1 and CMDC2 funding has gone to the Greater South East than expected.

Table 32   Regional split of government R&D spending (2021)

Region	Government R&D funding (£m)
East Midlands	651
East of England	1277
London	2737
North East	408
North West	1120
Northern Ireland	218
Scotland	1283
South East	2690
South West	1168
Wales	361
West Midlands	747
Yorkshire and The Humber	788

Source: ONS.

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[37] The 2019 to 22 Johnson Conservative Government's Levelling Up White Paper's technical annex: missions and metrics (2022), included an objective to increase domestic public R&D investment outside of London, the South East and East of England by 40% by 2030, with UK SHORE funding counting as public R&D. Specific objectives for regional growth are not set out for the new government (2024) at this stage.

[38] House of Commons (2023) Research and development funding.

Table 33   Business case expected areas of development

Technologies	Areas for deployment (based on regional competitive advantage)
Shore side power	Aberdeen and London, followed by Grimsby & Immingham, Holyhead, Lerwick, Liverpool, Orkney, Tees & Hartlepool, Clyde and Peterhead.
Ammonia	Teesside, Merseyside and Humberside, followed by Scotland and South Wales.
Hydrogen	North West and Orkney, followed by Clyde, Aberdeen, Forth, Holyhead, Lerwick and London.

Source: E4Tech and UMAS (2021) Clean Maritime Clusters Research Study.

Projects are often located in coastal areas

To understand the location types of UK SHORE project deliveries, survey respondents were asked about the type of area where their projects were mostly delivered. Figure 60 presents the number of responses per location type for each scheme (this is a subset of the information presented in Figure 12). Coastal locations are the most common location type reported, followed by city areas for CMDC2 (there are likely urban sites for basic research and feasibility studies) and rural areas for CMDC1.

The UK SHORE business case did not include specific targets for activity in coastal communities.

Figure 60   Which of the following best classifies the nature of the area in which most of the project is being delivered?
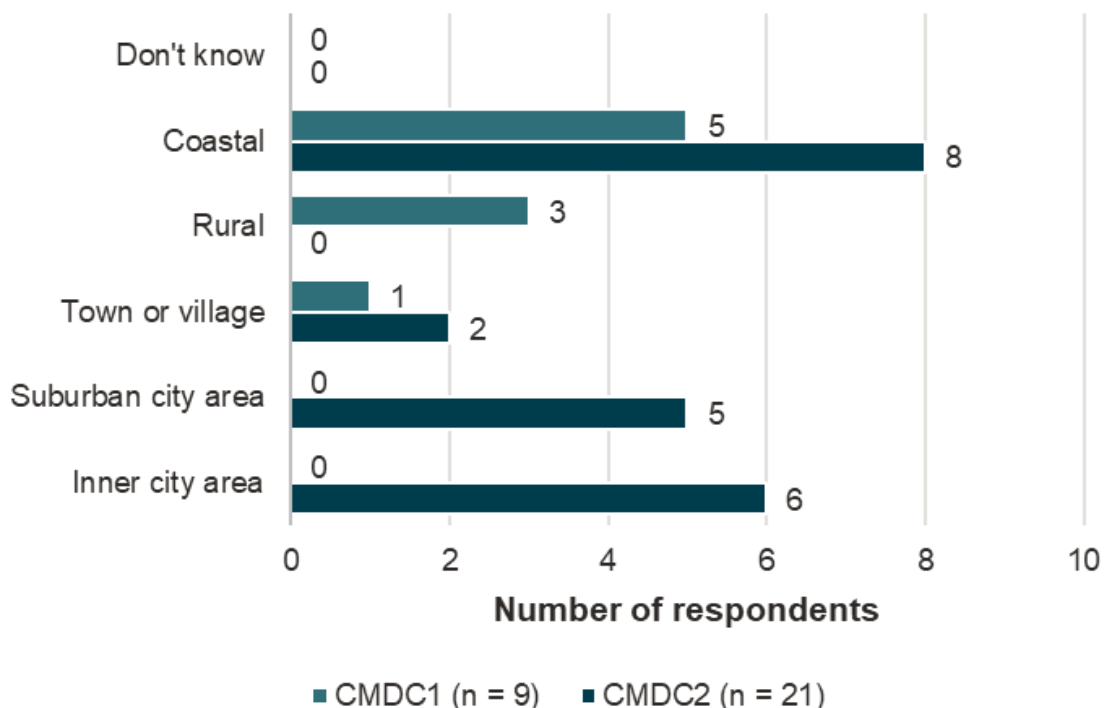
Source: Frontier analysis of survey data.

Wider social benefits

Applicant interviews also noted other social benefits. One noted that the project resulted in a positive working environment by reducing the burden on employees. The same participant noted improvements in safety in the sector as a result of their work:

> *"There's a lot of problems in the marine sector with mental health and with the treatment of the staff on there and we believe that by having these vessels that are nicer places to work on and require more expertise … but certainly in terms of the well-being, there is the obvious stability of the vessel and also the reduction in the pollution on the vessel. This technology has been developed by this UK company and it's supported by UK government. Isn't this brilliant?"*

CMDC2 successful applicant

6.6   Overall findings and recommendations

Development of clean maritime technologies

Most CMDC1 and CMDC2 projects submitted end-of-project reports. Over three-quarters reported successful achievement of intended project outcomes in the end-of-project

monitoring data. While most respondents judged their projects successful, other project outcomes (eg TRL progression) did not always align with expectations set out in the UK SHORE business case. This indicates a difference between subjective and more objective measures of project outcomes.

Comparing baseline and end-of-project monitoring data, fewer than half of the projects in CMDC1 and CMDC2 reported TRL improvement between the start and the end of the project. A small number of projects reported a decrease in TRL during their project. Existing data provides insufficient evidence to determine why reported TRLs declined: they may be genuine, for example, if project testing and validation highlights problems which require returning to an earlier design phase, or due to be due to misinterpretation of TRL typology at the start or the end of the project. It would be useful to collect information about reasons for TRL regression in future evaluation phases. **It would be useful to review how TRL and project technology outcomes are monitored so that the results can be more clearly interpreted. Evaluation survey questionnaires will be designed in the future in view of this aim.** There are some variations in TRL progression across technology type, but these findings are caveated by these limitations with TRL data.

In the monitoring data, most CMDC1 and CMDC2 organisations reported positive experiences with their consortia and intentions to continue working with collaborators. In both the monitoring data and survey data, most respondents also reported gaining long-term benefits associated with collaboration, such as developing collaborative skills and building new partnerships.

The most common barriers for continued project development reported in the monitoring data by CMDC1 and CMDC2 participants were further technical or scientific challenges, availability of finance, regulations and lack of industry standards. **A next step would be to review the resources that UK SHORE offers to projects to support them in navigating regulations and standards.**

The majority of projects (63% of CMDC1 and 78% of CMDC2 projects) reported in monitoring data that they would not have gone ahead without UK SHORE funding, with a significant minority reporting that they would have proceeded but at a slower pace (29% and 16%) or smaller scale or scope (21% and 14%). Interviewees from CMDC1 and CMDC2 expressed that UK SHORE removed barriers to entry for otherwise commercially unviable projects and increased industry recognition and competitiveness of small startups.

The collection process for monitoring data should be reviewed to ensure that there are not duplicate responses per organisation for a given project, and so that multiple projects do not self-identify as the lead organisation for a given project.

Environmental benefits

CMDC1 and CMDC2 projects aimed to have large environmental impacts in the future, including whole energy system effects, sector-wide effects and self-reported 'paradigm-

shifting' effects. It is too early to determine the extent to which the project technologies will ultimately achieve their environmental objectives, as many projects were feasibility studies, and developed technologies that are not yet near commercialisation. **A majority of survey respondents reported that they had not yet realised carbon savings.**

It would be useful for UK SHORE to review reporting standards for future monitoring and evaluation activities. CMDC1 and CMDC2 projects reported emissions estimates with a variety of different units and assumptions, which prevented comparison and aggregation of the estimates.

Commercial opportunities

UK SHORE generated £103 million of match funding. Beyond this funding, survey respondents typically reported having secured, or expecting to secure, follow-on funding to support the further development of their projects. Data has not allowed us to distinguish between private and public funding at this stage and it is difficult to comment on the scale of investment due to a lack of targets or clear benchmarks.

Monitoring data shows that most projects achieved CRL development, although achievement was slightly below expectation as reported at the start of the project. Like TRL, a small number of projects reported a decrease in CRL during their project (albeit fewer than those reporting a fall in TRL). **It would be useful to review how CRL is monitored, to ensure that results are accurate and interpretable.**

Most organisations reported seeing improvements in commercial opportunities and have plans to further develop their projects, a finding from both the monitoring and survey data. Increased exposure was a key driver benefit identified from applicant interviews.

Limited immediate, tangible commercial benefits have been identified in the monitoring data: only about half of organisations reported financial benefits, and only a minority of organisations had been granted or applied for intellectual property rights.

Wider social objectives

Monitoring data suggested that few organisations created jobs during the delivery phase of CMDC1 and CMDC2 projects, but organisations expected job creation and retention to increase in the future. The large majority of jobs created and retained are high-skill and green jobs. These initial findings only relate to employment directly within organisations associated with CMDC1 and CMDC2; at this point in time, evidence is not available to assess the impact on the sector more broadly.

Job creation and retention during the delivery phase of CMDC2 broadly met business case expectations, according to monitoring data. However, the business case appears to have over-stated future job creation.

Survey data suggest projects are typically located in coastal areas, aligning with UK SHORE objectives to support coastal communities. **It would be useful to have consistent quantitative benchmarks for supporting coastal areas and areas outside the South East, which ideally could be used beyond UK SHORE to compare DfT initiatives' contributions to regional development.** Regional distribution of funding from monitoring is comparable to broader public R&D spending, for example, 45% CMDC1 and CMDC2 funding went to the Greater South East compared to 52% of total R&D spending.[39] However, it does not appear to be targeted at locations identified as having a comparative advantage in the business case.

Interviewed stakeholders also identified improved safety and a more positive working environment as wider social benefits.

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[39]   House of Commons (2023) Research and development funding.

7 Interim impact evaluation findings – TRIG

7.1 Development of clean maritime technologies

This Section presents initial findings for the TRIG programme on EQ 1: To what extent, and through what mechanisms, did UK SHORE help to accelerate and support the development of clean maritime technologies relative to what would have happened in the absence of UK SHORE? The relevant data and data sources for each sub-question under EQ 1 are reported in Table 34.

Table 34   EQ 1 data sources

Sub-question	Data	Data source
To what extent did the projects funded through UK SHORE schemes deliver the outputs as anticipated in the business cases (eg feasibility studies, pre-deployment trials, demonstrations, deployment trials in operational settings and market-readiness plans)?	Number of projects and outputs delivered for TRIG21 and TRIG22	End-of-project reports
	Number of projects reporting success and assistance from programme for TRIG21 and TRIG22	Monitoring data
	Expectations for TRIG project success	Business Case
	Project views on measures of success and project achievements for TRIG21 and TRIG22	Monitoring data
	Project views on years away from demonstration	Monitoring data
To what extent did the overall portfolio support technologies through the TRL scale?	Reported TRL progress for TRIG21 and TRIG22	Monitoring data
	Reported TRL start and end levels for TRIG21 and TRIG22	Monitoring data
What role did UK SHORE play in facilitating parties to	Number and type of collaborators per project	Monitoring data

Sub-question	Data	Data source
come together to advance the development of clean maritime technologies?	Project views on the benefits of collaboration	Monitoring data and End-of-project reports
What factors or investments played a role in enhancing the influence of UK SHORE in meeting its aims for accelerating UK clean maritime?	Project and unsuccessful applicant views on assistance and additionality of TRIG21 and TRIG22 programmes	End-of-project reports, Monitoring data and Qualitative interviews
	Reported TRL levels and progress for TRIG21 and TRIG22	Monitoring data

Source: Frontier Economics.

7.1.1   Evaluation evidence

Projects and outputs delivered

All TRIG21 and TRIG22 participants submitted end-of-project reports, a requirement for the programme.[40]

Most projects reported the TRIG programme helped them to successfully prove their initial concept

Figure 61 displays the distribution of participants' assessment of whether they had successfully proved the concept they set out to at the start of the project.

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[40]   As mentioned in Section 4.2.3, the sample size of the monitoring data is as follows: TRIG21 baseline (7) and end of project (13) and TRIG22 baseline (12) and end of project (11).

Figure 61   What was the TRIG project outcome (in terms of proving your concept)?
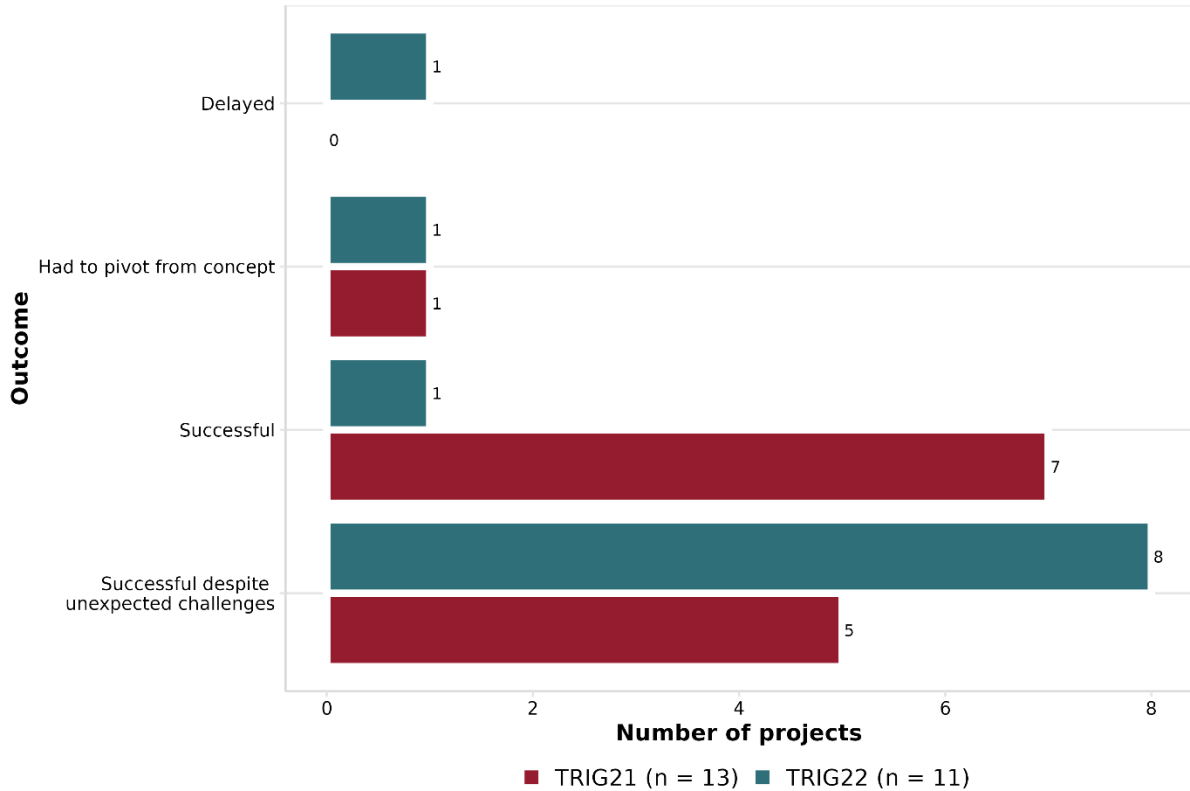
The majority of respondents from TRIG21 (12 of 13) and TRIG22 (9 of 11) had successfully proven their intended concept, either with or without unexpected challenges. Compared to TRIG21, more TRIG22 successful respondents had experienced unexpected challenges. End-of-project reports suggested that challenges encountered by projects included time and budget constraints as well as external factors, such as supply or supplier issues, data availability, in-field testing factors, and weather conditions.

One TRIG22 project was delayed by unexpected events (including a non-work-related injury), although their response caveats that they had "achieved functionality of main elements and aim to prove the concept soon." One respondent from both TRIG21 and TRIG22 had to pivot from their original concept during the project. Both organisations note key supply issues causing project setbacks or delays in their end-of-project reports.

Overall, these results broadly align with business case expectations that all projects should be delivered successfully by the end of the programme.

The TRIG programme demonstrates at least some degree of additionality

All respondents felt that the TRIG21 or TRIG22 programme helped their project progress (either fully or partially) towards proof of concept or feasibility.[41] When asked to comment on this, a common theme of TRIG21 respondents was the importance of the TRIG funding, for example, to cover developing, testing, staffing, sub-contracting, or materials costs and to encourage the organisation to partly self-fund the project:[42]

> *"The TRIG 2021 Programme was extremely successful and invaluable in helping the project to move forwards to the next stage."*

$\underline{\text{TRIG21 end-of-project report}}$

However, this does not indicate the exact degree of additionality. Hypothetically, it may be the case that some of these projects would have still been able to make at least some of this progress without the TRIG programme, even if this was at a slower rate, for example.

At the end of the programme TRIG21 participants were asked if they would have completed any of their activities without the TRIG programme.[43] The majority of responses noted at least something they would not have done without TRIG support or funding, such as a specific piece of analysis, experiments, or attending Maritime Innovation Week. A few organisations suggested the programme was needed for them to undergo the project in general, with 1 even noting "The entire project would not be possible without TRIG support." However, 2 respondents did indicate a lack of TRIG impact on technical aspects, although 1 of these did note a positive marketing and networking impact.

Additionally, an unsuccessful TRIG applicant expressed in an interview that they were able to conduct their project without TRIG funding, but were not able to validate their concept:

> *"It [TRIG funding] would have enabled us to get a more thorough data set. Because we could have afforded the equipment and the instrumentation to really validate the claims … The actual achieving of the initial aim is not hard, validating it is the hard bit, and that's really what our grant was about, trying to give ourselves data sets [to have evidence]."*

$\underline{\text{Unsuccessful TRIG applicant}}$

Overall, the evidence does suggest at least some degree of additionality of the TRIG programme. Having said this, it is important to caveat that this is based on self-reported

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[41] Question: "Please indicate your level of agreement with the following statement: The TRIG 2021 programme has helped your project progress towards or make it to proof of concept/feasibility" (TRIG21). "Please indicate your level of agreement with the following statement: The TRIG 2022 programme has helped your project progress towards or make it to proof of concept/feasibility" (TRIG22). Responses ranged from 'Agree' (5 of 13 TRIG21 and 3 of 11 TRIG22) to 'Strongly agree' (8 of 13 TRIG21 and 8 of 11 TRIG22).

[42] Question: "Please also provide any relevant comments about your view on this."

[43] Question: "Are there any valuable activities undertaken during the programme that you wouldn't have done without this support (testbed, trials, etc)? Please specify." All 13 project leads responded, although 1 reported "N/A". Equivalent data for TRIG22 is not available.

estimations of what would have occurred in a hypothetical scenario (if TRIG funding and support had or had not been achieved).

TRL progress was the most commonly identified measure of success, and all respondents reported achieving this

Participants were asked at the beginning of their project which type of activities would signal a successful project. This was one of the questions mentioned in Section 4.2.3 where responses were open-ended for TRIG21 (discussed below), and closed for TRIG22 (presented in Figure 62).

Figure 62   Which activities will signal to you that your project has been successful? (TRIG22)
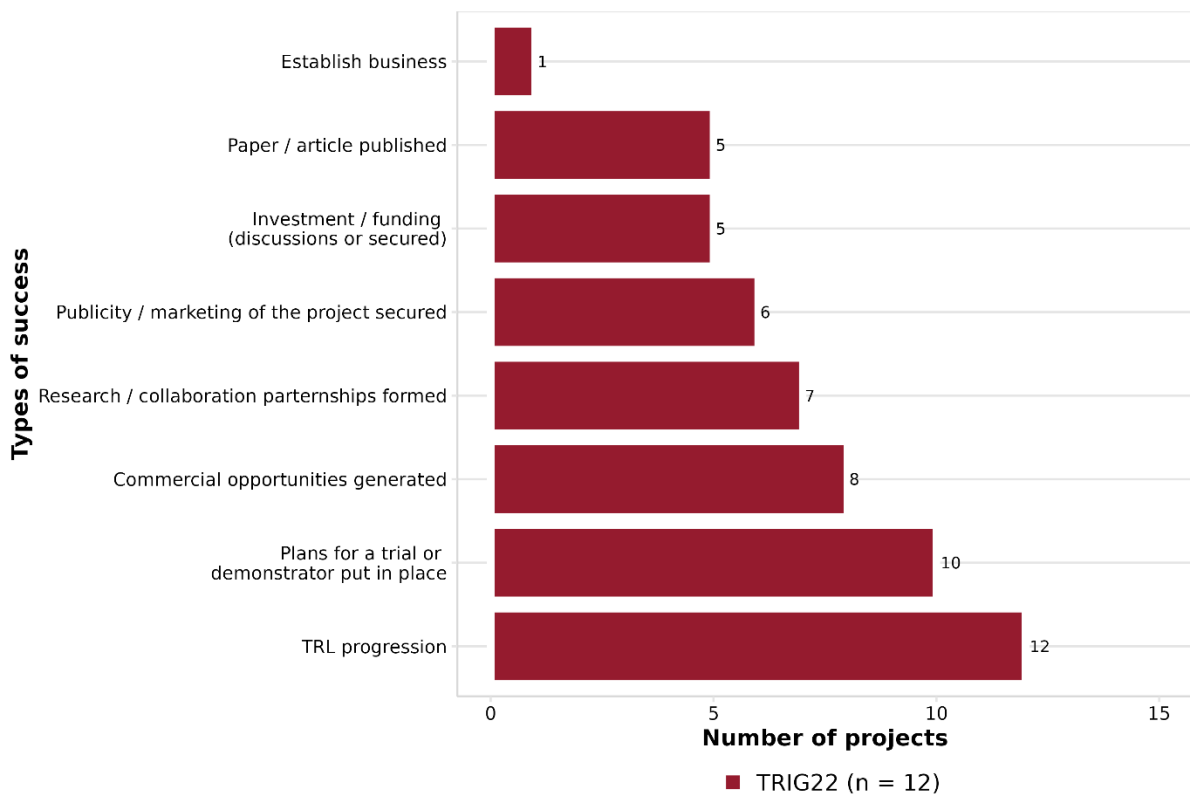
Source: Frontier analysis of baseline project monitoring data.

Note: "Thinking where your project will be at the end of the TRIG 2022 programme again, which of the following activities will signal to you that your project has been successful? Please tick all that apply." Responses from TRIG21 projects for the equivalent question ("How will you know if your project has been successful in addressing at least 1 of the programme's priority areas?") were open-ended, so they cannot be included in the chart and are instead discussed below.

The most common proposed measure of success was TRL progress (selected by all 12 TRIG22 respondents). This was followed by putting in place plans for a trial or demonstrator (10) and generating commercial opportunities (8).

TRIG21 respondents also identified several potential measures, with TRLs and progress the most commonly discussed (by 4 of the 7 respondents). Other themes included achieving specific results or project specific-aims and assessment of deliverables and outputs. Measures highlighted by a single (different) respondent included: introduction to potential collaborators, targeted publicity or marketing of the project, and understanding specific data requirements.

At the end of the project, TRIG22 participants were then asked to select which activities had been successfully achieved (Figure 63) whileTRIG21 participants were asked what else they had gained from the programme.

Figure 63   Do you think that your project has been successful in any of the following ways? (TRIG22)
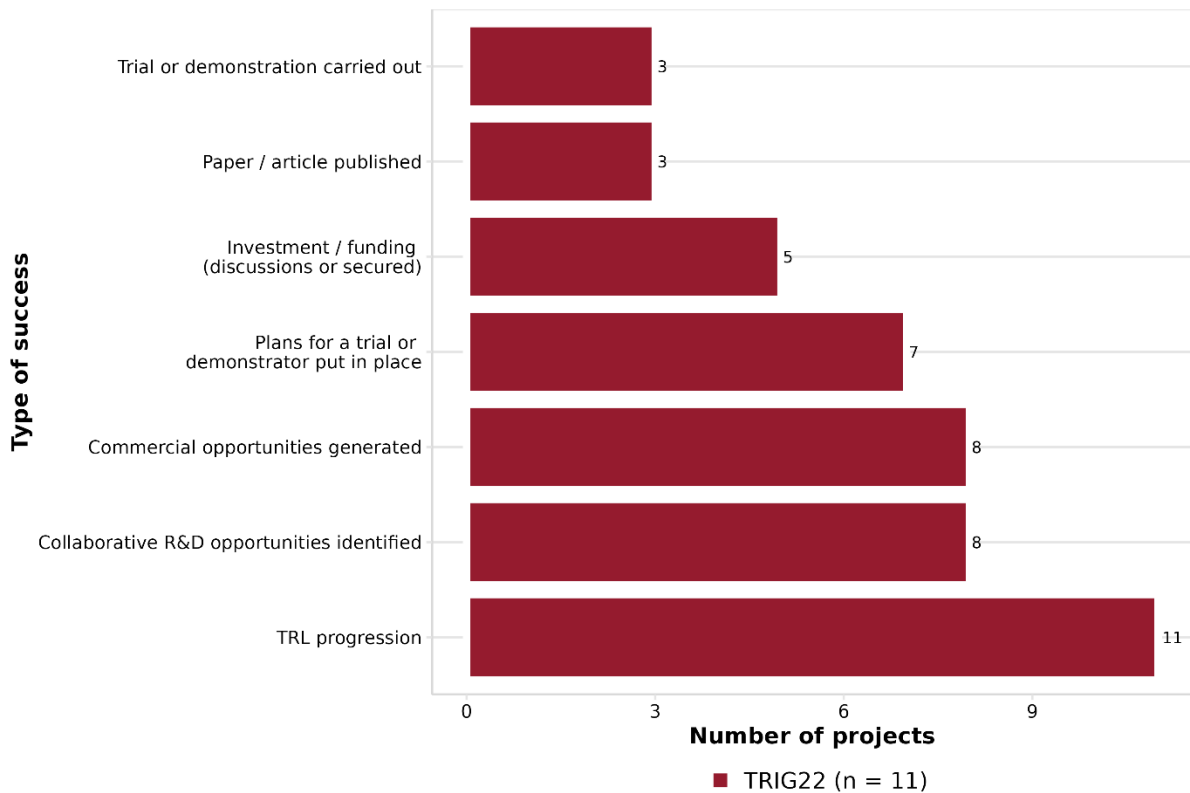
Source: Frontier analysis of end-of-project monitoring data.

Note: "Do you think that your project has been successful in any of the following ways? Please tick all that apply."
Responses from TRIG21 projects for the equivalent question ("What have you gained from of the programme more widely?")
were open-ended, so they cannot be included in the chart and instead are discussed below.

TRL progress was the most common reported option for TRIG22 (selected by all 11 respondents). All respondents selected TRL progress as a proposed measure of success, and all reported achieving it, although direct comparison between Figure 62 and Figure 63 should

be interpreted slightly cautiously.[44] Notably, no respondents reported feeling that their project had not been successful.

Turning to TRIG21, at the end of their project all 13 participants reported achieving TRL progress (Figure 64). Regarding what they had gained from the TRIG21 programme, common themes noted across responses included collaboration and building relationships with stakeholders and potential collaborators, as well as increasing market-specific and technical knowledge and understanding.

Technology readiness level (TRL)

All projects reported TRL progress

Figure 64 presents the levels of TRL progress reported by participants at the end of the programme. All respondents reported some level of TRL progress, in line with 1 of the programmes' metrics for success. In fact, this may exceed expectations for the programme given the expectation within the business case that: "projects at this level [of the TRIG project applicants, TRL 2 to 5] often simply move up within their TRL level rather than move a level." This being said, the low starting point for TRIG projects means that it is relatively easier to progress TRL compared to higher TRL schemes, as things can be done on a smaller scale.

The majority of TRIG22 respondents reported progressing 1 level (7 of 11). This was also the most common outcome for TRIG21 respondents (6 of 13).

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[44] For example, there is a slightly different sample size (12 v 11) and are only 10 common respondents across groups. Also, while the majority of the success measure and achievement activities overlap, there are a few differences in the list of responses presented for the 2 questions. For example, the option 'trial or demonstration carried out' in Figure 63 was not an option to select in Figure 62, and both questions included an open textbox for 'other' activities. This lead to the inclusion of the 'collaborative R&D opportunities identified' in Figure 63 (which notably seems to have been in place of the 'Research and collaboration partnerships formed' option, although this was still included as a response option).

Figure 64   How many levels has your technology progressed, if at all?
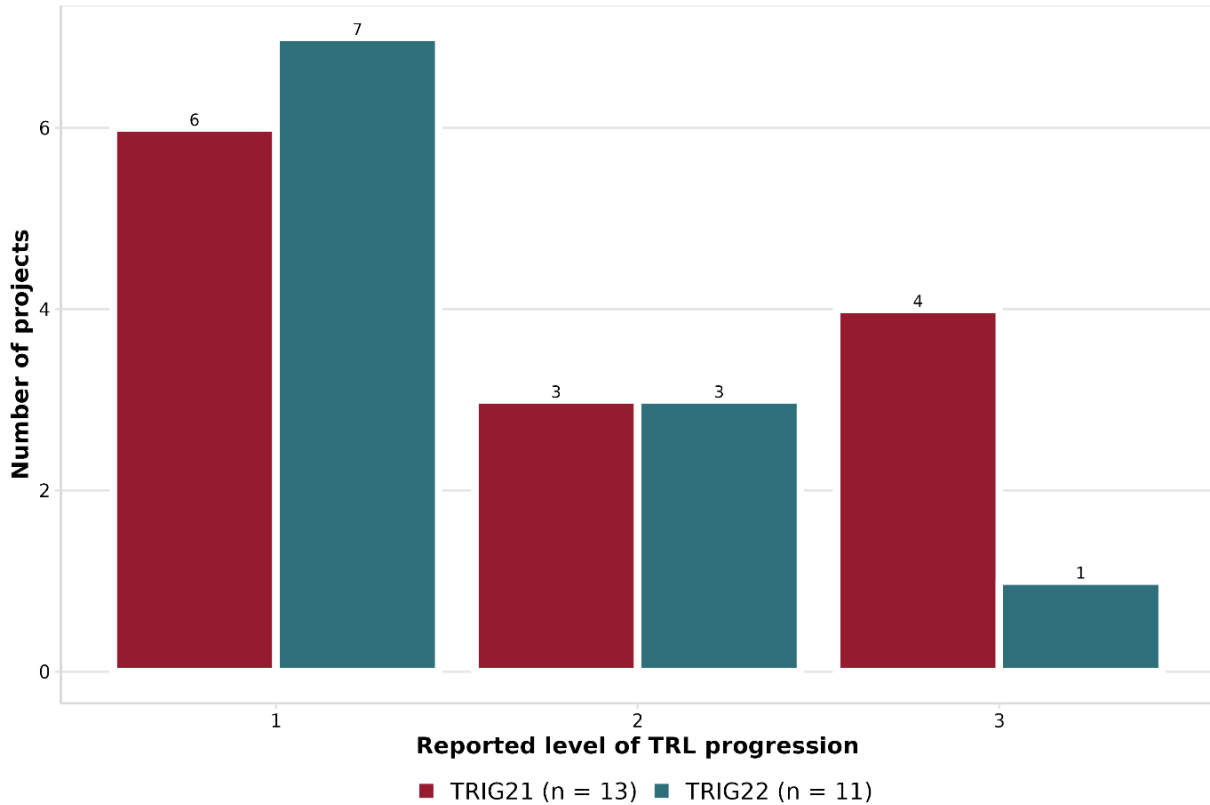
The most common TRL journey for TRIG21 and TRIG22 respondents is from TRL 2 to TRL 3, although some results are inconsistent with reported TRL progress

Figure 65 presents the TRL levels reported at the start of the programme compared to the end of the programme for TRIG21 and TRIG22 respondents where this comparison was possible. The most common responses (5) indicate 1 level of progression, from TRL 2 to TRL 3. Another 8 respondents showed some form of TRL progression. However, 1 respondent reported no TRL change (remaining at TRL 3) and 3 respondents reported a lower TRL level at the end of the programme compared to the start (from TRL 2 to TRL 1, TRL5 to TRL 4 and TRL 7 to TRL 4). Notably, this is inconsistent with the reported TRL progression in Figure 64, where all responses indicate TRL progress. This potentially suggests data unreliability, likely stemming from its self-reported nature.[45]

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[45]   For both TRIG21 and TRIG22, the question asked on TRL progression reported in Figure 64 did not give an option to report a negative TRL movement. However, it was possible to report no movement (0 change) or answer 'Don't know or N/A', but no projects did so.

Figure 65 How many levels has your technology progressed, if at all?

Start TRL \ End TRL	1	2	3	4	5	6	7
1	-	Increase in TRL		-	-	-
2	1	-	5	4	2	-	-
3	-	-	1	1	-	1	-
4	-	-	-	-	-	-	-
5	-	-	-	1	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	1	-	-	-
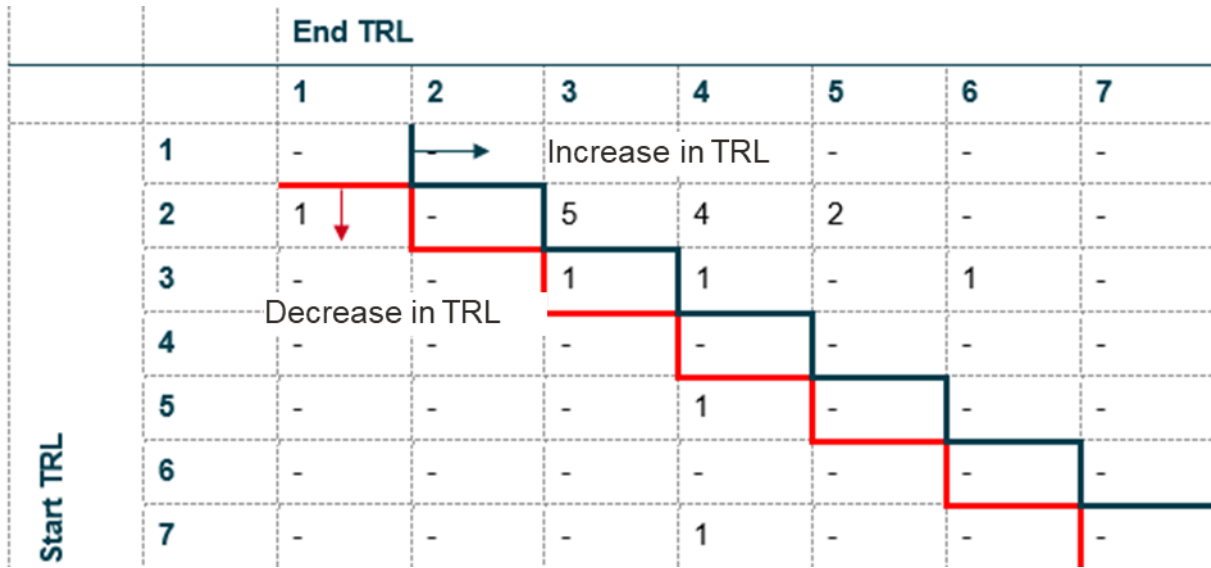
Source: Frontier analysis of end-of-project monitoring data.

Note: n = 17; Compared answers to the questions: "What level is your technology on the TRL scale upon entering the programme?" and "What level is your technology on the TRL scale upon finishing the programme?" (TRIG21) and "At what level was your idea or technology on the TRL (Technology Readiness Level) scale at the time of your application?" and "What level is your technology on the TRL scale now i.e. upon finishing the programme?" (TRIG22) asked at the start and end of the projects. While the questions for the start TRL is slightly different for TRIG21 (at start of the programme) and TRIG22 (at the time of application), we would expect the differences to be negligible. In 6 instances (2 in TRIG21 and 4 in TRIG22) the numbers reported for start or end TRL do not correspond to the reported TRL progress (displayed in Figure 64).

Progression towards demonstration

Most projects report to be between 1 and 2 years away from demonstration

TRIG22 participants were asked at the start and end of their projects to forecast the number of years their project was away from demonstrating the solution in the real world. TRIG21 participants were also asked this at the end of the projects. Figure 66 displays the results.

Figure 66   How many years away from demonstrating the solution in the real world do you believe you are?
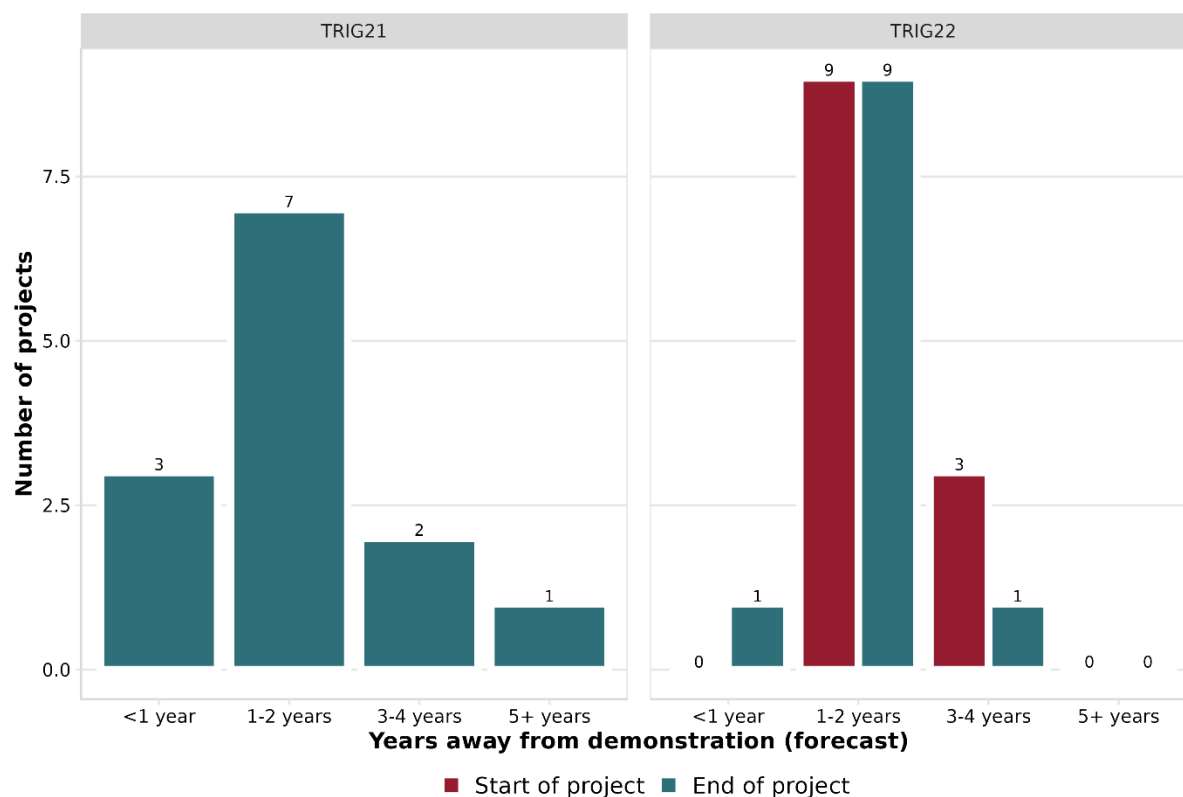
Source: Source: *Frontier Economics analysis of baseline and end-of-project monitoring data.*

Note: *n: TRIG21 start = 0 and end = 13; TRIG22 start = 12 and end = 11. Compared answers to the questions "If possible to forecast, how many years away from demonstrating the solution in the real world do you believe you are?" and "Now that you have completed the programme, if possible to forecast, how many years away from demonstrating the solution in the real world do you believe you are?" (TRIG22) and "If possible to forecast, how many years away from demonstrating the solution in the real world are you?" (TRIG21). TRIG21 participants were not asked at the start of their project.*

The majority of respondents, in both TRIG21 (end of the project) and TRIG22 (start and end of the project) forecasted to be between 1 and 2 years away from demonstration.

Comparing the TRIG22 results specifically, overall projects do seem to estimate they are closer to demonstration at the end of the project. The number of participants forecasting they are 3 to 4 years away falls from 3 to 1, and 1 participant estimates they are less than a year away from demonstration. Out of the 10 respondents who reported estimates at both the start and end, 2 forecasted a shorter period at the end of the project (from 3 to 4 years to 1 to 2 years) and the rest issued the same forecast.

Collaboration

The majority of TRIG projects had between 1 and 5 collaboration partners

Figure 67 reports the number of collaboration partners for each TRIG project. The majority of respondents from both TRIG21 (7 of 13 projects) and TRIG22 (5 of 9 projects) had between 1 and 5 partners, with almost all other respondents having more than 5 partners (where the

number of partners is known). Only 1 respondent from each year of the programme indicated they had no collaboration partners.

Many responses from projects in TRIG21 also provided more detail regarding the collaboration partners and the nature of their support. Examples included support with system design, fabrication and testing; support from materials suppliers or manufacturers; and academic or technical advice, support and research. TRIG22 projects most commonly noted collaborating with other SMEs.[46]

Figure 67   How many individuals or organisations have you collaborated with to develop your project?
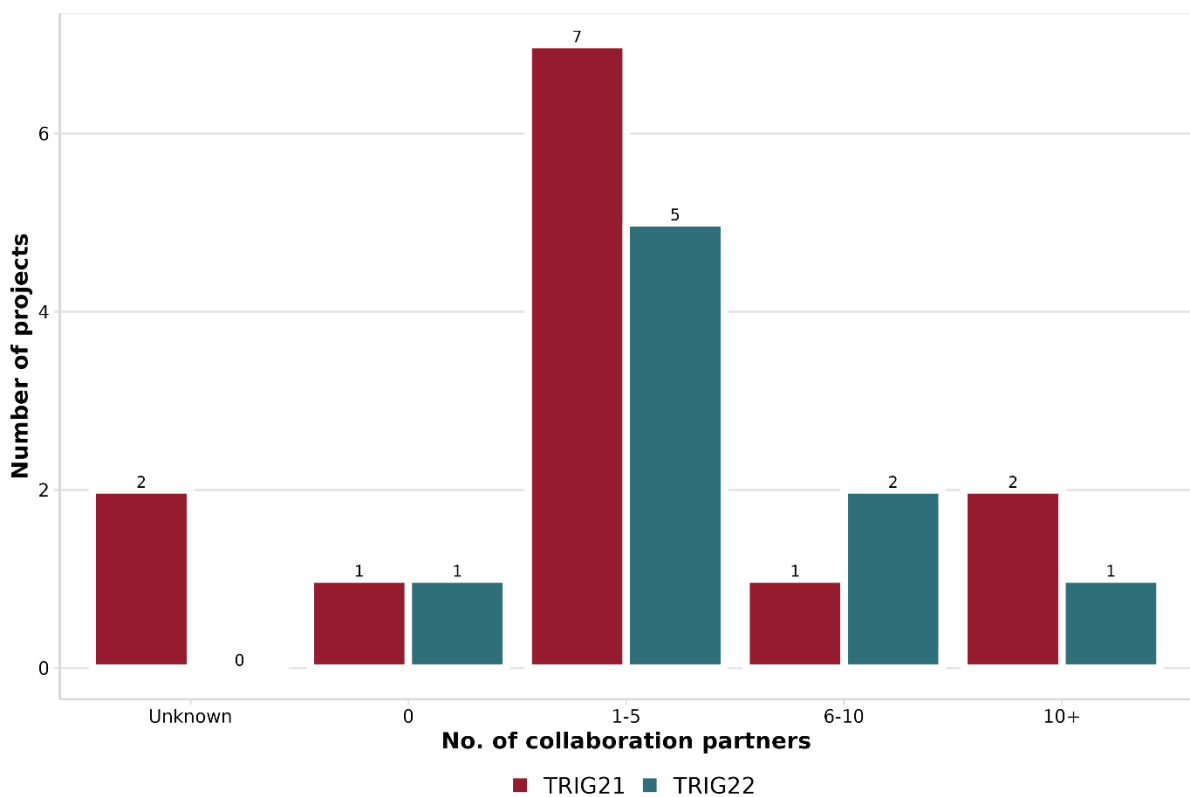
Source: Source: Frontier analysis of end-of-project monitoring data.

Note: "How many individuals or organisations have you collaborated with to develop your project?" Some TRIG21 responses included more detailed explanations, which have been classified by Frontier into the above categories. Two of these responses did not include clear details on the number of collaborators, so have they been classified as 'unknown'. The 2 missing responses for TRIG22 were from academic organisations, which could potentially be a result of survey design.

Organisations also discussed the benefits of collaboration for their projects, in their end-of-project reports and the TRIG21 end-of-project monitoring data. Many TRIG participants noted plans to jointly apply for additional funding along with various partners, as a consortium. Several also discussed receiving specific support to aid project development and success, for example:

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[46]   Question: "If you have collaborated with individual SMEs or organisations, please indicate which ones."

"Working with [partner] and tapping their sales acumen, we have developed sales offers to [two companies] which have resulted in agreement in principle, subject to contract … "

TRIG21 end-of-project monitoring data[47]

"One key learning is the importance of collaboration between technology developers and end-users to ensure seamless integration and address operational requirements and safety concerns."

TRIG22 end-of-project report

"During the project, we established valuable collaborations with key industry stakeholders and research institutions. These collaborations are integral to the successful implementation and adoption of our technologies."

TRIG22 end-of-project report

Such collaboration will likely also positively impact the later technology development timeframes for these projects, given connections and relationships fostered early on should continue to accelerate project progress.

7.2   Environmental benefits

Initial findings on EQ 2 for the TRIG programme are presented below: To what extent, and through what mechanisms, can environmental benefits be attributed to UK SHORE? The relevant data and data sources for each sub-question under EQ 2 are reported in Table 35.

Table 35   EQ 2 data sources

Sub-question	Data	Data source
To what extent has UK SHORE facilitated emissions of CO_2e or air pollutants to be reduced from UK maritime?	Project views on expected benefits for TRIG21 and TRIG22	End-of-project reports
	Expectations for TRIG projects' environmental impact	Business Case

Source: Frontier Economics.

7.2.1 Evaluation evidence

It is not expected that any TRIG projects will have delivered environmental benefits at this stage, given the low TRL levels involved, and no questions were asked regarding this in the

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[47]   Question: "Skills & Market Understanding."

start or end-of-project monitoring data.[48] However, some organisations did discuss the proposed and expected future environmental benefits of their projects in their end-of-project reports. Specific examples include:

> *"We expect we can provide a 5% reduction time for idling ships, reducing carbon by 900,000 tonnes/port, saving the environment £45m a year."*

TRIG21 end-of-project report

> *"Our team has conducted an extensive feasibility study, revealing the promising potential of our proposed technology to achieve a remarkable 20% reduction in fuel consumption within the target market."*

TRIG22 end-of-project report

As with CMDC (discussed in Section 6.2.1), these estimated environmental benefits are reported in various, non-standardised ways and may have been calculated using different assumptions and timescales, limiting comparability.[49] They are self-reported estimates of potential benefits which have not yet materialised and must be further caveated compared to CMDC projected figures, given the longer time scales involved in materialisation.

7.3   Commercial opportunities

This section presents initial findings related to the TRIG programme on EQ 3: To what extent, and through what mechanisms, did UK SHORE improve the commercial prospects and opportunities for clean maritime in the UK? The relevant data and data sources for each sub-question under EQ 3 are reported in Table 36.

Table 36   EQ 3 data sources

Sub-question	Data	Data source
To what extent was additional private investment crowded in for developing clean maritime technologies?	Investment received before and during programme and share attributed to programme participation for TRIG21 and TRIG22	Monitoring data
	Project views on investment, internal investment and future investment	End-of-project reports

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[48]   For example, "TRIG is a 100% grant funding competitive scheme to deliver **early-stage** research projects and prototyping," and "covers projects with TRL 2-5 at the application stage" (emphasis added, TRIG Financial Spending Business Case, September 2022). The business case also did not include a specific expectation regarding the environmental benefits of the TRIG programme.

[49]   Section 6.2.2 discusses options for how UK SHORE could collect future monitoring and evaluation data on emissions to be able to better compare project outcomes.

Sub-question	Data	Data source
	opportunities for TRIG21 and TRIG22	
	Grant funding received during programme and share attributed to programme participation for TRIG21 and TRIG22	Monitoring data
	Project views on programme assistance to secure future grants for TRIG21 and TRIG22	Monitoring data and End-of-project reports
	Investment and grant expectations for TRIG projects	Business case
How far have commercial benefits for UK business been realised or are expected to be realised in future for clean maritime technologies?	Revenue generated during programme and share attributed to programme participation for TRIG21	Monitoring data
	Revenue expectations for TRIG projects	Business case
	Project views of impact of programme on market understanding for TRIG21 and TRIG22	Monitoring data
	Number of private sector connections developed per programme and related project views for TRIG21 and TRIG22	Monitoring data and End-of-project reports
	Project views on additional commercial benefits for TRIG21 and TRIG22	End-of-project reports
	Planned next steps after programme and project views on programme impact on future activities for TRIG21 and TRIG22	Monitoring data and End-of-project reports
	Project views on potential benefits for wider maritime sector and long-term commercialisation	End-of-project reports

Sub-question	Data	Data source
To what extent did UK SHORE facilitate IP to be generated and retained in the UK for clean maritime technologies?	Planned next steps after programme for TRIG21 and TRIG22	Monitoring data and End-of-project reports
To what extent has TRIG played a role in convening parties from industry to drive forward clean maritime concepts that offer commercial potential? What remaining barriers are there for the development of concepts?	Collaboration during TRIG21 and TRIG22 are discussed in Section 7.1.1	Not Applicable

Source: Frontier Economics.

7.3.1   Evaluation evidence

Crowding in investment

The majority of TRIG participants received additional grant during their time in the TRIG programme, to varying amounts

The number of TRIG21 and TRIG22 respondents who received additional grants during their time in the TRIG programme (and the respective amounts they received) is shown in Figure 68. A majority of respondents in each year reported receiving additional grant funding while affiliated with TRIG (7 of 12 for TRIG21 and 5 of 9 for TRIG22). The most common amount received was £50,001 to £100,000 for TRIG21 and up to £50,000 for TRIG22. Both TRIG22 participants who did not provide an answer to this question were academic institutions. One of these reported receiving between £1-£50,000 of academic institutions funding during programme participation, although the other reported receiving £0.[50]

A potential reason for the higher levels of grant funding received by TRIG21 respondents overall could be that the TRIG22 question asked about investment received during programme participation, whereas the TRIG21 question instead referred to programme 'affiliation'. Projects may have considered themselves to have been affiliated with programme for some time before starting the programme (eg once they had been selected), or after finishing the programme (up to the completion of the end-of-project monitoring survey).

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[50]   Question: "What is the value of Academic institutions funding you have received (for this particular innovation) while participating in the TRIG 2022 programme, excluding the TRIG 2022 programme itself (in ...)." There were no other responses to this question.

Figure 68   What is the value of the grant funding you have received while participating or being affiliated with the TRIG programme?
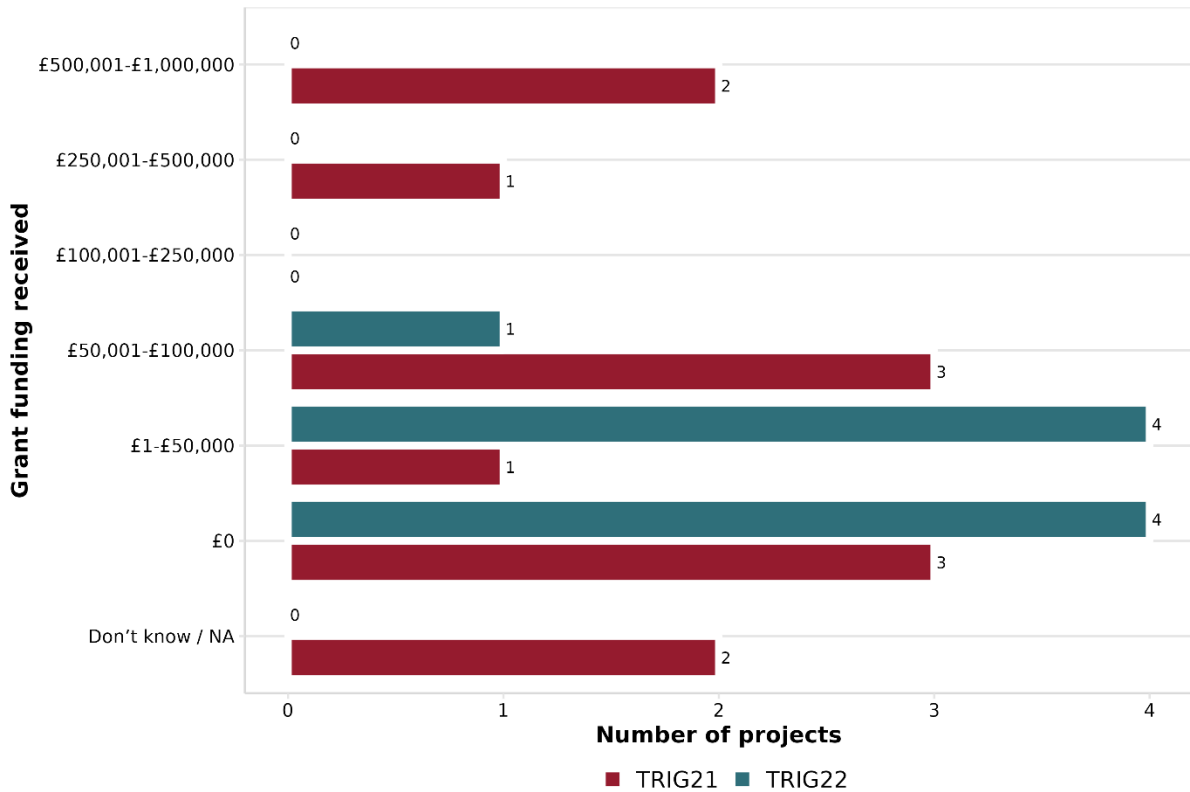
Source: Frontier analysis of end-of-project monitoring data.

Note: "What is the value of the grant funding you have received while being affiliated with the TRIG 2021 programme (in GBP)," and "What is the value of any grant funding you have received while participating in the TRIG 2022 programme, excluding the TRIG 2022 programme itself." TRIG21 response '£25,001-£50,000' has been grouped into a '£1-£50,000' category for consistency with TRIG22 responses. The 2 missing responses from TRIG22 and 1 missing response from TRIG21 were from academic institutions, which could potentially be a result of survey design. However, the other academic institution from TRIG21 responded '£25,001-£50,000'.

Figure 69 indicates that the majority of TRIG21 respondents who received additional grant funding attributed this (at least in part) to their TRIG programme participation (6 of 7). However, the most common share attributed to TRIG was relatively low, between 0 and 10% (3). Conversely, only 1 out of the 5 TRIG22 respondents who reported receiving an additional grant attributed any share of the funding to their involvement with the TRIG programme.[51] The TRIG22 participant who reported receiving academic institutions funding also did not consider this to have been due to their involvement in the programme.[52]

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[51]   Question: "Did you receive any of the above grant funding because of your involvement with TRIG 2022." The attribution share was not recorded. One respondent who answered "Yes" despite reporting having received £0 of grant funding during their TRIG programme participation, indicating issues with the self-reported data.

[52]   Question: "Did you receive any of the above grant funding because of your involvement in TRIG 2022?"

Figure 69   How much of this grant funding do you think is at least partly thanks to your participation in the TRIG 2021 programme? (TRIG21)
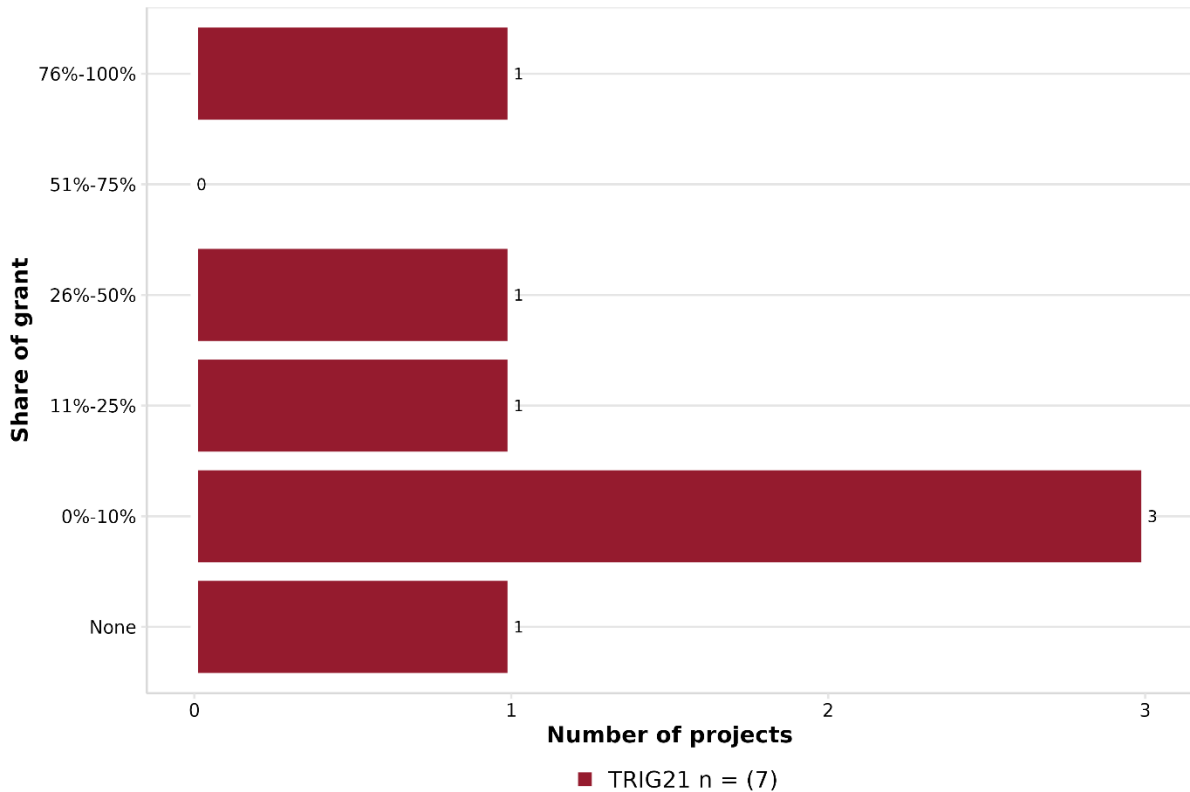
Source: Frontier analysis of end-of-project monitoring data.

Note: "How much of this grant funding do you think is at least partly thanks to your participation in the TRIG 2021 programme?" Responses are only included for organisations who reported receiving grant funding during the time of their programme participation (see Figure 68). Responses from TRIG22 projects for an equivalent question were in a 'yes or no' format, so they cannot be included in the chart and are discussed above instead.

A potential explanation for this stark differential between TRIG21 and TRIG22 is the differences in the answer options presented. While TRIG21 participants were asked to attribute a share of the grant received to their TRIG participation, TRIG22 participants were asked just to respond either 'Yes' or 'No' whether any of their grant funding was due to their TRIG involvement. TRIG22 respondents who considered only a small share of their grant funding to be due to the programme, potentially may have answered 'No', but would have chosen the '0 to 10%' TRIG21 option.

Most organisations did not receive any investment during their TRIG involvement, particularly in TRIG22

Figure 70 presents the value of investment organisations received during their TRIG programme involvement.[53] Only 1 TRIG22 respondent received any investment during this

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[53]   Investment, usually from the private sector, is given in return for some form of stake in the business (equity, debt, etc). This is in contrast to the grant funding questions (see Figure 68 and Figure 69) which refers to grants, usually publicly-funded, which do not require any stake in the business in return.

period. TRIG21 responses are slightly more varied, with 5 out of 12 responding organisations having received investment. There is quite a substantial range in reported value of these investments, from £1 to £10,000 to £250,001 to £500,000.

A potential reason for the larger number of TRIG21 respondents reporting receiving investment compared to TRIG22, is that the question asked to the TRIG22 project leads refers specifically to equity investment. However, the TRIG21 project leads were asked a question involving a wider definition (just 'investment'). Only 3 out of 5 of the TRIG21 respondents who received investment reported that this investment involved selling some of the company's equity.[54] Additionally, as in Figure 68, TRIG21 respondents were asked about investment received while affiliated with the programme. This potentially covers a longer period of time than the TRIG22 question, which refers to investment received while participating in the programme.

Figure 70   What is the value of the (equity) investments you have received while participating or being affiliated with the TRIG programme?
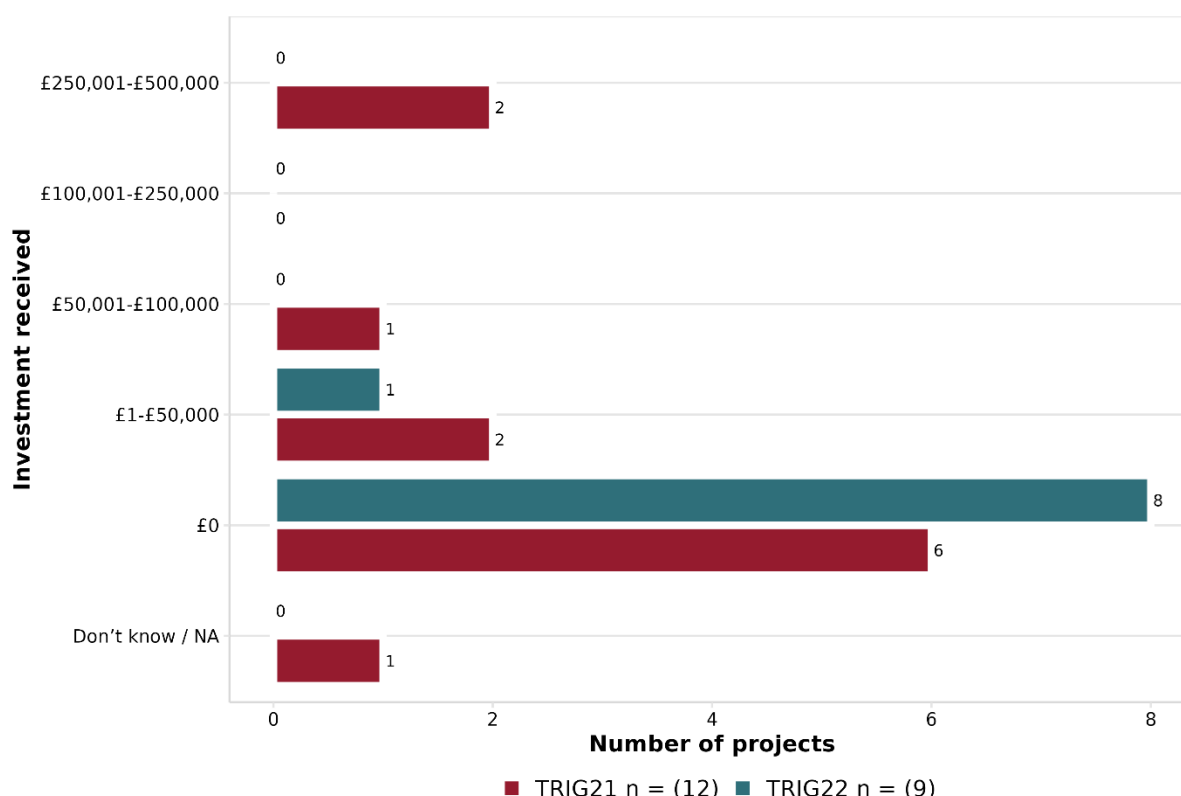
Source: Source: Frontier analysis of end-of-project monitoring data

Note: *"What is the value of the investments you have received while being affiliated with the TRIG 2021 programme (in GBP)?" (TRIG21) and "What is the value of any equity investments you have received while participating in the TRIG 2022 programme (in GBP)?" (TRIG22).TRIG21 responses '£1-£10,000' and '£10,001-£25,000' have grouped into a '£1-£50,000' category for consistency with TRIG22 responses. The 2 missing responses from TRIG22 and 1 missing response from TRIG21 were from academic institutions which could potentially be a result of survey design. However, 1 of the £0 TRIG21 responses was also from an academic institution.*

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[54]   Question: "What percentage of the company's total equity was sold through these investments?"

The TRIG22 respondent who reported receiving equity investment also reported that this investment was received thanks to their involvement in the TRIG programme.[55] All 5 TRIG21 organisations who reported receiving any investment attributed some share of that investment to their TRIG programme participation, although the amount varied from 0 to 10% to 76 to 100%.[56]

Notably only 1 of 10 TRIG22 respondents reported receiving equity investments within the 12 months prior to the TRIG programme.[57] Therefore, the lack of investment during the programme cannot be attributed to substantial investment occurring before the project had started. In contrast, 5 of 7 TRIG21 respondents reported receiving investment in the last financial year (again, the question did not specify the type of investment).

However, it is important to note that the evidence discussed above refers only to investment received before or during the TRIG programme, which is likely a suboptimal metric compared to investment received after the programme. The limited evidence surrounding future investment is discussed in more detail later on in this Section.

The TRIG programme has also helped organisations in their journey to secure future grants

Figure 71 presents participants' opinions on how the TRIG22 programme impacted their options of securing future grants. At the time of response, the majority of respondents had identified a potential funder (and were either in the process of developing or had submitted a bid) (5 out of 9), but only 1 had actually secured funding. Again, both of the TRIG22 missing responses were from academic institutions, and they did report that the programme helped them to identify a potential funder for future research grants (1 with a bid submitted and 1 with a bid in development).[58]

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[55]   Question: "Did you receive any of the above equity investments because of your involvement with TRIG 2022." One respondent who answered "Yes" despite reporting having received £0 of investment during their TRIG programme participation, indicating issues with the self-reported data.

[56]   Question: "What proportion of this investment attraction do you think is at least partly thanks to your participation in the TRIG 2021 programme? Or in other words, what proportion of this investment do you ...". One respondent reported 76-100%, despite answering 'Don't know or N/A' when asked if they had received investment during their TRIG participation, indicating issues with the self-reported data.

[57]   Question: "Did your organisation receive any equity investments in the last 12 months? If so how much (in GBP)?" (TRIG22) and "What is the value of the investments you have received in the last financial year (in GBP)?" (TRIG21). One of the 2 missing responses from TRIG22 was from an academic institution, with the other from a micro enterprise. The other academic institution (and only Charity, Not for Profit or Third Sector Organisation) responded Don't Know, N/A or Zero.

[58]   Question: "How, if at all, has the programme impacted your options of securing future research grants? Please tick all that apply." There were no other responses to this question.

Figure 71   How, if at all, has the programme impacted your options of securing future grants? (TRIG22)

Four open-ended responses were received from TRIG21 projects, noting the programme helped strengthen their research proposals and secure funding from other programmes (including EU Horizon), created collaborative grant application prospects, and helped organisations to feel better informed when making research grant applications.[59]

> *"We very much valued the opportunity for smaller 'seed' funding that has enabled to focus our new research ideas without having to embark on a major programme of activities. As a result, we feel better informed and well placed to tackle more substantive applications and partnerships in related areas."*

TRIG21 end-of-project monitoring data

> *"Drawing from the experience and insights gained, we are currently developing two CMDC4 funding proposals set to be submitted in September."*

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[59]   Three responses of 'N/A' were also received, all of which were from SMEs (although 2 of the responses provided were from SMEs).

TRIG22 end-of-project report

Overall, these results appear to suggest the TRIG programme has met business case expectations of 'projects applying for other public funding competitions' (one of the programme's measures of success).

Data on investment received after the TRIG programmes is not available, but several TRIG participants anticipated securing investment opportunities in the future

As mentioned previously, investment received after programme participation is likely a key metric. The programme's success (as defined by the business case) is measured by helping organisations: "secur[e] further private investment **following** the programme and one year after" (emphasis added). Given the low TRL of projects involved, it seems reasonable to suggest that investment potential may depend on progress made by the end of or following the programme. For example:

> *"Success in proof-of-concept of the [technology] will make a strong case for investment, and it is hoped that that milestone can be reached and exploited to secure that essential funding."*

TRIG22 end-of-project report

> *"Encouraging data obtained from laboratory experiments strongly supports the case for continued investment in these … technologies."*

TRIG22 end-of-project report

Unfortunately, data for investment received in the subsequent years after the programme is not available. However, there is some evidence to suggest that following the TRIG22 programme, several participants planned to find new investment opportunities (see Figure 73 and surrounding discussion), although their success is unknown.

Some participants also discussed specific prospective investment opportunities in their end-of-project report, but again it is unclear whether this has actually been received:[60]

> *"[Company] will invest £34k to … in December 2023,"* and *"[Organisation] will now use this success story to convince VCs, having raised £280k in a March's pre-seed round, to secure funding for its ongoing operations till the end 2024."*

TRIG21 end-of-project report

> *"In terms of progression for further funding, **we have in place a current venture fund backer**, we have agreement that they will support the match fund should a grant be put in place and we are now identifying larger grant funds and are in the process of applying for funding via the CMDC fund."*

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[60]   Of the 3 examples, 2 are from organisations that also reported receiving investment during the programme, and data is not available for the other organisation. However, they still demonstrate that Figure 70 fails to capture all investment secured once the years following the programme are taken into account.

	TRIG22 end-of-project report (emphasis added)

"Being on the TRIG programme and working towards … has also attracted public investors such as [company], who have shown an interest in investing £1.5 million to support [technology] commercialisation."

	TRIG22 end-of-project report

Other commercial benefits

The majority of TRIG21 organisations generated revenue during their programme affiliation, with many attributing some share to their TRIG21 participation

TRIG21 participants were asked about their revenue during their affiliation with the programme.[61] Of the 11 respondents, 8 reported receiving revenue ranging between £1 to £10,000 and £1 million and over. The most common response received was between £100,001 and £250,000 (3). Regarding the other projects, 2 of the 11 respondents reported receiving no revenue and 1 responded 'Don't know or N/A'; the 2 academic institutions did not provide an answer.

Table 37 shows that the majority of TRIG21 organisations who generated revenue attributed some share of this to their participation in the TRIG21 programme, at least partly (5 of 8 respondents). Of those attributing revenue to TRIG, the most common share was 0 to 10%. Notably, the organisations attributing the highest shares to TRIG (11% to 25% and 76% to 100%) did not generate the highest revenue (earning £10,001 to £25,000 and £25,001 to £50,000, respectively). The organisation with the highest revenue (£1 million and over) did not consider any part of this to be thanks to their participation in the TRIG programme.

Overall, this aligns with business case expectations that organisations should achieve an increase in revenue by the end of or following the programme (up to 1 year after).

Table 37 How much of the revenue generated during affiliation with the TRIG programme do you think is at least partly thanks to your participation? (TRIG21)

Share (partly) attributed to TRIG21 participation	Number of organisations
None	2
0%-10%	3

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[61] Question: "What is the value of your revenue while being affiliated with the TRIG 2021 programme (in GBP)?" Equivalent data was not available for TRIG22.

Share (partly) attributed to TRIG21 participation	Number of organisations
11%-25%	1
26%-50%	0
51%-75%	0
76%-100%	1
Don't know or N/A	1

Source: Frontier analysis of end-of-project monitoring data.

Note: n = 8. "How much of this revenue generation do you think is at least partly thanks to your participation in the TRIG 2021 programme?" The table excludes 1 TRIG21 project that responded to the question: "What is the value of your revenue while being affiliated with the TRIG 2021 programme (in GBP)?" with £0, 2 TRIG21 projects that responded 'Don't know or N/A', and 2 TRIG21 projects that did not respond. These were both academic institutions, so this could potentially be a result of survey design. Equivalent data was not available for TRIG22.

The TRIG22 programme helped improve organisations awareness of their projects' requirements and current challenges

Participants were asked at the end of their project how the programme had improved their understanding of the intended market. Figure 72 shows that of 11 TRIG22 respondents, the majority reported that the programme enhanced their awareness of the requirements (8) and current challenges (8), for their innovation. A slightly smaller number found the programme had enhanced their awareness of the competition or other solutions (5). Notably, responses were not mutually exclusive, with 5 of 11 respondents confirming all 3 response options.

Figure 72   How has your understanding of your intended market changed due to the programme? (TRIG22)
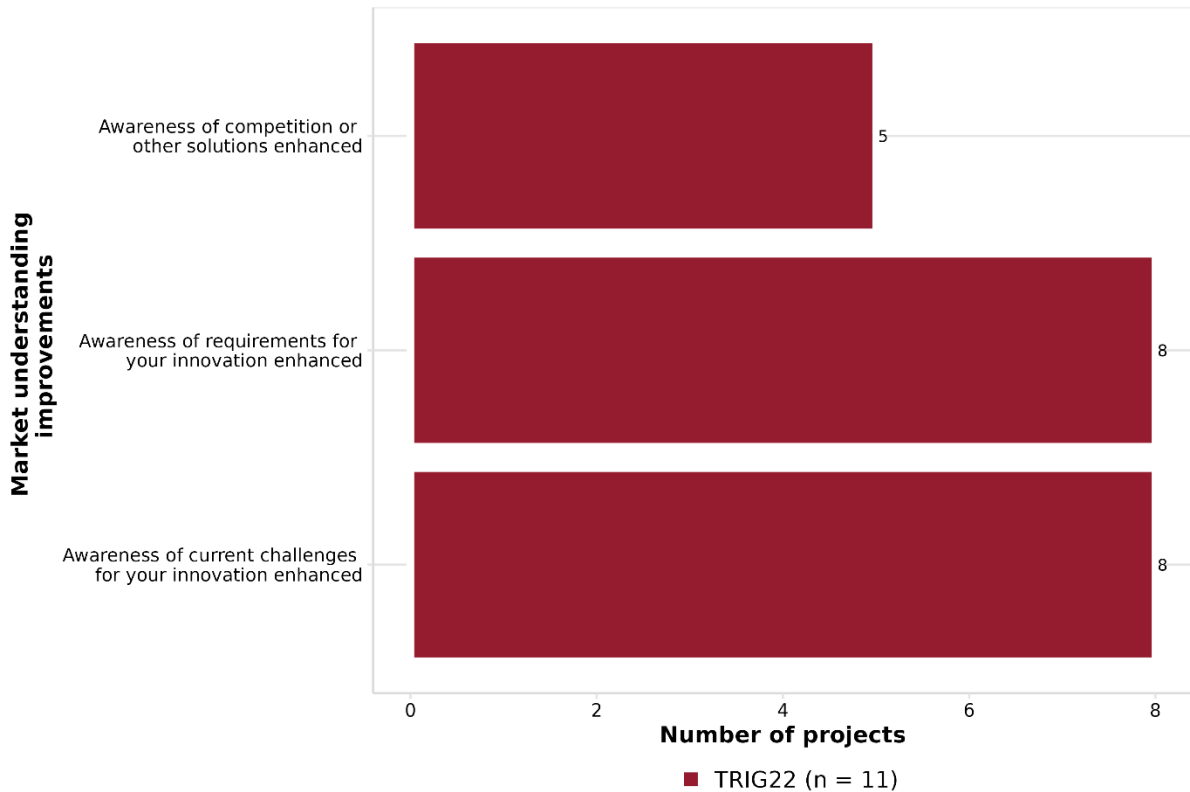
Source: Frontier analysis of end-of-project monitoring data.
Note: "How has your understanding of your intended market changed due to the programme?" Responses from TRIG21 projects were open-ended, so they cannot be included in the chart and instead are discussed below.

For TRIG21, the qualitative feedback received was quite mixed. Several respondents noted they already had a solid understanding of the market, which did not change significantly. However, others did report an improved market understanding, for example:

> *"Our understanding of the market has strengthened due to the opportunity to network and discuss our technology with the various stakeholders."*

TRIG21 end-of-project monitoring data

The TRIG programme appears to have helped participants in developing private sector connections due to the programme

Almost all TRIG22 respondents (11 of 12) noted connections with the private sector as something they expected to gain from the programme.[62] After completing the programme, 9 of 11 respondents felt they had gained these connections.[63] Of the 10 respondents where a

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[62]   Question: "What do you expect to gain through the programme? Please tick all that apply."

[63]   Question: "Did you gain any of the following from the programme? Please tick all that apply."

comparison between responses at the start and end of the programme was possible, only 1 hoped to gain private-sector connections but did not achieve it. Conversely, 1 respondent reported creating private-sector connections but did not expect to do so at the start of the programme:

*"During the project, we established valuable collaborations with **key industry stakeholders** and research institutions. These collaborations are integral to the successful implementation and adoption of our technologies."*

TRIG22 end-of-project report (emphasis added)

For TRIG21, some organisations mentioned at the start of the programme that they hoped to attend networking events, make industry connections, or connections with technology-focused companies. [64] Equally, at the end of the programme several respondents noted they had made or developed contacts.[65] While these did not specify private-sector contacts directly, the contacts included connections within the TRIG cohort and industry stakeholders (including manufacturing and builders):

*"Thanks to the TRIG2021, we were also provided with opportunities to establish new connections with **other members of the cohort**, and via key networking events … There, [organisation] was also presented with the opportunity to give a 3-minute pitch to a panel of investors, which also gave us additional exposure and further opportunities to refine our business model."*

TRIG21 end-of-project report (emphasis added)

Projects also noted a range of other commercial benefits from the TRIG programme

In their end-of-project monitoring reports, some projects also discussed various other commercial benefits they received from the TRIG programme. For example, projects also noted developing skills and gaining relevant experience. This included project-specific technical skills and experience, as well as softer skills relevant for commercialisation. These included administrative, communication and presenting skills:

"Throughout the project period we were engaged in different new aspects of the project which led to learning different skills and to enhancing our experience in the project subject as a team."

TRIG21 end-of-project report

"The TRIG2021 also successfully funded the development of a 3-minute pitch-video, which will also be a valuable piece of media that could be used to further promote the business. It was a valuable experience not only to have feedback on the content of the pitch, but also on how to deliver the pitch by vocally emphasising certain key words or pausing for effect."

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[64]   Question: "What do you hope to gain from of the programme more widely?" The question was open-ended.

[65]   Question: "What have you gained from of the programme more widely?" The question was open-ended.

<div style="text-align: right;">TRIG21 end-of-project report</div>

"There were several learning opportunities within the project both in terms of working partnerships between ourselves and the [technology] developer, where clear communication was always the most important factor and provided the biggest benefit when timing allowed."

<div style="text-align: right;">TRIG22 end-of-project report</div>

Projects also highlighted benefits for the wider clean maritime sector

In the end-of-project reports, some participants provided examples of how they expect their project will benefit the sector more widely. This includes the dissemination of project learnings (evidenced in Figure 73) through various means, such as webinars and academic publications cost savings; and a reduction in ship delays. As with the environmental benefits discussed in Section 7.2.1, it is worth mentioning (particularly for the latter 2 quotes) that these are self-reported projections, which have not yet materialised:

"The learnings from the project will be shared with the local community and marketplace to ensure that the project impact is maximised."

<div style="text-align: right;">TRIG21 end-of-project report</div>

"The outcomes of this project will provide direct benefits to ports, shipbuilders, shipowners, and fuel suppliers that will support the marine sector decarbonisation."

<div style="text-align: right;">TRIG21 end-of-project report</div>

"Ship owners will benefit from reductions in payable carbon tax and reduced emissions when in port," and *"resulting in an expected annual saving of £22.7m."*

<div style="text-align: right;">TRIG21 end-of-project report</div>

Longer term plans for commercialisation

After the TRIG programme, the most common next step is to informally share output and insights (TRIG21) and continue further trials (TRIG22)

The organisations' planned next steps for their project (following the TRIG22 programme) are displayed in Figure 73. The most common response was embarking on further trials (9 of 11 respondents), with a substantial number of respondents also noting plans to apply for further grants or the accelerator programme (7) and find new investment and partnership opportunities (6).

Additionally, the 2 TRIG22 academic organisations responded to a similar question, highlighting different planned next steps. These included formally publishing work and developing, protecting or licensing their IP.[66]

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[66] Question: "What are your planned next steps after the programme? Please tick all that apply".

Figure 73   What are your planned next steps after the TRIG22 programme?
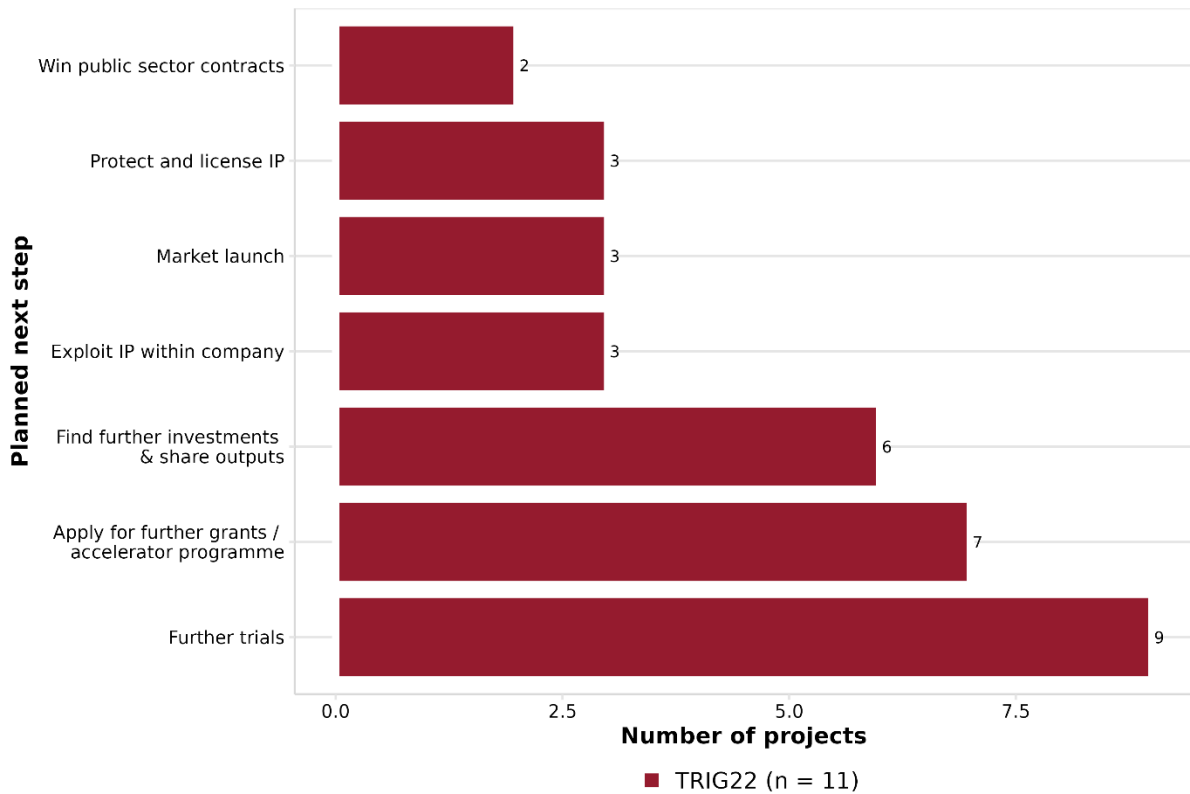
Source: Frontier analysis of end-of-project monitoring data.

Note: "Now that you are at the end of the TRIG 2022 programme, what are your planned next steps for the project? Please select all that apply." There were only 7 responses from TRIG21 projects for the equivalent question (What are your planned next steps after the programme? Please select all that apply), so these have not been included in the chart and are instead discussed directly below this chart.

Only 7 TRIG21 projects responded about their planned next steps. Sharing outputs or insights informally was the most commonly reported option (4 of 7 respondents). This was followed by developing, protecting and licensing IP (2) and formally publishing work (2). One project also discussed feeding outcomes to an EU horizon project, and another referenced looking for further grants or investment:

> *"I plan to apply for new grants (e.g. CMDC3), deliver on successfully awarded grants (i.e. CMDC2) whilst also looking for venture capital and developing new partnership opportunities."*

TRIG21 end-of-project report

To caveat, any comparison between the next steps of the 2 cohorts should be interpreted cautiously, given the sample size difference and because they were not presented with an identical response list. Additionally, while a limited number of TRIG21 projects discussed looking for further grant and investment opportunities (and none discussed planning further trials) in relation to this question, other evidence suggests some TRIG21 projects did consider

these next steps. For example, as noted earlier (in the Crowding in investment sub-section), 4 TRIG21 projects noted ways in which the TRIG programme had positively impacted their options of securing future research grants. Other TRIG21 projects (those who did not respond to the question presented in Figure 73) indicated they planned to pursue additional funding options in their end-of-project reports. One project mentioned both additional funding and potentially developing further trials, although neither of these next steps were discussed in their response to the question presented in Figure 73:

"We are reviewing funding opportunities from various sources."

TRIG21 end-of-project report

Responses to 'Summary of Possible Future Directions and Work' include: "Find new development funding from grant and/or customer (or other source/investment)."

TRIG21 end-of-project report

"Following on from this project, the [organisation] is actively looking for funding opportunities and project partners," adding *"the team is eager to develop an operational trial based on the work carried out."*

TRIG21 end-of-project report

Overall, this does suggest that following the TRIG programme projects were at least seeking additional private investment and public funding, as expected by DfT. However, the success of these planned next steps is not yet known.

TRIG22's immediate impact on the future activities more commonly relates to research, rather than commercial work

Figure 74 presents results for the impact of the TRIG22 programme on the future activities and outputs of the participating organisations. The most common responses received relate to 'identifying' or 'identifying and beginning' further research (6 of 9). Relatively few responses related to 'generating or beginning' commercial work (3). This is to be expected, given the TRIG programme is aimed at projects towards the lower-end of the TRL scale, who are generally not expected to reach commercialisation by the end of the programme.[67]

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[67]   Given the scheme is aimed at early-stage research projects with low TRLs (TRIG Financial Spending Business Case, September 2022).

Figure 74   How, if at all, has the programme impacted your future activities and outputs? (TRIG22)
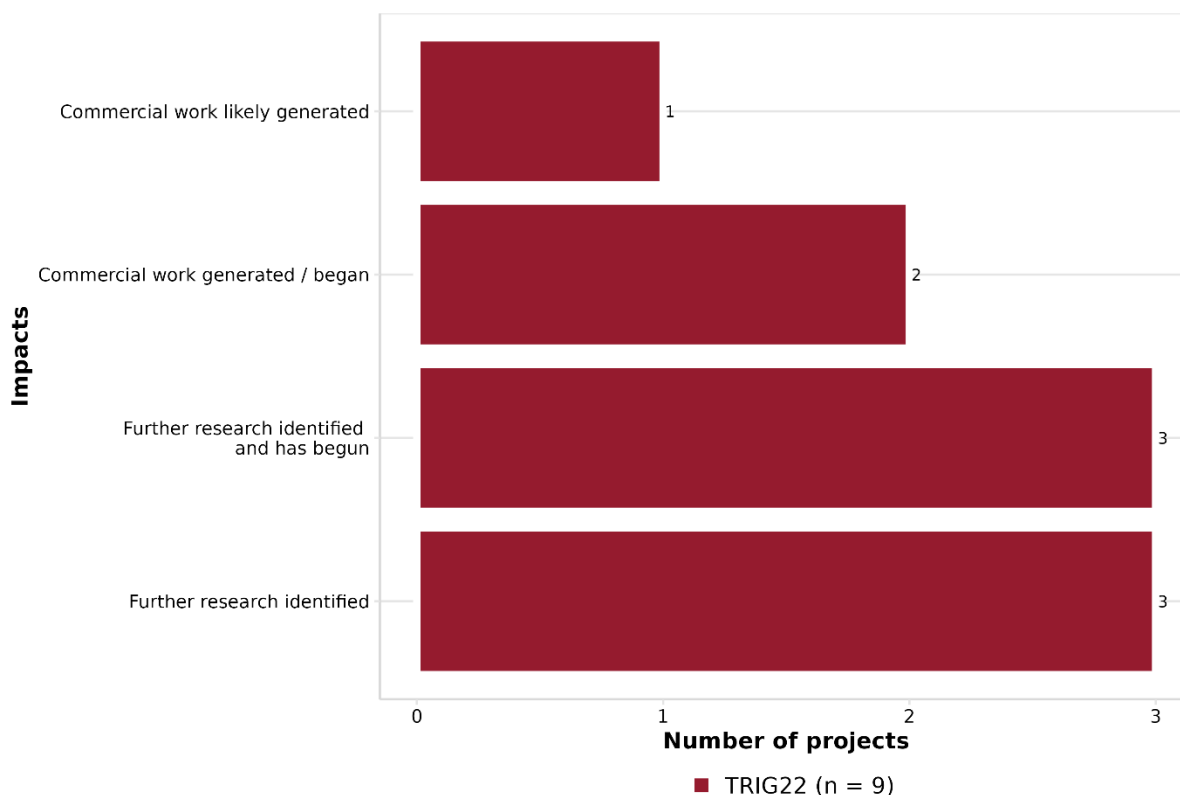
Source: Frontier analysis of end-of-project monitoring data.

Note: "How, if at all, has the programme impacted your future activities and outputs?" Equivalent data was not available for TRIG21. The 2 missing responses from TRIG22 were from academic institutions, which could be a result of survey design.

Having said that, some projects across TRIG21 and TRIG22 did discuss their long-term commercialisation prospects and goals in their end-of-project reports, with varying degrees of specificity. These include self-reported goals or projections, which have not yet materialised:

> "Overall, the serviceable available market of our solution is around £67.7m in the UK. We anticipate to reach a 20-30% market share in UK port operations in a 5-year timeframe, scaling our total serviceable obtainable market to £13.54m-£20.3m by 2026."

TRIG21 end-of-project report

> "The fundamental conclusion is that the concept is viable and that if testing proves successful it will form the basis of a new design ethos and product line that can be scaled up and sold commercially within the next two-three years."

TRIG21 end-of-project report

> "The promising results and increased TRL from 3 to 5 indicates the commercial potential of [project]. Further research and development are necessary, but this project has positioned us to explore commercialisation opportunities."

TRIG22 end-of-project report

7.4   Spillover benefits

EQ 4 asks: To what extent is there evidence that UK SHORE has generated positive spillover benefits?

7.4.1   Evaluation Evidence

As with environmental benefits discussed in Section 7.2.1, it is not expected that any TRIG projects will have delivered spillover benefits at this stage, given the low TRLs. Like with EQ 2, no questions were asked regarding this at the start or end-of-project monitoring data, and no specific expectation was included in the TRIG Financial Spending Business Case. However, as well as the broader spillovers to clean maritime identified in Sections 7.3.1 and 7.5.1, some projects highlighted potential spillovers to other transport sectors, including road, rail and aircraft. These are self-reported predictions which have yet to materialise:

> *"The proposed concept can be adopted for applications in other transport sector[s], namely in road, rail and air transport system."*

TRIG21 end-of-project report

> *"Both small aircraft and small ships lack [technical detail] and so the investment indirectly benefits 2 strands of Transport Decarbonisation."*

TRIG22 end-of-project report

7.5   Wider social objectives

This section presents initial findings for the TRIG programme on EQ 5: To what extent has UK SHORE achieved wider social objectives? The relevant data and data sources for each sub-question under EQ 5 are reported in Table 38.

Table 38   EQ 5 data sources

Sub-question	Data	Data source
To what extent has UK SHORE contributed to sustaining or creating jobs in the UK in the clean maritime or related sectors?	Number of jobs created by TRIG22 projects and number of employees	Monitoring data
	Project views on potential job creation impact, for TRIG21 and TRIG22	End-of-project reports

Sub-question	Data	Data source
	Job creation expectations for TRIG projects	Business case
To what extent has UK SHORE contributed towards levelling up of coastal areas?	Project views on potential wider social benefits, for TRIG21 and TRIG22	End-of-project reports
To what extent has TRIG generated evidence that supports potential employment and learning opportunities in UK maritime decarbonisation technologies?	Sources for TRIG job creation impacts noted above	Not applicable
	Dissemination of TRIG project learnings discussed in Section 7.3.1	Not applicable

Source: Frontier Economics.

7.5.1 Evaluation evidence

Similar to the environmental and spillover benefits discussed in Sections 7.2 and 7.4, it is not expected that TRIG projects will have delivered significant social benefits at this stage, given the low TRLs.

Job creation

The TRIG22 programme has so far had a limited impact on total job creation, although job creation is significant compared to employment levels in the relevant organisations

Figure 75 presents the number of Full-time equivalent (FTE) employees organisations reported adding during their participation in the TRIG22 programme (equivalent data was not available for TRIG21). It is important to highlight that the TRIG programme is not expected to have a large immediate impact on job creation, given the "short length of the competition" and early-stages of the research projects. The business case expectation is to "at least maintain[ing] the number of employees in participating organisations."[68]

A substantial number of respondents did not add any FTE employees (5 of 9), and all other respondents added 1 to 5 FTE employees. Although, all organisations reporting job creation had fewer than 10 employees at the start of the programme. The addition of 1 to 5 FTE employees during the programme can be seen as a substantial increase for these organisations.

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[68] TRIG Financial Spending Business Case, (September 2022).

Figure 75   Did you add any (FTE) employees during the programme? (TRIG22)
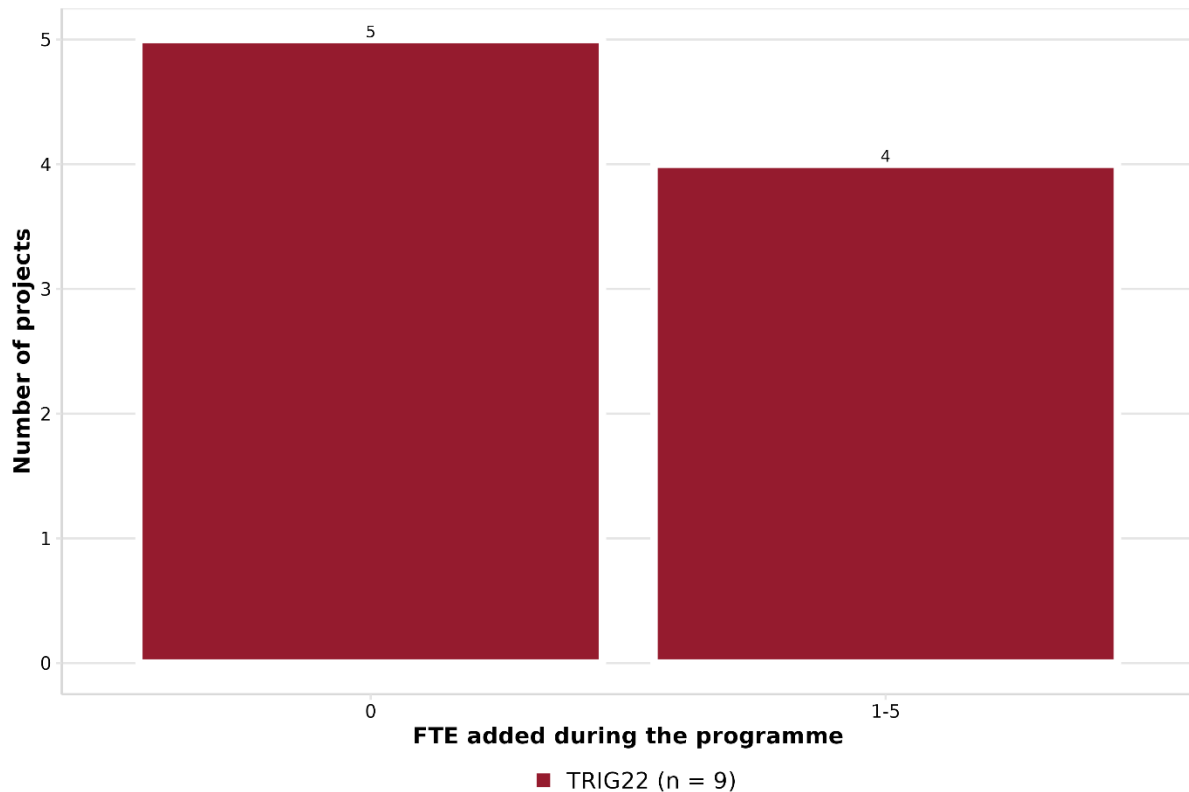
Source: Frontier analysis of end-of-project monitoring data.

Note: "Did you add any (FTE) employees during the programme?" The 2 missing responses from TRIG22 were from academic institutions, which is potentially a result of survey design. Equivalent data was not available for TRIG21.

However, it was not specified whether these employees were added due to an organisation's involvement in the TRIG programme or for other reasons. In particular, given each TRIG project received up to £30,000 in funding it is unrealistic to attribute job creation directly to TRIG.[69] Instead, this may be an indicator that TRIG is supporting the project moving on, so more employees are needed. It was also noted in a TRIG22 successful applicant interview (with an organisation that reported adding FTEs during the programme) that the employee hired was on a short-term basis only. Whether this was the case for any of the other organisations is unknown.

Several TRIG participants anticipate creating more jobs in the future

In their end-of-project reports, several organisations noted their project does have the potential to generate job opportunities, following development and commercialisation of the relevant technologies. Given these are only impact projections, whether projects have been successful in doing so is unknown:

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[69] We note that later TRIG rounds received up to £45,000. Funding for projects in TRIG21 and TRIG22 was up to £30,000.

"[Organisation] will create more local employment with high value jobs. The technology and final product will lead to the creation of 50 new direct jobs, and several additional jobs in the supply chain."

TRIG21 end-of-project report

"It is anticipated that further development here could potentially unlock a whole new industry of maritime carbon management within the UK. This includes, but not limited to, jobs in R&D, manufacturing of [specific] technology, installation and deployment roles, and maintenance/servicing of the technology and can fuel future growth of the new carbon disposal/trading industry."

TRIG22 end-of-project report

"Future development will involve growing our engineering and development capability, creating jobs and opportunities … "

TRIG22 end-of-project report

Wider social benefits

Some end-of-project reports discussed several other potential social benefits of their projects, once completed

These self-reported, potential future benefits (which are yet to materialise) included:

■ Potential **development of coastal areas** – a couple of projects noted plans to concentrate their technology's development and manufacturing in particular areas of the UK, such as Teesside and Liverpool. This is expected to lead to increased local jobs, growth and development in those areas. Some other projects also anticipated similar benefits for coastal towns (with marine industry dependencies) and islanded communities in general:

> *"This aligns well with the economic, decarbonisation, island-frameworks and governmental strategies for rural growth with islanded communities in a unique position to act as exemplars for the decarbonisation of the transport sector … "*

TRIG21 end-of-project report

> *"With the future potential for a transformational revenue, jobs and technology scenario at [organisation] which benefits the highest unemployment region in the country (TeesSide = 10.3%)."*

TRIG22 end-of-project report

■ Potential improvements to **air quality**, which would generate health benefits for the local population:

> *"UK ports will practically benefit from locally reduced air pollution … Reduced localised air pollution has been proven to reduce cases of respiratory infections, heart disease."*

TRIG21 end-of-project report

■   Potential to improve the **safety of lives at sea:**

*"This would prove to be a significant benefit to society not just from a net zero perspective but also from the perspective of job creation, **safety of lives at sea** and also export potential."*

TRIG22 end-of-project report

7.6   Overall findings and recommendations

Development of clean maritime technologies

All 13 TRIG21 and TRIG22 projects submitted end-of-project reports. The vast majority of project respondents from both years of the programme successfully proved their initial concept. All respondents felt the programme helped them progress towards proof of concept or feasibility. There is also evidence to suggest the TRIG programme demonstrates at least some degree of additionality. For example, several TRIG21 participants reported something valuable they had done, which they would not have without the TRIG programme. Also, an unsuccessful TRIG applicant noted that while they were still able to conduct their project, they were unable to validate their concept without TRIG funding.

All project respondents reported TRL progress, most commonly by 1 level, likely exceeding the programme's expectations based on the caveat within the business case that projects may move with TRL rather than up the scale. However, the low TRL starting point of these projects means it is relatively easier to progress TRL compared to higher TRL schemes, as things can be done on a smaller scale. Additionally, there is evidence to suggest that the self-reported TRL data is potentially unreliable. For example, several of the TRIG project respondents reported TRL progress which is inconsistent with their reported TRL at the start and end of the programme. As discussed in Section 6.6, **it would be useful to review how TRL outcomes are monitored so that the results can be more clearly interpreted, or to increase standardisation in TRL reporting.**

The majority of project respondents reported to having between 1 and 5 collaboration partners. Participants noted key benefits of such collaboration, including receiving specific support to aid project development or success and the ability to apply for further funding as a consortium. Only 1 project from TRIG21 and 1 from TRIG22 noted having no collaboration partners.

Commercial opportunities

The majority of project respondents did not receive any investment during their TRIG participation, particularly in TRIG22. However, some of the difference in results between years may be due to differences in question wording and all projects who reported receiving investment attributed some share to their TRIG programme participation. This might be

consistent with the business case expectation that projects would secure private investment after participating in the programme. In particular, given the low TRL nature of the projects, some of their investment potential may depend on the progress made by the end of or following the programme. While evidence relating to the post-TRIG investment actually secured is not available, several projects stated they plan to find new investment opportunities after the TRIG21 and TRIG22 programme.

On the other hand, the majority of TRIG project respondents received a grant during the TRIG programme. Although, substantially fewer TRIG22 projects attributed this to their programme participation. However, this may be due to differences in question wording between the TRIG21 and TRIG22 surveys. Additionally, evidence suggests that several organisations felt the TRIG programme helped them in their journey to secure future grants and they plan to apply for further grants after the programme, for both TRIG21 and 22. This is consistent with DfT's expectation for the programme.

It would be helpful to collect evidence on the private investment and grant funding received by projects in the immediate years following the TRIG programme.

Limited evidence for environmental and spillover benefits and wider social objectives

There is limited evidence of the TRIG programme's environmental and spillover benefits and how well it met wider social objectives. This is expected given the low TRLs, early stages and small scale of the projects involved.

Aside from limited data on job creation impact for TRIG22, the evidence available consists of self-reported projections of future impacts. While these suggest impressive potential, limited weight must be placed on such evidence given the uncertainty of whether these impacts will actually materialise, particularly due to the lengthy time scales involved. **A next step would be to collect evidence (whether quantitative or qualitative) from TRIG projects, several years after the programme, on the extent to which such impacts have materialised or whether there is further progress towards them.**

8 Interim impact evaluation findings – The Clean Maritime Research Hub

This section brings together the Hub monitoring data with interview evidence. It focuses primarily on outputs produced by the Hub over the first 6 months of their work (until April 2024), with some early discussion of outcomes. The findings relate to 6 months of a 42-month scheme and should be understood in this context. Future evaluations will build on this as the Hub progresses overtime.

8.1 Development of clean maritime technologies

This section presents initial findings on EQ 1: To what extent, and through what mechanisms, did UK SHORE help to accelerate and support the development of clean maritime technologies relative to what would have happened in the absence of UK SHORE? The relevant data and data sources for each sub-question under EQ 1 are reported in Table 39.

Table 39 EQ 1 data sources

Sub-question	Data	Data source
To what extent did the overall portfolio support technologies through the TRL scale?	Change in TRL for the Hub projects	Baseline and end-of-year-one data
To what extent did the overall portfolio generate evidence to help inform market players as they develop maritime decarbonisation technologies?	Number of academic papers published	End-of-year-one report
	Hub self-assessment of research aims	End-of-year-one report
	Number of policy papers published	End-of-year-one report
	Research projects supported	End-of-year-one report
	KPIs relating to academic papers, policy papers and research projects	End-of-year-one report
	Views of the Hub on policy engagement	End-of-year-one report and stakeholder interviews

Sub-question	Data	Data source
What role did UK SHORE play in facilitating parties to come together to advance the development of clean maritime technologies?	Improvements in collaboration skills	End-of-year-one data
	Number of Hub organisations who had not collaborated with other Hub members before	Baseline data
	Hub contact list	End-of-year-one report
	Collaborations and presentations with other bodies	End-of-year-one report
	KPIs relating to the Hub contact list and number of presentations	End-of-year-one report
	Views of the Hub on collaboration	End-of-year-one report and stakeholder interviews
What factors or investments played a role in enhancing the influence of UK SHORE in meeting its aims for accelerating UK clean maritime?	Skills developed as a result of the Hub	End-of-year-one data
What role did UK SHORE play in facilitating international engagement in relation to the development of clean maritime technologies?	Engagement at an international level	End-of-year-one report

Source: Frontier Economics.

8.1.1   Evaluation evidence

Research

The Hub is advancing research across 5 key themes of clean maritime

A primary aim of the Hub is to support research in clean maritime technology, focused on 5 key themes which align with the research objectives set out in the Hub funding call. As reported in its annual monitoring report, Table 40 sets out the Hub's self-assessment of whether it is on schedule to meet the objective for each theme. It rated itself as 'on track' for 3 of 5 themes, with delays in aspects of other themes due to issues in recruiting post-doctoral associates.

Across these research areas, the Hub's annual report lists 19 academic articles published, with 3 additional articles forthcoming. The Hub's KPI is to publish 34 journal papers per year, and given the annual report was written on month 7 of the first year, the Hub is well placed to achieve this target. However, due to the timescales of academic research, it is likely that a significant number of articles would have been published without the Hub (this research was likely being pursued by the individual universities involved in the Hub). Therefore, the additional impact of the Hub (at this early stage) is unclear. It is unrealistic to think the Hub would have been able to publish research that had started less than 1 year following its inception. There is also no evidence to assess additionality relating to the quality of the output, although it is likely that the Hub's scale and position as a centre for clean maritime research has helped increase the reach of its outputs.

Table 40   The Hub's self-assessment of whether research objectives are on track

#	Theme	Hub self-assessment
1	Marine fuel scale up and safety	Slight delay at some universities
2	Power and propulsion systems	Delay in some work packages. Other work packages on track or well progressed
3	Port and vessel support systems	On track
4	Vessel design and efficiency	On track
5	Digitisation, marine operations and finance	On track

Source: Frontier analysis of Hub annual report.

There is currently no evidence of TRL advancement in Hub research projects, although progress is expected by the end of the Hub

Annual and baseline monitoring data asked the Hub lead about the TRL of each research project. Three data points are available: baseline, end of year 1 and expected TRL by the end of the project (as measured at baseline). It is not possible to match all projects in the baseline data to the first-year survey to understand the extent to which individual projects have advanced TRL.[70] Only 3 projects can be matched, all of which report no change in TRL.

Given projects cannot be compared at an individual level, Figure 76 reports average TRL at each of these 3 points. Comparing the first and third bars shows that the Hub expect to

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[70]   Twenty-nine projects reported at baseline and 10 projects reported at the end of year, of which only 3 can be matched to the baseline data. Matching is based on project names and it is unclear whether project names are consistent across monitoring data.

increase projects by 1 TRL on average. However, the first and second bars show that TRL reported at the end of the first year has fallen compared to TRL at baseline. Since not all projects can be matched, there may be additional projects in the first-year data not reported at the baseline. The Hub may have taken on additional, lower TRL projects, driving the average down. Therefore, this analysis tells us little about the impact of the Hub. For future monitoring data, it may be beneficial to allocate projects unique IDs to allow for ease of matching between multiple monitoring surveys and a better assessment of TRL development.

During the interview, the Hub lead was asked about some inconsistent results in TRL (for example relating to lower expected TRL as compared to baseline TRL). They were not able to explain this discrepancy and suggested that it may be due to data entry issues, indicating another issue with the use of TRL data to evaluate success at this stage.

Figure 76   Current and future TRL
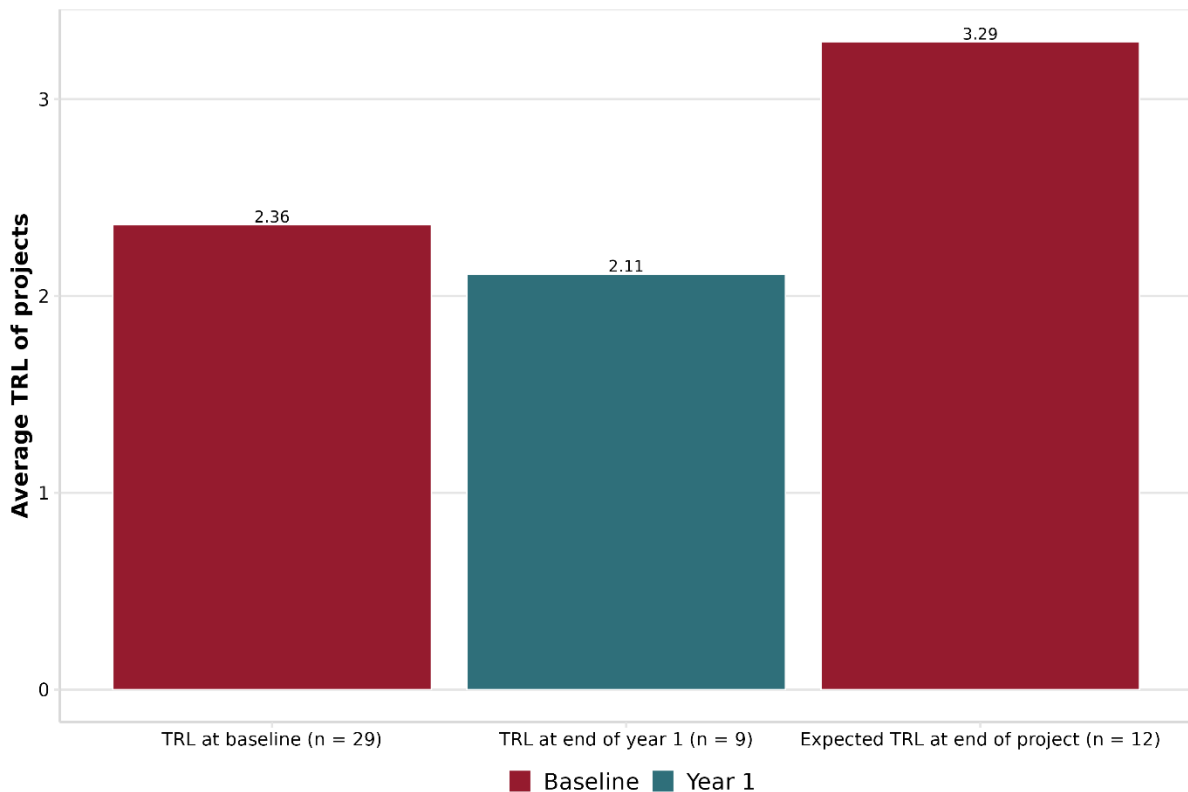
Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: "The work of the hub includes researching the feasibility of technical innovations. Please state what technologies will be researched, their current technical proximity to the market in terms of technical readiness level (TRL) and commercial readiness level (CRL), and the expected TRL and CRL level by the end of the Hub." And "Please state the technologies being researched and their current technical proximity to the market in terms of technical readiness (TRL) and commercial readiness (CRL). Please note that these should be updated values to those provided in the baseline surveys."

The Hub has produced 2 key outputs to date, including its contractual landscape mapping

Beyond research under the specific themes, the Hub has produced 2 key outputs to date. First, it undertook an infrastructure survey for UK Research and Innovation (UKRI) titled 'Future Opportunities in Maritime Research and Commercialisation Scale-up of Infrastructure' (not publicly available). This involved researching over 100 academic institutions, 100 companies and more than 50 groups. It summarised the UK-wide clean maritime current research and innovation infrastructure assets and which gaps the Hub could fill to accelerate research in the sector.

In addition, as required by the contract, the Hub has produced the Landscape Mapping and Gap Analysis, published in the Journal for Green Energy and Sustainability. [71] The article sets out the research needed to decarbonise the maritime sector and should support the wider research environment by helping to identify where additional research is needed. According to Research Gate, this has been cited by 1 other academic article at the time of writing.[72] The Hub article also has 46 downloads from the Ulster University research website.[73] This is likely an underestimation of total reach, given it can also be found on several other websites, such as Pivot Science Publications and Durham Research Online, which do not appear to disclose viewing or download figures.

The Hub is funding other research projects

As well as conducting its own research, the Hub funds other research projects. It has set out 3 waves of funding for this year, with 8 applications under review at the time of publication. This compares to a KPI of 30 projects funded by the Hub over its lifetime, of which 10 should be funded by matched contributions. Impacts are not yet expected from these research projects.

Policy

Policy influence is a core aim for the Hub

The Hub has an explicit focus on policy influence. The funding call included: "Deliver papers with policy recommendations for the clean maritime sector for DfT and wider UK Government to consider," as part of the Hub's scope. Smaller research projects would have been unlikely to have this specific focus on policy outcomes, pointing to additionality of the Hub.

In order to fulfil this scope, the Hub has a Clean Maritime Policy Unit. It has been involved in conversations with DfT, including presentations of 2 working papers, 'The Implications of Green Seaworthiness on the Insurability of Risk' and 'Determinants of the Price Premium for

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[71]   Ling-Chin et al (2024). Research and innovation identified to decarbonise the maritime sector.

[72]   W Yifan et al (2024). Modelling environmental life cycle performance of alternative marine power configurations with an integrated experimental assessment approach: A case study of an inland passenger barge [Accessed 8 August 2024].

[73]   The Ulster University website [Accessed 8 August 2024].

Eco Vessels' and discussions on maritime fuel priorities following on from the Biomass Strategy (2023) with DfT. In addition, they have engaged with MCA (on the Determinants of the Price Premium for Eco Vessels) and the Department for Energy Security & Net Zero (DESNZ) around low carbon fuels.[74] Further conversations with DfT, DESNZ and the Scottish government have been planned.

Evidence suggests this policy focus has been beneficial for some organisations in the Hub. As shown in Figure 77, 4 out of 13 Hub organisations reported benefits in terms of improved policy engagement skills. In addition, the Hub lead commented that the ability to influence policy has increased industry buy-in:

> *"We already had lots of engagement with shipping companies, but the opportunity to have an input into potential policy and informing policy allows you to engage more widely than you were."*

The Hub

The Hub's policy influence has been limited compared to its key performance indicators

Despite some progress in this area, the Hub is currently not on track to achieve its KPI of 10 policy documents across the year, with only 1 white paper and working paper delivered so far. It had been unable to appoint a Policy Fellow who can drive policy engagement, primarily due to recruitment issues as discussed in the process evaluation (see Section 5.3), although the Policy Fellow has now been appointed.

In addition, 1 stakeholder felt that they were not able to have the scale of policy influence they would like because of limited funding:

> *"We don't have the resource that we need to do [policy engagement] on the scale that would be really beneficial to DfT."*

The Hub

Skills and expertise

Organisations have reported increased skills as result of participating in the Hub

As part of year 1 monitoring data, universities involved in the Hub reported the skills they had developed as part of their work. Figure 77 shows the number of responses to these questions, with 'Collaborating and partnering' (11 of 13) and 'Technical skills or knowledge' (7 of 13) being the top responses. Considering specifically the skills relevant for research (compared to broader 'soft skills'), 12 of 13 organisations reported improving at least 1 'Technical skills or

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[74] The Biomass Strategy (2023).

knowledge', 'Scientific research skills', 'Problem solving' and 'Strategic thinking'. Qualitative responses to these questions also show that skills have been improved:

> *"The scientific research skills (and the technical skills/knowledge) have been enhanced through conducting research related to the Hub; e.g. [university] have been conducting research on the marine insurance aspects of environmental regulations, an area in which there was no significant prior expertise."*

Hub end-of-year-one monitoring data

Figure 77   Did participation in the Hub result in the development of any of these skills?
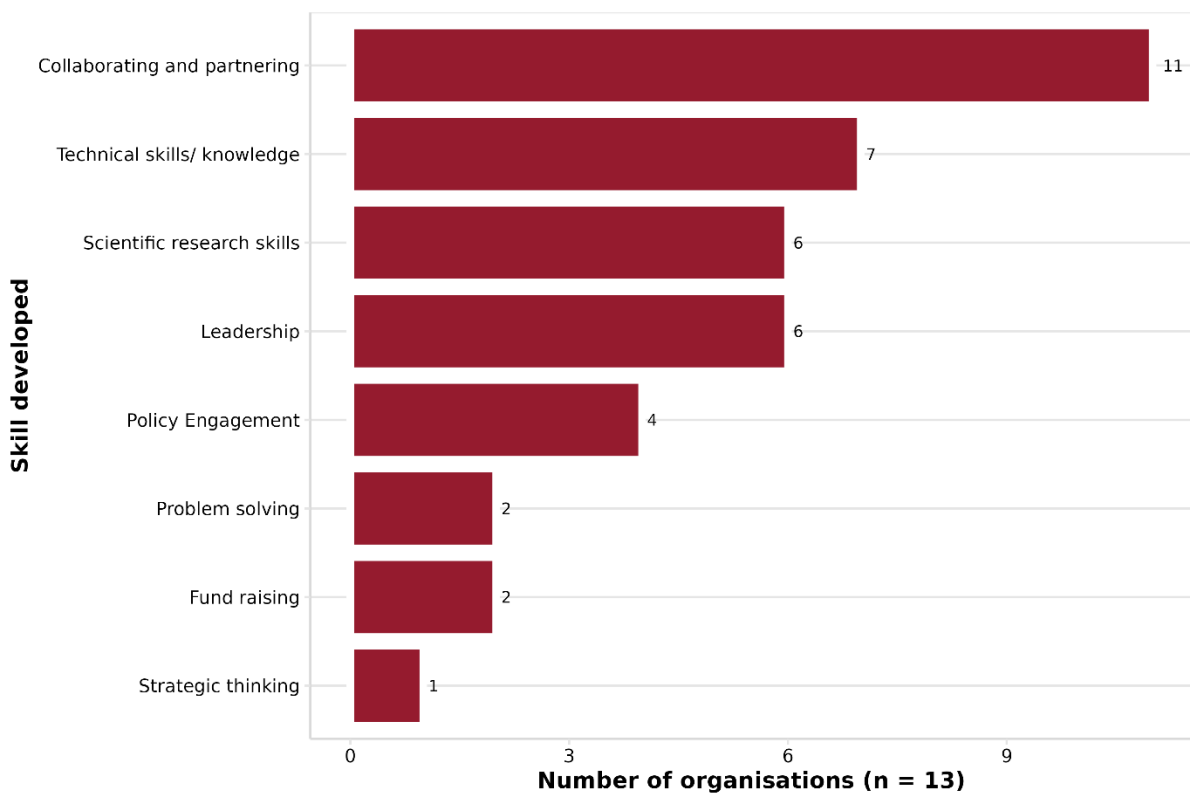
Source: Frontier Economics.
Note: "Did participation in the Hub result in the development of any of the skills listed below for the work force associated with the hub in the previous year? Please select the top 3 that apply."

Universities involved the Hub reported that they employed 210 'subject matter experts' in baseline monitoring data. In end-of-year-one monitoring data, they reported 116 subject experts employed.[75] Of 13 universities, 10 reported more subject matter experts employed in the Hub at the end of year 1 compared to the number at baseline.

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[75]   Question: "Please state the number of people associated with the hub considered to have maritime related subject-matter expertise. This may include academic staff, technical staff, or any other staff (permanent or temporary) that can be considered as having maritime related subject-matter expertise. This may include individuals previously considered as

The Hub is helping to improve the skills of Early Career Researchers

Moreover, the Hub is helping to support the development of Early Career Researcher skills, in line with expectations set out in the Hub funding call:

> *"The Hub should actively support career development across all career stages in the clean maritime sector. A key focus should be on early career researchers, including provision of targeted flexible funding opportunities."*

Clean Maritime Research Hub Funding Call

Its first wave of funding directly targeted Early Career Researchers and all applicants came from this group. In addition, the Hub is establishing an Early Career training programme to build capacity and skills across the maritime research community.

Collaboration and knowledge sharing

The Hub is taking a co-innovation approach to research, putting collaboration at the centre of what it does. The Co-Innovation Impact Group includes the Hub's Research Theme Leads plus stakeholders from the Port of Dover, Teesport, Belfast, Liverpool Freeport and the Port of Felixstowe.

There have been collaboration benefits within organisations involved in the Hub

Evidence suggests organisations involved in the Hub have benefitted from collaboration, with 11 of 13 Hub organisations reported improving their collaboration skills (shown in Figure 77). The Hub has formed new connections, as 2 organisations reported in baseline monitoring data that they had not collaborated with any other members of the Hub before.

> *"The Hub has brought together all of the required skills from across academia to undertake a holistic approach. Strong sense of teamwork already apparent."*

Hub end-of-year-one monitoring data

Each of the 5 research themes includes multiple universities across the Hub, and the Co-Innovation Impact Group includes the leads of each theme. One applicant identified that a key benefit of the co-innovation approach is the ability to prevent silos between those working on each research theme.

Collaborations include other academics and research bodies

The Hub's contact list has grown from 152 to 1,401 members, exceeding its KPI of 300 members by the end of the year; this points to a significant success of the Hub to date. With reference to this growth in contact list, 1 stakeholder highlighted the connections made so far has been the main impact of the Hub:

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maritime experts, or individuals who have gained maritime related expertise through work with the hub (eg a combustion engineer who gained maritime context expertise via involvement with hub research challenges)."

"In terms of impact, primarily at the moment that's measured in terms of our interactions."

The Hub

Additionally, researchers from the Hub have presented at 7 conferences and it is on track to deliver their KPI of 12 presentations annually. In February 2024, it held its Clean Maritime Research Partnership workshop, and achieved the feedback and attendance KPIs. The event achieved maximum capacity (60 attendees, compared to a KPI goal of 30 attendees minimum) alongside a waitlist and received more than 75% positive responses (which was the goal) on event feedback surveys. The Hub's first conference 'The Clean Maritime Research Conference' was held on 3 July 2024, although no monitoring data is available to assess its success.

The Hub has engaged with key groups in this area, such as the Hydrogen Delivery Council, Innovation Zero, Society of Maritime Industries and CPC. Engagement has also been at an international level, for example, with the Hydrogen Europe Research Group. There is no benchmark against which to compare collaboration with these groups.

Collaborations include industry partners

Monitoring data provides evidence of improving industry collaboration. Eight (of 13 total Hub organisations) are involved in 17 projects with industry (meaning 5 organisations were not collaborating with industry according to the end-of-year-one monitoring data). Notably, 5 of these projects were CMDC4 projects (benefits from the portfolio-wide evaluation are discussed in Section 9.6). Collaboration includes a wide range of stakeholders, including shipping companies, fuel producers and ports.

In addition, Figure 78 shows that 11 out of 13 organisations agreed or strongly agreed that the Hub has improved their collaboration with industry. No organisations disagreed with this statement. Qualitative responses supported this finding:

"The increasing number of collaboration with industry and other institutes also reflects our development in capability, facility and networking."

Hub end-of-year-one monitoring data

Figure 78   Our connections with industry have improved as a result of participation in the Hub
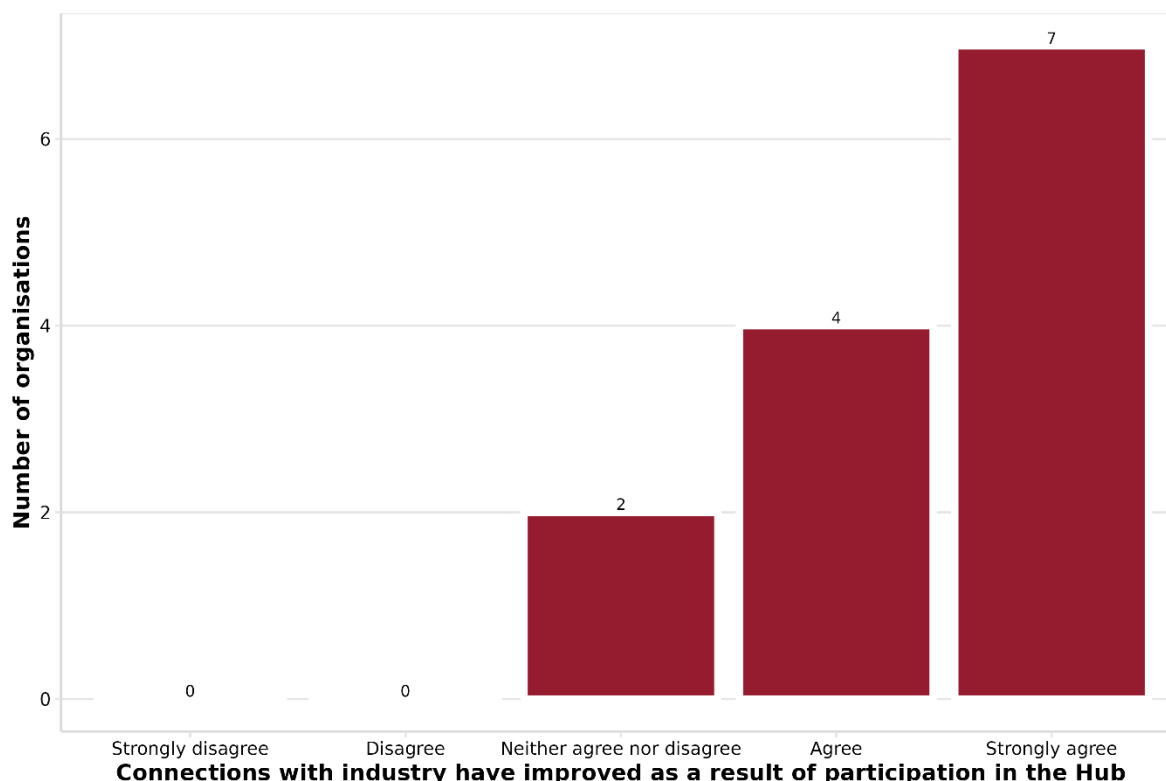
Source: Frontier analysis of end-of-year-one monitoring data.

Note: n = 13. "Please rate your agreement with the following statement: Our connections with industry have improved as a result of participation in the Hub."

Collaboration enabled by the Hub's scale is the main driver of additionality

During qualitative research, 1 stakeholder felt that the main additionality of the Hub, as compared to funding for individual research projects, is its large scale and profile. This has enabled collaboration with academic bodies and industry.

Regarding academic bodies, the Hub has been able to engage with other relevant large research centres, such as the Faraday Institution and the Supergen Hub. Findings from these research centres further support clean maritime research. In this way, the Hub is involved in knowledge sharing and gathering and the stakeholder felt this was important given the multi-disciplinary nature of the challenges. Researchers at the Hub have been involved in groups that they would likely not have otherwise been involved with.

> [With reference to a recent seminar on hydrogen and its uses]: "I was invited because of the Hub. The profile has been raised in terms of the work, the research that we're doing and moving on to do."
>
> **The Hub**

In addition, the stakeholder highlighted the funding of a professorship by a shipping company as an example of the benefits of collaboration with industry due to the Hub's scale and scope, as this investment would have been unlikely with a smaller project:

> *"If it was just a small project, we'd never have got that interest and that kind of investment. It triggers more buy in from stakeholders and more sense of an idea that something more tangible is going to come out from the activity."*

The Hub

The participant felt that the industry's desire to get involved was driven by the fact that the Hub provides the opportunity to influence policy in a way that individual, smaller research would not.

8.2   Environmental benefits

No evidence is available to assess EQ 2: To what extent, and through what mechanisms, can environmental benefits be attributed to UK SHORE?

Given the low TRL of their research, it is not expected that the Hub will have delivered environmental benefits at this stage.

8.3   Commercial opportunities

This section presents the initial findings on EQ 3: To what extent, and through what mechanisms, did UK SHORE improve the commercial prospects and opportunities for clean maritime in the UK? The relevant data and data sources for each sub-question under EQ 3 are reported in Table 41.

Table 41   EQ 3 data sources

Sub-question	Data	Data source
To what extent was additional private investment crowded in for developing clean maritime technologies?	Match funding	End-of-year-one report
How far have commercial benefits for UK business been realised or are expected to be realised in future for clean maritime technologies?	Collaboration with industry	End-of-year-one report, end-of-year-one data and stakeholder interviews
	Change in CRL	Baseline and end-of-year-one data

Sub-question	Data	Data source
To what extent did UK SHORE facilitate IP to be generated and retain in the UK for clean maritime technologies?	Patents progressed	Monitoring data
What wider policy changes have been facilitated by UK SHORE to address barriers to commercial deployment of clean maritime technologies that might otherwise exist?	Hub research themes	Monitoring data and stakeholder interviews

Source: Frontier Economics.

8.3.1   Evaluation evidence

Collaboration with industry may enable commercial benefits going forward

Evidence in EQ 1 (sub-section Collaboration and knowledge sharing) identified that a key benefit of the Hub has been its engagement with industry, in particular through the Co-Innovation Group. Going forward, this group will give the Hub the opportunity to see the 'real-world' impact of its research, providing a greater focus on the commercial benefits for the Hub. Industry collaboration with the Hub also suggests that the Hub will likely have commercial benefits: industry would not collaborate with the Hub unless it thought there would be benefits. However, at this stage, it is too early to say whether follow-on commercial benefits, such as improved revenue and profits, have resulted from this collaboration.

There is no evidence of CRL progress to date and CRL progress is expected to be lower than TRL progress

As with technology readiness, the Hub lead was asked about the CRL of each research project at baseline and end of year 1. In addition, they were asked what they expected CRL to be by the end of the Hub. Similar to TRL, it is impossible to match all projects across the 2 surveys (see Section 8.1 for more details). Of the 3 projects which can be matched, 2 saw a 1-level fall in CRL and 1 did not reported a baseline CRL. As discussed in Section 8.1, the Hub lead was not able to explain these results when asked in interviews.

Figure 79 displays the average CRL reported for each measure. Projects are only expected to improve by around half a CRL, which is lower than the expected improvement in TRL. This suggests that the Hub is expecting to have a larger impact on technology than on commercial readiness (this is expected given the academic nature of the Hub and its focus on low TRL projects). In addition, the reported CRL fell from the baseline to the first year. As with TRL, this may be driven by the fact that there are additional projects in the first-year data which are not reported at baseline, suggesting this could be driven by the Hub taking on additional, lower CRL projects. Therefore, it is difficult to draw strong conclusions about the impact of the Hub from this data, and improvements to data collection may aid future evaluations (as discussed in Section 8.1).

Figure 79 Current and future CRL
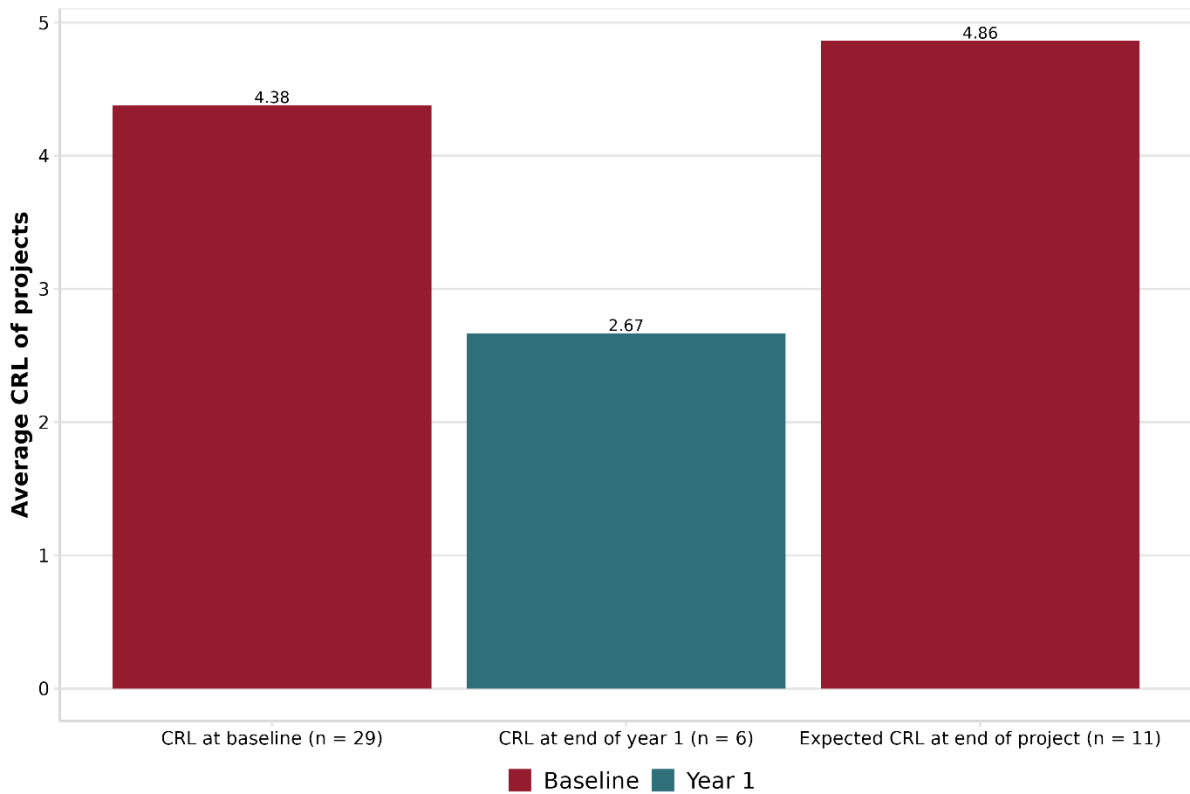
Source: Frontier analysis of baseline and end-of-project monitoring data.

Note: "The work of the hub includes researching the feasibility of technical innovations. Please state what technologies will be researched, their current technical proximity to the market in terms of technical readiness level (TRL) and commercial readiness level (CRL), and the expected TRL and CRL level by the end of the Hub." And "Please state the technologies being researched and their current technical proximity to the market in terms of technical readiness (TRL) and commercial readiness (CRL). Please note that these should be updated values to those provided in the baseline surveys." Baseline projects are not the same as end-of-year-one projects.

The Hub's work may also have indirect commercial benefits

The Evaluation Framework identified that internationally-recognised maritime research within the UK could support commercial prospects by encouraging inward investment. Although it is too early to assess the extent to which the Hub is 'internationally leading', indicative evidence (as covered in EQ 1) suggests the Hub is beginning to work at an international scale (eg collaborating with international organisations such as Hydrogen Europe Research Group).

In addition, 1 of the Hub's 5 key themes, 'Digitisation, marine operations, and finance' (theme 5), includes research into the effects of decarbonisation regulations on marine insurance and shipping investment. This may create commercial benefits for businesses involved in this area.

Some evidence is available for other benefits identified in the Evaluation Framework

The Hub has not achieved additional match funding beyond the match funding secured as part of the application. The Hub is expected to secure match funding for a further 17 months compared to the 43 months required at application (60 months total). Data is not available to

understand what is driving this, although the Hub plans to focus on achieving further match funding going forward:

> *"This remains a priority for the Hub and a number of new avenues are being explored."*

Hub end-of-year-one report

The Hub is progressing 1 patent. No benchmarks are available to assess whether this can be deemed as a success at this stage.

8.4   Spillover benefits

EQ 4 asks: To what extent is there evidence that UK SHORE has generated positive spillover benefits?

As noted in EQ 1, the Hub is engaging with academic bodies in related fields, such as hydrogen and fuel cells. Findings from the Hub research may spill over into other sectors via this collaboration, but it is too early to assess the extent to which this has been achieved.

8.5   Wider social benefits

This section presents initial findings on EQ 5: To what extent has UK SHORE achieved wider social objectives? The relevant data and data sources for each sub-question under EQ 5 are reported in Table 42.

Table 42   EQ 5 data sources

Sub-question	Data	Data source
To what extent has UK SHORE contributed towards levelling up of coastal areas?	Regional distribution of Hub organisations and collaborators	Baseline data and end-of-year-one report
To what extent has UK SHORE contributed to sustaining or creating jobs in the UK in the clean maritime or related sectors?	Jobs created	End-of-year-one data
	Green and highly skilled jobs	End-of-year-one data

Source: Frontier Economics.

8.5.1   Evaluation evidence

Job creation has occurred, but there is no good benchmark against which to compare these figures

In its first year, the Hub involved the participation of 28 FTEs, of which 10 jobs were newly created for the Hub. Except for 1 administrator role, all jobs participating in the Hub are in green, high-skilled roles. No benchmarks are available against which to compare this figure, although the newly-created roles are specific to the Hub funding. The increased capacity also provides early evidence that the Hub may be conducting additional clean maritime research, conferences and policy influence than would have occurred without the Hub (relevant for EQ 1).

The Hub's organisations and the stakeholders it collaborates with are distributed across the UK

Figure 80 shows the geographical distribution of the organisations involved in the Hub. Participating universities are spread across the UK, including 3 of the 4 UK countries (there are no organisations from Wales) and all the regions of England (except for South West England). This multi-regional approach aligns with expectations as part of the funding call.

The funding call also sets out the expectation that the Hub will work with stakeholders across regions. The Hub is achieving this through its Co-Innovation Impact Group, which works with ports across the UK (shown in Figure 80). The approach aims to understand the geographic challenges of each area and benefit all parts of the country. The Hub collaborates with ports in Dover, Teesside, Belfast, Liverpool and Felixstowe; 2 of these are in the South East of England, but the others have a broader distribution. Interviews with the Hub identified that the ports were chosen for the variety of services they focus on (such as container ports or 'roll-on, roll-off' [RORO] ferry ports).[76]

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[76]   Roll-on, roll-off (RORO or ro-ro) ships are cargo ships designed to carry wheeled cargo such as cars.

Figure 80   Locations of the organisations involved in the Hub
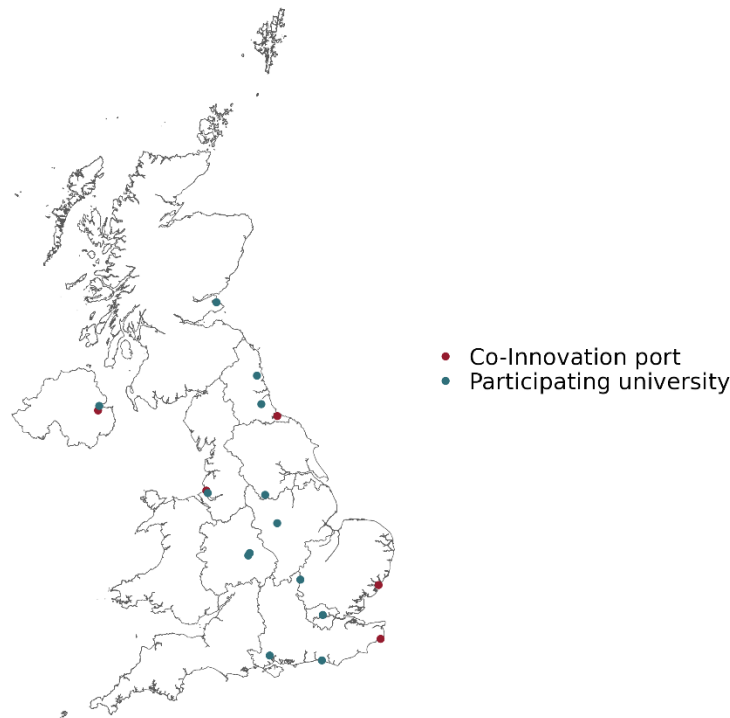
Source: Frontier Economics.

8.6   Overall findings and recommendation

The Hub is performing well against its KPIs, research targets, conferences, and policy output. It is unclear whether these outputs are additional or would have been produced without the Hub. Given the long lead times on academic research, publications to date are likely not fully additional. However, the co-innovation approach and engagement with other academic bodies (such as the Faraday Institution) will likely enhance the research output in the longer term. Job creation also suggests additionality for future outputs, but it is unclear whether the new jobs would have been involved in outputs produced to date. In addition, it is too early to understand the quality and reach of the Hub's outputs.

The Hub's policy work is likely beyond what might have been achieved without it since it has a unit focussing on policy influence and has been involved in multiple engagements. One participant has suggested that industry is engaging with the Hub to influence policy. Nonetheless, there is evidence that this work is at a smaller scale than expected, with DfT's desire for increased policy work and issues with recruitment.

Average TRLs and CRLs suggest that projects the Hub is working on have seen TRL and CRL regression, but this is not a comparison of like-for-life projects. **To better assess the TRL and CRL development of the Hub projects, it would be beneficial to assign each project a unique ID so they can be compared across multiple project sources.**

Evidence of expected TRL and CRL improvements suggests that the Hub is likely to have a greater impact on technology development than commercial development. However, industry engagement with the Hub implies that businesses expect to see benefits from engagement.

Organisations within the Hub have reported benefits from collaboration, and the Hub has engaged with a wide range of stakeholders across industry and academia. Evidence suggests the key additionality of the Hub has been in bringing researchers together and creating a sizeable body with buy-in from other researchers and industries, putting an increased focus on clean maritime research. If the Hub was operating at a smaller scale or if the research was being undertaken in small research projects, some outcomes may not have been possible. This enables clean maritime to have a role in broader research and could lead to spillover benefits in the future.

Evidence suggests the Hub is contributing to wider social objectives, with a distribution of organisations across the UK and a small number of new high-skilled, green jobs involved in the Hub.

The Hub lead highlighted that there has been significant support for the Hub from both industry and academia, although this must be caveated as it is the view of the Hub itself. Other stakeholder interviews have not tested the impact of the Hub specifically:

> *"I think the enthusiasm for the Hub from the wider community has demonstrated that the Hub was necessary."*

The Hub

9 Interim impact evaluation findings – Portfolio-wide

This section draws on the scheme-level evidence, wider stakeholder interviews and the portfolio-wide summary statistics presented in Section 3. It provides an early understanding of the portfolio-wide impact of UK SHORE, considering each EQ and providing a summary of findings and recommendations. An early VfM evaluation (Section 9.8) is included.

These findings should be considered in light of the fact that evidence to support this interim impact evaluation has only been collected for CMDC1 and CMDC2; TRIG21 and TRIG22; and the Hub. The impact of later CMDC rounds and ZEVI has not been assessed, meaning that any emerging portfolio-wide findings can only be a partial picture at this stage. In addition, even for the schemes included, it is too early for all the benefits (such as job creation and environmental benefits) to have been observed and assessed. The final evaluation is expected in 2025 and will include a more thorough portfolio-wide impact evaluation and VfM evaluation.

Sections 9.1 through 9.5 draw on the scheme-level assessments made in this interim impact evaluation to provide a summative assessment of the UK SHORE portfolio. Section 9.6 considers broader evidence of benefits emerging across the schemes.

9.1 Development of clean maritime technologies

The portfolio has supported a range of technologies at different TRLs for use in a variety of applications

Interviews with DfT identified that a clear strategic objective of UK SHORE was to address all scales of TRL:

> *"From the beginning … there was always a clear strategic objective behind the UK SHORE programme that we wanted to address challenges at all levels of the technology readiness scale."*

> DfT

Early findings suggest that this objective is being delivered. The schemes within UK SHORE support a range of TRLs, as shown in Figure 17. The portfolio has also been able to target a range of technology types (see Figure 18), such as batteries, fuel cells or engines with ammonia fuel, for use in vessels, port infrastructure or more specific foci such as green shipping corridors.

Funding is supporting technology development, although data limitations inhibit the ability to measure this

Including all schemes (those assessed in this interim evaluation, ZEVI and later rounds of CMDC), UK SHORE has funded 175 research projects. The Hub is also conducting and supporting additional academic research projects with 10 projects reported in its first annual monitoring data. For the schemes of focus for this interim impact evaluation, where it has been

possible to review end-of-project data, many projects feel they have achieved their project goals.

While supported firms generally self-report success (79% across CMDC and TRIG schemes), there are some limitations of the data available on specific measures of success, such as TRL progression, as discussed in detail throughout this report. This included discrepancies between measures of TRLs reported at the start and the end of projects and self-reported views on whether technologies had progressed. The reasons for these differences are not clear, though stakeholders noted some limitations in the use of TRL as a measure of project progress in isolation:

> *"From my perspective, [TRL] is quite useful but it's really only to do with technology and not all of the solutions are directly technology related… Not everything can be fully described in terms of TRL."*
>
> DfT

Early signs suggest that UK SHORE has benefitted the clean maritime academic sector

One stakeholder highlighted that UK SHORE has particularly benefitted academia, with universities not previously involved in maritime research now taking part. Specifically, they stated that from what they knew, prior to this, less than 10 establishments had been involved in marine-related activities. The participant was also confident that the partnerships between universities and SMEs would be 'durable'. Monitoring data suggests that academic organisations have been involved in all UK SHORE schemes. Of the organisations involved in CMDC and ZEVI, 8% were academic and received around 8% of the total funding for these schemes. Of the 26 lead TRIG21 and TRIG22 organisations, 4 were academic institutions. In addition, the Hub is comprised entirely of academic organisations. This engagement and involvement of academia could have positive implications for future technological developments in clean maritime; academics can develop low TRL technologies, which can be taken forward by firms and commercialised in the future:

> *"Traditionally, there was only 5 or 6 universities in the whole of the UK that did anything to do with marine and another couple dabbled occasionally. Now there's more."*
>
> Industry stakeholder

Collaboration consistently emerges as a key benefit of UK SHORE schemes

Across each of the schemes included in this interim impact evaluation (CMDC1 and CMDC2, TRIG21 and TRIG22, and the Hub), organisations reported positively on the collaboration effects of the scheme. TRIG projects felt that collaboration was important for project success and further development, for example, when entering funding bids with partners. For the Hub, significant collaboration with industry and other academic bodies has been possible because of the Hub's scale and has provided funding and insight from other academic bodies. Across

schemes, projects felt that these collaborations would continue beyond the end of the scheme. These collaborations will likely aid technology development:

> *"It's led to some really fruitful collaborations between universities and SMEs that wouldn't have happened … The partnerships that have spun out of this [UK SHORE] will be durable. People will continue to work together."*

Industry stakeholder

Based on interviews with DfT, knowledge sharing is 1 of the key intended benefits of UK SHORE. The understanding developed by projects within UK SHORE can be demonstrated to the rest of the sector, expecting that once larger projects funded by ZEVI complete their operational phase, this will set a strong example for the industry, and the understanding can be shared more broadly.

9.2   Environmental benefits

At this stage, evidence does not suggest that the UK SHORE portfolio has resulted in significant emissions reductions. The business case did not expect emission savings from CMDC2 until 2025, and no emission savings were modelled for TRIG. For CMDC1, emission savings were expected from 2023. Across different parts of the portfolio, there are challenges in developing a common way to capture actual or potential environmental benefits given the different technologies and TRLs of projects within the scope of UK SHORE. Therefore, it is impossible to assess whether the CMDC1 business case assumptions have been met.

Emission savings will likely be a longer-term outcome of some projects. For example, many CMDC1 and CMDC2 projects are expecting to have 'gamechanger' or 'considerable' effects on the levels of emission reduction either across the energy system or in a specific sector or region (as shown in Figure 40 and Figure 41).

9.3   Commercial opportunities

Evidence suggests that the portfolio has unlocked investment, with qualitative indicators that funding is at least partly additional

A total of £120 million of match funding has been raised to support all UK SHORE projects (ZEVI and later CMDC rounds, as well as projects included in this interim evaluation), equal to half of the public value of UK SHORE grants. Monitoring data provides evidence that additional funding has been raised to support CMDC projects during the project (about 20% of projects, from monitoring data) and to support the project's next steps (63% have or expect to have follow-on funding, from survey data). To a lesser extent, additional funding (through grants or internal or external investment), was also raised by TRIG projects. Of 26 projects, 6 reported receiving additional investment and 12 reported receiving grant funding.

In stakeholder interviews, DfT commented they had received feedback from industry that investment would not have taken place without government funding and that UK SHORE has given industry given direction as a result:

> *"That then unlocked their internal business cases within their organisations, enabling them to put up money that otherwise wouldn't have been spent in the space."*

DfT

Another stakeholder felt UK SHORE encouraged risk-taking and innovation within the industry:

> *"It has completely changed the relationship with government and research because it has created a mechanism where companies can get funded for doing things that are innovative."*

Industry stakeholder

This interim evaluation has looked at lower TRL schemes (the Hub, TRIG, and CMDC1 and CMDC2). Therefore, the extent to which commercialisation has been a sufficient focus of UK SHORE is hard to judge. However, 1 stakeholder commented that more commercial focus would be desirable. Our findings illustrate other commercial benefits besides co-investment. These include:

■ around two-thirds of CMDC1 and CMDC participants reported increased CRL, and around half reported financial benefits (in terms of sales revenue, licensing revenue, cost reduction, or other financial effects)

■ the Hub engaging with industry to a significant extent through their Co-Innovation Group, suggesting industry are expecting to see commercial benefits

■ TRIG projects benefitting from private sector connections (9 of 11 TRIG22 projects, including additional qualitative evidence from TRIG21), improved market understanding and skills relevant for commercialisation

9.4 Spillover benefits

At this stage, we have not identified specific spillover benefits from UK SHORE. Spillovers will be reviewed as part of the final evaluation in 2025 but may be expected to emerge in the longer-term as part of future evaluation work.

9.5 Wider social objectives

The term 'wider social objectives' refers primarily to job creation and regional growth effects.

Regional growth effects

Section 3.2 and Section 6.5 discuss the regional spread of CMDC and ZEVI funding, as well as of CMDC1 and CMDC2 funding, respectively. Overall, UK SHORE funding has been concentrated in South East England (£67 million), with Scotland (£33 million) and the North West (£30 million) receiving the second and third largest funding amounts, respectively. It is difficult to assess the extent to which this spread of funding aligns with regional growth impacts since specific targets for regional funding are not in place. Forty-two percent of CMDC and ZEVI funding has been allocated to the Greater South East (South East, East of England and London). This is slightly lower than the proportion of total government R&D funding going to these regions (52%), suggesting that UK SHORE funding may be less concentrated than other public R&D in those regions.[77] Later CMDC rounds (CMDC3 and CMDC4) are more regionally spread than earlier CMDC rounds and ZEVI.

Notably, though, the distribution of investment for clean maritime R&D will be guided in part by the location of businesses and researchers active in this area. Specific regions of the country have a comparative advantage in clean maritime research (as highlighted in Section 6.5.1), so a more substantial proportion of funding would be expected to go to these regions. It is also expected that there will be a bias towards coastal regions (as set out in Section 3.2). Half of all projects surveyed reported coastal areas as the primary area of project delivery. Benchmarks are not available to assess this metric.

For the Hub and TRIG, data is not available to assess the regional spread of funding. For the Hub, it is possible to assess the geographic spread of organisations involved (see Figure 80): organisations are distributed across almost all the UK regions (except Wales and the South West).

As well as the spread of funding, it is important to consider the extent to which benefits from UK SHORE schemes are spread across the country. Limited evidence is available at this stage, but the impact evaluation of CMDC1 and CMDC2 finds that organisations in the South East saw the largest financial benefits (see Table 31). These benefits reflect where an organisation is based, which may not align with where the benefits are felt.

Job creation

Given the early phase of delivery of UK SHORE, it was not expected that significant job creation would be observed at this stage. Based on self-reported data, in particular from CMDC1 and CMDC2, there is some evidence of projects helping to create or retain high-skilled and green jobs, with further job creation expected within the next 5 years and CMDC2 job creation in line with the business case. However, the additionality of this is unclear, and there do not appear to be early signs of broader portfolio-level effects. In stakeholder

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[77] The 2019 to 22 Johnson Conservative Government's Levelling Up White Paper's technical annex: missions and metrics (2022), included an objective to increase domestic public R&D investment outside of London, the South East and East of England by 40% by 2030, with UK SHORE funding counting as public R&D. Specific objectives for regional growth are not set out for the new government (2024) at this stage.

interviews, 1 stakeholder identified jobs as a key secondary benefit that is occurring as some technologies move through TRLs.

9.6   Portfolio-wide impacts

The Evaluation Framework set out some specific portfolio-wide impacts to test as part of the evaluation. First, the portfolio nature of UK SHORE as projects and technologies develop and move between schemes, and the extent to which this adds value beyond the schemes being run in isolation. Second, activities delivered across UK SHORE to help disseminate and join the schemes. The interim evaluation has focused predominately on scheme-level impacts, so, at this stage, there is limited evidence on these portfolio-wide benefits, which will be tested further in the final evaluation.

No evidence has been found to show the potential impacts of UK SHORE-wide activities for dissemination. However, some relevant evidence is available on the extent to which projects develop and move between schemes. A key aim for DfT when designing the portfolio was to support early TRL schemes that could progress to higher TRL schemes. This is evident from business cases, such as the TRIG business case which identified a measure of success as: "Creating a pipeline of projects for future UK SHORE programmes" and interviews with DfT. This section presents evidence on whether this has been achieved:

> *"We did want projects to feed through and we do have some projects now that have … gone from initial idea only two years ago or kind of a very early concept through to something that's commercial – brilliant … That's kind of the strategic aim."*
>
> DfT

There is evidence that organisations received UK SHORE funding through multiple schemes

Of the 371 organisations who received funding from these schemes, 30% (110 organisations) received funding from multiple schemes (including 7 organisations, which were funded by 5 of the 6 schemes). Table 43 shows the percentage of organisations from each scheme that received funding from at least 1 other scheme. Between 42% and 70% of the organisations from each scheme received funding from another scheme, and these rates were highest for both TRIG rounds, The Hub and CMDC2. This provides indicative evidence that the portfolio nature of UK SHORE allows organisations to gain continued financial support to help progress clean maritime technology.

Table 43 Organisations receiving funding from multiple competitions by scheme

Competition	Total number of organisations	Percentage receiving funding in other schemes
ZEVI	51	51%
CMDC1	166	42%
CMDC2	96	70%
CMDC3	83	54%
CMDC4	129	54%
TRIG21	13	62%
TRIG22	13	70%
The Hub	13	62%
All	371	30%

Source: Frontier Economics.

Note: Percentages are higher on average than the 30% reported for the portfolio level since firms who receive funding from multiple schemes are only included once in the portfolio level calculation but are included multiple times in the scheme level calculation. Analysis is based on matching firms on their organisation name.

The process evaluation (see Section 5.1) also identified that projects typically had good awareness of other schemes, with 90% of all survey respondents aware of CMDC1 through 4.

However, it is not necessarily the case that organisations receiving funding across multiple schemes are using this funding to develop the same project, nor that organisations would not receive funding if these schemes were organised individually rather than as a portfolio. The final evaluation will seek to understand whether organisations that received funding from multiple schemes benefitted from the portfolio nature of UK SHORE.

Increased interdependencies between schemes could improve the portfolio-wide impact of UK SHORE

One stakeholder highlighted minimal interdependencies between schemes such that projects must reapply for funding at the end of one scheme and the start of another. Projects are not guaranteed across multiple schemes, even if the outputs in the first scheme are a success. In addition, the lack of visibility about upcoming projects means organisations would bid for schemes which were not most ideally suited for them:

> *"If you knew it was going to be five years and what it was going to look like, it is unlikely companies would bid to every round. They would pick around and bid on the round that most suited them."*

In interviews, the DfT was aware of this issue and noted that it strived to provide early indication to the industry if a more appropriate competition was coming.

Nonetheless, a more unified approach might support a larger impact from the portfolio as a whole. For example, projects may benefit more from UK SHORE as a portfolio if there were clearer routes for progression from one scheme to another.

This being said, it is important the funding is not simply guaranteed to companies when alternative organisations may have more successful projects. In interviews, the DfT acknowledged that some companies received a number of different grants. The DfT took action to ensure that it targeted the advertising of schemes to address sub-sectors, organisation types and regions which had received limited grant support.

9.7   Overall findings and recommendations

UK SHORE is novel and is impacting the clean maritime sector, particularly through the development of technology

While it is still too early to assess the full range of outcomes and impacts of UK SHORE, the evidence presented in Section 6, Section 7 and Section 8 shows that individual schemes have begun to generate outcomes and impacts in line with those set out in the logic models in Annex E. The impacts have been strongest against EQ 1 (technology development) and there is good evidence for impacts in EQ 3 (commercial benefits) from the higher TRL schemes (CMDC1 and CMDC2).

Stakeholders felt that the UK SHORE portfolio markedly changed the maritime research industry. The funding is seen as particularly important post-Brexit, now that EU funding is no longer available. The programme has drawn more attention to the clean maritime sector, for example, appearing on the BBC or in the Guardian:

> *"The maritime sector has never had anything like this in the UK … A good change from where we were."*

Many of the UK SHORE's impacts are expected over the longer term

Stakeholders acknowledge that it will take a while for the full benefits of UK SHORE to play out. It will take longer for evidence of environmental (EQ 2), spillover (EQ 3) and wider social benefits (EQ 5) to emerge. However, some (particularly higher TRL) projects are reporting early benefits across these EQs. It is expected that more benefits will be realised by the final evaluation next year. However, many benefits will occur only over a much longer time horizon and will be captured by the longer-term evaluation methodology:

"What I really want to see is a return on investment, but that's going to be something that's going to take 5 to 10 years to fully display."

Industry stakeholder

In addition, in interviews, the DfT acknowledged that there is still more to do to support the sector through further funding and it believes this reflects the feeling of industry:

"I still think, and I think the industry would agree, that there is more to do on R&D over the coming months … Some of the technologies are very much closer to commercialisation than others … Some of the other fuel types, like hydrogen fuel cells and things like that, are much further away. So, you know, there's quite a lot to do to pull them through to commercialisation yet."

DfT

9.8   Value for Money (VfM)

The Evaluation Framework set out 3 key questions to be answered as part of a VfM assessment:

1. to what extent have UK SHORE and its component schemes demonstrated strategic fit with government priorities
2. to what extent have UK SHORE and its component schemes been delivered in an economic and effective way
3. to what extent are the socioeconomic benefits (monetised and non-monetised) of UK SHORE and its component schemes likely to exceed the public costs of delivery

The first 2 EQs are addressed in this interim evaluation. However, the third EQ cannot be addressed at this stage, given the need for a full impact evaluation to be conducted before assessing VfM. A more substantive VfM evaluation, including a cost-benefit assessment, is expected in the final evaluation.

9.8.1   Strategic fit

Any assessment of VfM first needs to show that a policy intervention provides a strategic fit with wider government priorities. By drawing on the evidence set out in the impact evaluation, this section assesses the extent to which UK SHORE supports 2 of the 5 government missions that are relevant to the programmes:[78]

1. kickstart economic growth, specifically "in every part of the country"
2. make Britain a clean energy superpower.

In this context, we consider the alignment of UK SHORE with Net Zero targets and regional growth impacts, investigated as part of EQ 5 and EQ 2, respectively.

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[78] Labour's Manifesto 'Mission-driven government'.

Alignment with Net Zero targets and trajectories

The extent to which UK SHORE has been able to achieve environmental benefits, and align with Net Zero targets and trajectories is discussed in Section 9.2. The evidence suggests that the UK SHORE portfolio has not yet achieved significant emissions reductions, although projects expect future benefits and there are difficulties in capturing environmental benefits across projects.

UK SHORE makes up only one part of a broader set of policies, funding and regulations to support the development of clean maritime technology as outlined in the Clean Maritime Plan (2019).[79] Limited evidence has been collected to assess the role UK SHORE played in this wider strategy, including the complementarities between policies and any potential overlap, but some anecdotal evidence is available. Other schemes, such as green corridors and local authority air quality plans, can create pull for UK SHORE technologies. The National Shipbuilding Strategy has a naval focus and is joined with UK SHORE via membership in the National Shipbuilding Office.

Alignment with regional growth impacts

The extent to which UK SHORE has had regional growth impacts is discussed in more detail in Section 9.5. It is difficult to assess this, given the lack of suitable benchmarks. Forty-two percent of CMDC and ZEVI funding is targeted at the 'Greater South East', lower than the proportion of total government R&D going to these regions (52%). Hub organisations are distributed across most UK regions.

9.8.2 Economic and effective delivery

VfM cannot be achieved without economic and effective delivery of the programme. This section assesses economic and effective delivery by comparing UK SHORE's anticipated costs and outputs with its achieved costs and outputs.

UK SHORE had a budget of £206 million, all of which was allocated to the schemes as expected. The total number of projects aligns with the expectations set out in the business case. There is no evidence of incomplete projects, and projects met expectations in terms of supporting a range of technologies and a spread of TRLs (see Section 9.1).

The process evaluation did not identify any obvious inefficiencies in the competition, mobilisation or delivery stages of UK SHORE. Projects did not identify issues with receiving their grant funding, and timelines stuck mostly to expectations. All UK SHORE schemes were built from previous successful projects, and learnings from earlier schemes were used to improve the process of later schemes.

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[79] Clean Maritime Plan.

Nonetheless, stakeholders identified potential areas for improvement in the efficiency of delivery from a UK SHORE perspective. For example, 1 industry stakeholder felt that some of the early projects should not have been funded but acknowledged that this only involved "small sums" of money. Another stakeholder who had applied unsuccessfully for funding commented on the opportunity costs for applicants:

> *"It is a poor commercial decision, especially for an SME, to spend that period of time without being paid on a completely speculative bid. It doesn't work, you know, and my feedback to Innovate at the time was … You need to have an expressions of interest stage."*

ZEVI Unsuccessful Applicant

While the portfolio-wide impact evaluation considers whether the UK SHORE portfolio delivered benefits beyond the individual schemes, it may also be that the portfolio-level approach to funding clean maritime R&D creates process efficiencies. This interim evaluation does not have evidence to suggest that there were efficiencies in the programme delivery because a single body delivered them; for example, because individuals were able to manage multiple schemes, costs were lower. However, there is evidence that the portfolio-wide approach supported well-designed schemes since later UK SHORE schemes were designed using learnings from the earlier schemes.

10 Key themes in the early findings and next steps for the evaluation

Several themes emerge across the process and impact findings, suggesting ways in which UK SHORE's delivery has affected the outputs and short-term outcomes. These themes are summarised below and are potential areas to be explored in greater depth in future stages of the evaluation.

Collaboration has been a key benefit of UK SHORE schemes

Participants have highlighted the benefits of collaboration and their success in working with collaborators across all schemes. Many CMDC projects have reported plans to continue working with their consortia, and some TRIG projects plan to apply for future projects with their collaboration partners. Bringing together partners has also raised the profile of clean maritime research (The Hub). Based on our early impact evaluation evidence, connecting organisations with others in the clean maritime sector appears to have been one of the major successes. In the longer term, based on the programme theory of change, these connections are likely to accelerate development and testing, whether by advancing the TRL of CMDC projects that have so far seen limited development or allowing the Hub to use the latest academic developments in other areas (such as hydrogen) to further clean maritime research. The short timeframe of UK SHORE activities to date means that it **may be useful to assess the extent to which collaboration has driven technological advancement in future evaluations so that we can confirm these expected outcomes are being realised**. Future evaluations should consider whether the portfolio-wide approach has supported increased collaboration and connections across schemes.

Project outcomes are challenging to report in a standardised way

UK SHORE works with different delivery partners to fund a wide range of different project types and technologies. As a result, it is difficult to report the realised and expected outputs and outcomes in a standardised way which is readily comparable across projects. This was highlighted in Section 6.2.1, which provides examples of the various emissions reporting units and standards used for CMDC, in Section 7.2.1, which shows a similar picture for TRIG, and in Section 5.4, which described how stakeholders that were interviewed found that fitting their project outputs and outcomes into UK SHORE monitoring templates can be challenging. The end-of-project reports for all schemes assessed in this interim impact evaluation provided unstructured data, meaning the organisations could report the information in their preferred way.

Although this approach provided depth of information for understanding an individual project in isolation, it is challenging to use unstructured data when comparing the realised project outcomes against those expected, aggregating outcomes at the scheme level and comparing the outcomes across projects or schemes. However, compared with other schemes,

unstructured data is more useful when assessing The Hub because there is only 1 organisation and data aggregation is not an issue.

Across all schemes, the lack of standardised project outcomes report may be responsible for the unexplained TRL results (see Section 6.1.1 for CMDC, Section 7.1.1 for TRIG and Section 8.1.1 for the Hub). These issues included reporting various different TRL responses within the same project and reasonably high rates of unexplained TRL regression (CMDC), a reported expected decrease in TRL for some projects (the Hub) and reported start and end TRLs, which did not match the projects' improved TRL report (TRIG). The specific reasons for the mismatches are not clear but might be because:

■ some projects' work did not fit neatly into TRL categories, leading to misreporting

■ in some cases, the TRLs genuinely regressed if UK SHORE support identified issues with the technology being developed

■ it is inherently difficult for individuals completing the data returns to assess TRL accurately

In addition, measuring TRL and CRL advances is somewhat biased against larger and more expensive technologies for which development is slower and advancement is harder. This is, in part, reflected in the TRL development across technologies in CMDC, although the small sample sizes may have limited the findings. This consideration will be particularly important when looking at higher TRL schemes (CMDC3, CMDC 4 and ZEVI) in the later stages of the evaluation.

One of the main purposes of UK SHORE is to financially de-risk investment in innovation, but UK SHORE has limited mechanisms for technologically de-risking innovation projects. Experimentation with new technologies should sometimes 'fail'. If all innovation projects 'succeed' in producing the expected outcomes, then opportunities for pursuing riskier research with higher expected value may have been overlooked. This means that it is expected that some projects experience TRL regression, particularly low-level TRL projects that may discover their technology does not work. TRL regression has been included in the UK SHORE business case expectations. Most of the medium- and long-term benefits of R&D projects are likely to be types of spillover effects, where the project results inform other collaborations, organisations, investments, implementations, or related technologies and may not occur in the maritime industry.

For this reason, different projects may report 'success' and 'failure' differently depending on their interpretation of the terms. A binary distinction between 'successes' and 'failures' may generally be counterproductive in innovation funding appraisal and evaluation. Reporting issues are also created when project plans change; for example, a project might produce useful knowledge outputs but not the expected project outputs. This issue may help to explain why, in Section 6.1.1, online survey and monitoring data responses about technological progression conveyed different patterns, and this interpretation of 'success' and 'failure' will be further explored in subsequent primary research.

In contrast to the binary indicator of success and failure used for CMDC, TRIG projects were asked at baseline to set out the outcomes they think would deem their project a 'success'. At the end of the project, they were asked whether these outcomes were achieved. While this is still not a perfect measure, it may be preferable as it moves away from a binary measure of success. However, it does not always overcome issues with measures of success as a result of changes to project plans. **Determining flexible, reliable, comparable and pragmatic formats for surveys and monitoring data on technology and environmental outcomes is a high priority.**

Industry experts are valuable to projects that face skills gaps

Staff with deeper expert content area knowledge could support more flexible project management and provide more confidence in the assessment process. Expert UK SHORE monitoring officers could more readily assess the logic of changes in the context of project objectives. This is related to the evidence in Section 5.4 that some interviewed stakeholders would have valued more technical, rather than project management, monitoring officers, and also reflected in Section 5.2, where interview participants raised concerns about the technical knowledge and experience of the bid assessors. Further, participants delivering projects, particularly in more research-based parts of UK SHORE (Hub or TRIG), highlighted concerns about recruitment and retention in the industry on a longer-term basis.

The evidence in this report pointed to several other areas where **projects would have valued more skills and expertise in maritime decarbonisation within UK SHORE**. Some projects reported difficulties navigating the relevant regulations and standards in writing their applications (Section 5.2). In future stages of the evaluation, it may be useful to understand whether there are particular types of organisations (such as SMEs) for which regulation and standards are particularly challenging. Interviewed stakeholders also reported that staff resourcing, recruitment and sourcing the right skills were barriers to mobilisation and delivery (Section 5.2). Survey respondents did not report that the existing support available for this had a strong impact on applications (Section 5.2). This suggests that more advice and support from UK SHORE about how to recruit the skills required would have been valued. Skills interventions may overlap with other initiatives outside UK SHORE, as skills may sit at the intersection of different departmental and agency remits. **It would be useful for UK SHORE to consider where and how skills gaps in maritime decarbonisation are being addressed (through DfT, Department for Education, Department for Science, Innovation and Technology, UKRI, CPC and local government), to review UK SHORE's current and potential role and collaborations in this area**.

Providing medium- and long-term certainty is an important aspect of de-risking innovation activities

Another element in de-risking innovation investment is providing medium- and long-term certainty and continuity of government support. DfT staff explained that initially, there was departmental interest in designing the UK SHORE portfolio, so that there were structural links between schemes. However, the final portfolio design has minimal interdependencies

between schemes, and projects must reapply for funding at the end of one scheme and the start of another. The portfolio does not guarantee funding across multiple schemes if the outputs of the first scheme are a success. In Section 5.3, some interviewed stakeholders reported that they had to self-fund the initial stages of a project because of a delay in receiving UK SHORE funding. **This may indicate that scheduling work plans around funding timelines may be difficult for organisations, and they may prefer rolling application windows. In future evaluation stages, it will be useful to explore whether and how this lack of certainty about follow-on funding affected applicants (to inform the design of future initiatives)**. It will also be useful to investigate the extent to which feasibility studies that found positive feasibility stage outcomes applied for and received funding in later schemes.

Annex A   Process evaluation questions

As defined by the Magenta Book (HMT 2020), a process evaluation asks: "What can be learnt from how the intervention was delivered". To answer this question, a series of sub-evaluation questions covering each stage of the process from competition design to delivery, have been developed incorporating the Department for Transport (DfT) feedback.

These evaluation questions (EQs) have been designed to cover all competitions within the UK Shipping Office for Reducing Emissions (UK SHORE) portfolio, although research materials are designed in conjunction with the process maps to ensure the relevant questions are raised for the individual schemes.

Table 44 Process evaluation questions

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
Scope	• Were clear strategic priorities or objectives set for the scheme? • Were these objectives linked clearly to the competition design? • What learnings were taken from previous rounds? How did these inform future rounds or competitions? • Was there any sense checking the scheme	• Were applicants clear on the scope? • Were scope and process queries managed effectively? • What could be improved?	• Was there an understanding of what projects were in-scope during the bid screening or review process? • How were the strategic priorities considered during the assessment phase? • To what extent were non-UK stakeholders or	• Were there any changes to project scope in the mobilisation phase? Why and how were these managed?	• How were project teams monitored to ensure their activities remained within scope? Was this effective? • Were the evaluation criteria for the competition assessment appropriate and fit for purpose?	• Was the scope communicated clearly to stakeholders or industry? • Were the resources or support available at this stage sufficient? • Were lines of communication clear when delivery partners (CPC and IUK) played a

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	design with partners, potential applicants or market before competition launch?		collaborators included in bids? • Did any challenges around capacity or multiple bids arise?			significant role?
Governance and Regulation	• Was an effective governance structure set up that was able to support the design of the schemes? • Did the scheme process align with existing governance structures or require new or	• How was the bid submission process managed? • What could be improved?	• Who defines the assessment process? • How was the scoring process decided (cut-off score for eligible projects and how total score is	• Were there sufficient governance arrangements in place to secure effective and timely mobilisation? • Were there any barriers or opportunities in relation to	• How were regulatory challenges during project delivery managed? • Did these impact project delivery? • Were the arrangements for change	• Were all applicants aware of the regulatory process within the maritime industry? • Were there any wider lessons learnt about regulation?

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	amended structures? • Were all partners clear on their role in the scheme?		calculated after the written and interview stages) and who is accountable for this? • What role did regulatory bodies like MCA play in the bid review process? • Did all parties, involved in the assessment phase, work together effectively? • How were conflicts or	regulatory issues in project set-up?	requests appropriate? • Was support provided to those facing regulatory difficulties? What type of support was this? Were risks and mitigations adequately managed?	

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
			• disagreements resolved? • What could be improved?			
Scheme Timeline	• How were timelines for the scheme decided? • Was time for bid preparation and mobilisation considered in the scheme design? • What learnings were taken from previous rounds? • How did these inform future rounds? • Was the promotion period,	• Were all interested applicants able to submit a bid application within the timelines provided? • What could be improved?	• Were feedback and outcomes provided in a timely manner? • Were interviews (CMDC3 and ZEVI) an effective step of the assessment? • Were any applications ineligible?	• Was the project set-up period appropriate? Was this feasible for the type of technology proposed? • Did all project teams start on the targeted project start date? • What could be improved?	• Was the delivery period for the scheme sufficient for teams to deliver all deliverables? • What barriers, if any, prevented full delivery of projects within the delivery period? • Were timelines for	• Were communication assets and guidance available to project teams when needed? • Was the timing of data sharing activities appropriate?

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	prior to scheme launch, sufficient to allow industry to prepare?				delivery appropriate and how was this managed?	
Funding	• Were funding risks considered during scheme design? • Were there any barriers to the agreement of funding?	• Were the requirements for funding clearly linked to scope? • Were the criteria for funding clear? • Was the presentation of costings clearly set out?	• What methods were used to decide the amount of funding that winning projects would receive? • What worked well or less well in the funding allocation process? • Were there any specific targets for	• Were project teams able to access funding for the scheme in a timely manner, to start the project on time?	• How was the project spend monitored? • How was poor financial performance managed during delivery? • What funding barriers, if any, prevented full delivery of projects?	

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
			match funding across different programmes? If yes, were these met?		• What role did other funding streams play in project delivery? • How was return on investment managed?	
Project Outcomes	• Did the scheme process result in the right outcome? • Which contextual factors, if any, impacted the delivery of the scheme?	• What went well in the application phase? What did not go well?	• What went well in the assessment phase? What did not go well?		• How were any tangible assets managed? • Was there any local press or social media coverage of project outputs following the	• Were the final showcase events useful for project teams to exhibit the project outputs? • How was Intellectual Property

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
					end of the project?	harnessed for UK use?
Unexpected Outcomes	• Were potential unintended outcomes considered during scheme design? • What unintended outcomes arose at the design stage?	• Was there anything unexpected from the range and type of bids?	• Were there any unexpected outcomes from the assessment phase? • Did the unsuccessful applicants continue to engage with the project?		• Did project teams report any unintended or unexpected outcomes at the end of project delivery? • Was there sufficient support for managing any risks or failures?	
Other Stakeholders	• What role did other bodies (Expert Advisory Group or Clean Maritime Council)	• Was sufficient support available for queries during	• Was sufficient support available for queries during the	• Was being assigned a Delivery Executive to guide the	• How have the outcomes of the scheme benefitted the	• How were collaborations between project teams and potential

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	play in the scheme design?	the application phase?	assessment phase?	project set-up useful?	wider industry or market?	customers managed?
	• Were there any additional stakeholders whose input may have been beneficial?	• Were any other organisations involved in this phase?	• Were any other organisations involved in this phase?	• What could be improved? • Which wider stakeholders (collaborators) were involved from the mobilisation stage? How and when were they engaged, and did any barriers emerge?	• What barriers to collaboration between project leads and their partners arose? How were these manged?	• Were any challenges faced with commercialisation? • What could be improved? • How well did UK SHORE integrate with other public support seeking to deliver similar objectives? • What factors enabled or hindered success, both within DfT and

Stage Items	Scheme Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
						with other delivery partners (eg EPSRC, IUK or CPC)? • How has UK SHORE built relationships with other stakeholders?

Annex B   Process maps

Similarly to how a logic model supports the development of the impact evaluation approach, a process map supports a process evaluation by mapping the processes and who does what. It sets out the steps in the process from scheme design through to delivery, and the stakeholders involved in those steps. Additional involvements from wider stakeholders are flagged in separate boxes to the process maps. In addition, common themes across the scheme, durations of processes and timescales are also contained in the process maps.

Five process maps have been developed, 1 to reflect the UK SHORE portfolio as a whole and 1 for each scheme: the Clean Maritime Demonstration Competition (CMDC), Zero Emission Vessels and Infrastructure (ZEVI), the Hub and Transport Research and Innovation Grants (TRIG).

Figure 81   UK SHORE portfolio process map

Source: SYSTRA Ltd.

Figure 82   CMDC process map
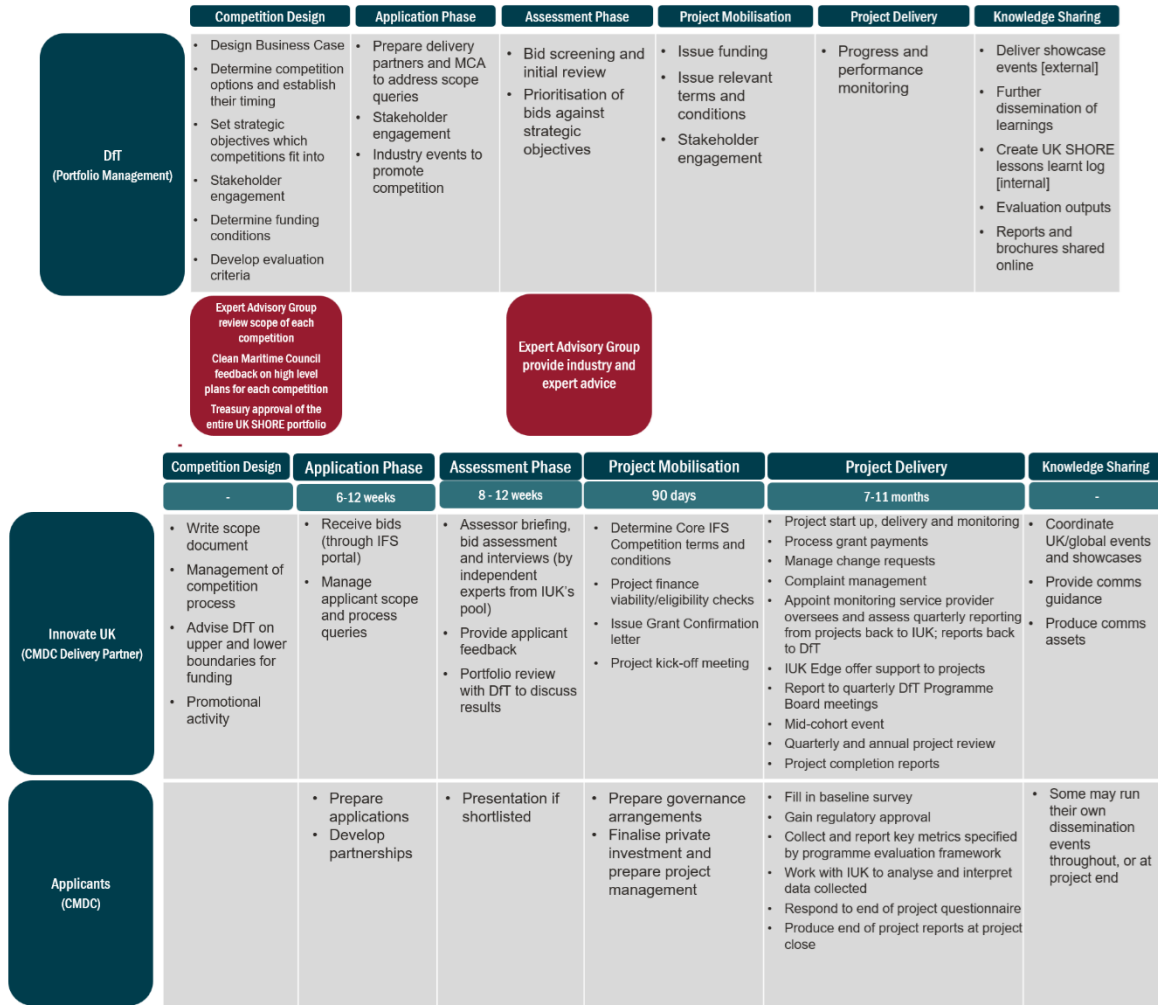
Source: SYSTRA Ltd.

Figure 83   ZEVI process map

Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
14 weeks	10 weeks	12 weeks	90 days	Build Phase (18 months); Deployment Phase (3 years)	-

DfT (ZEVI)

Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
• Share high-level objectives and regulatory involvement necessary with MCA • Options framework workshop • Engage with Clean Maritime Council to consider input from key industry stakeholders is fed into design • DfT CoE review business case • Develop scope • Define budget and timing • Obtain necessary sign-offs • Competition launch	• Support IUK with managing applicant scope and process queries • Support IUK/KTN with launch and consortia building events during application phase	• Agree proposed list of winners with IUK at portfolio review meeting • Secure internal and ministerial sign-off after portfolio review • Funders Panel with IUK – final list of winners confirmed	• Ministers announce winners • Support project kick-off meeting	• Issue funds; • Approve change requests • Hold regular update meetings, and quarterly Programme Board meetings ran by IUK • Provide regular ministerial updates • Support on creation of case studies • Ongoing requirement to manage competition beyond initial funding period (manage ongoing relationships with IUK and project partners, manage flow of outputs, outcomes and lessons learned and how they feed into benefits management of overall programme) • Technical evaluation (Deployment Phase only)	• Coordinate UK/global events and showcases • Branding and marketing of competition

Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
14 weeks	10 weeks	12 weeks	90 days	Build Phase (18 months); Deployment Phase (3 years)	-

Innovate UK (ZEVI delivery partner)

Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
• Write and publish scope document • Management of competition process • Competition setup; Authorisation Gateway process manages all aspects of competition setup and design • Launch competition • Calculate anticipated administrative costs and present to DfT for review and approval • Promotional activity during design phase	• Receive bids (through Innovation Funding Service portal; IFS) • Manage applicant scope and process queries • Advertise competition on IUK website • Launch events during application phase (supported by Maritime UK and DfT)	• Assessment eligibility and quality checks • Manage conflicts of interest • Assessor briefing, bid assessment and interviews (by independent experts from IUK's pool) • Calculate project scores after assessment and manage line draw • Agree line draw cut-off point with DfT • Final internal checks to ensure application process was adhered to • Funders Panel with DfT – List of winners agreed with a range of teams	• Update administrative costs with actual number of projects approved for funding • Determine Core IFS Competition terms and conditions • Project finance viability/eligibility checks • Issue Grant Confirmation letter • Project kick-off meeting	• Quarterly and annual project review • Project completion reports • Complaint management • Project start up, delivery and monitoring • Provide DfT with reports on financial forecasting provided by the beneficiaries (via monitoring officer) • Process grant payments • Manage change requests • Unspent funds returned to DfT or re-allocated • Appointed monitoring service provider oversees and assesses quarterly reporting from projects back to IUK; reports back to DfT • Create project case studies	• Coordinate UK/global events and showcases • 9 roadshows engaged via Society of Maritime Industries (SMI) and Maritime UK during application phase • Provide comms guidance • Produce comms assets

Experts Working Group input on draft technical scope; MCA inform the scope	IUK Knowledge Transfer Network input at application phase (provide informal advice and guidance to bidders)	MCA provide possible compliance issues for assessors			In collaboration with IUK Knowledge Transfer Network, MCA and Maritime UK

Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
14 weeks	10 weeks	12 weeks	90 days	Build Phase (18 months); Deployment Phase (3 years)	-

Applicants (ZEVI)

Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	• Prepare applications • Develop partnerships	• Presentation if shortlisted • Approve a technical data collection agreement and uphold the requirements of it for the duration of the project	• Prepare governance arrangements • Put in place regulatory requirements	• Fill in survey at start of project build stage on regulatory requirements • Collect and report key metrics specified by programme evaluation framework • Work with IUK to analyse and interpret data collected • Produce end of project reports at project close • Respond to end of project questionnaire • Engage with MCA when requested	• Support knowledge sharing activities • Some may run their own dissemination events throughout, or at project end

Source: SYSTRA Ltd.

Figure 84 The Hub process map

DfT (UK SHORE)

Competition Design	Application Phase (12 weeks)	Assessment Phase	Project Mobilisation	Project Delivery (43 months)	Knowledge Sharing
• Develop budget and timing for competition with EPSRC • Develop scope with support from EPSRC • Input to ensure UK SHORE strategic objectives are incorporated into EPSRC's general structure for the hub • Ensure the metrics for data collection align with UK SHORE strategic objectives	• Lead major announcement • Review expressions of interest • Develop pool of reviewers with EPSRC • DfT assist in identifying partners • Agree on standard assessment questions with EPSRC prior to review panel briefing	• Agree winning hub with EPSRC following interviews • Agree standard questions with EPSRC from EPSRC pool of questions and provide input	• Invest up to £3.7m funding from September 2023 until March 2025 (end of current UK SHORE funding period)	• Expected to be formal participants of hub steering board • Regular meetings with EPSRC and the Hub • Attend end user advisory board meetings as observers (with UK Research and Innovation; UKRII)	• Share information about the knowledge sharing events/resources produced by the hub with key stakeholders

Input from Expert Advisory Group and Chief Scientific Advisor (under Competition Design)

Chief Scientific Advisor offers support to projects (under Assessment Phase)

EPSRC (Hub Delivery Partner)

Competition Design	Application Phase (12 weeks)	Assessment Phase	Project Mobilisation	Project Delivery (43 months)	Knowledge Sharing
• Develop the competition process • Develop budget and timing for competition with DfT • Support DfT in developing scope • Have a general structure for research hubs • Launch and showcase events	• Setting up partnerships • Receive applications through Joint Electronic Submission (Je-S) portal • Guidance on how to submit applications using Je-S provided through UKRI website • Review expressions of interest • Develop pool of reviewers with DfT • Contact pool of reviewers to request their participation and brief them • Agree on standard assessment questions with DfT prior to review panel briefing • EPSRC ensure no conflict of interest with reviewers	• Oversee assessment phase; determine assessment criteria • Panel reviews bids and shortlist • EPSRC convene prioritisation panel for competitive applications • Sift panel ranks proposals based on assessment criteria • EPSRC decides, based on review panel advice, which applications will be invited to interview stage • Agree standard questions with DfT from EPSRC pool of questions and DfT input • EPSRC select 5 panel members to assess interviews; brief them on process and standard questions • Independent panel assess interviews and recommend highest scoring bid • Agree winning hub with DfT following interviews	• Invest up to £3.7m funding from April 2025 until March 2027 (remainder of hub's lifetime)	• Expected to be formal participants of hub steering board • Regular meetings with DfT and the Hub • Annual data collection from monitoring officers and projects via Research Fish online platform	• Press releases • Case study developments • Networking events • Share information about the knowledge sharing events/resources produced by the hub with key stakeholders • Produce annual reports

Applicants (Hub)

Competition Design	Application Phase (12 weeks)	Assessment Phase	Project Mobilisation	Project Delivery (43 months)	Knowledge Sharing
	• Mandatory expression of interest • Prepare applications • Form project partner collaborations with academia, industry, policymakers and the third sector • Evidence at least £2m of matched funding at application phase	• Bid lead (principal investigator) can respond and challenge any reviewer comments/judgements • Prepare presentations for interview stage • Receive feedback from panel following interview stage	• Prepare governance arrangements; EPSRC and DfT project officers to be formal participants on the hub steering board • Establish independent end user advisory board (include appropriate industry and policy maker representation); UKRI and DfT appointed project officers to attend as observers • Complete baseline survey provided by EPSRC	• Collect and report key metrics specified by programme evaluation framework • Monitoring and evaluation expectations include: • Annual reporting and responding to quantitative survey on Research Fish portal • Mid-term review (by independent panel) • Post-investment evaluation • Landscape evidence base report at end of first year of investment • Answer standard questions (e.g. about progress, financial performance) as part of quarterly reporting • Provide a flexible funding mechanism to support research and encourage involvement; funds released annually throughout hub's lifetime, amounting to maximum fund of £1.3m for the hub's duration • Engage with other relevant major complementary, research and innovation investments	• Create a website • Engage in multi-regional manner with local authority/civic stakeholders in meaningful collaboration • Actively support career development across all career stages in clean maritime sector • Facilitate cross sectorial and interdisciplinary networking, knowledge exchange, engagement and dissemination activities • Provide research advice and evidence for policy input and development, develop papers with evidence-based policy recommendations • Support knowledge exchange with relevant stakeholders on a regular basis

Source: SYSTRA Ltd.

Figure 85 TRIG process map

	Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	-	5-6 weeks	8-10 weeks	-	6 months	-
DfT (UK SHORE)	• Develop and draft the scope; agree scope with Connected Places Catapult (CPC) • Define budget and timing **Chief Scientific Advisor has oversight of the whole TRIG programme** **Input from technical experts (i.e. MCA) on priorities for the scope**	• Receive bids • Social media advertising • Industry engagement	• Representative of DfT policy and SciTech team involved in assessment phase • SciTech team conduct final review with CPC to identify best bids and recommend final winners • Agree final winners with CPC • Determine final fund amount once all bids reviewed • Announce list of funded projects	• Support project kick-off meeting • Distribute grant funding to CPC	• Approve change requests regarding scope changes • Agree on project deliverables with CPC at project close • Support projects within cohort • Attend monthly coffee connectors sessions (networking and support for winning projects)	• Monthly meeting with CPC and other winners in networking event

	Competition Design	Application Phase	Assessment Phase	Project Mobilisation	Project Delivery	Knowledge Sharing
	-	5-6 weeks	8-10 weeks	-	6 months	-
Connected Places Catapult (TRIG Delivery Partner)	• Agree scope with DfT • Promotional activity • Responsible for competition process • Develop start and end of project questionnaires	• Manage applicant scope and process queries • Application support sessions, including one-to-one sessions with applicants if requested • Social media advertising	• Oversee scoring and assessment of bids (screening phase, technical review, interview) • Pre-briefs with interviewees before interview process • Agree final winners with DfT • Announce list of winners	• Responsible for administering grant funding the winning projects; 60% of total project costs awarded during mobilisation • Adviser reviews winners Business Needs Declaration and engages with them to understand/support their needs	• Provide templates for deliverables (monthly cohort and final report, Statement of Grant Usage, Compendium) • Manage change requests • Project start up, delivery and monitoring • Release remaining 40% of total project costs once all deliverables have been agreed with DfT at project close. • Create impact report using data from start and end of project questionnaires • Monthly coffee connectors sessions (networking and support for winning projects)	• CPC Marketing team involved • Academic impact session • Monthly meeting with DfT leads and other winners in networking event • Communications portal
Applicants (TRIG)	• Open call for bidder-led suggestions regarding scope/which challenges to run for the year	• Prepare applications • Develop partnerships	• Prepare presentations for interview stage	• Prepare governance arrangements • Respond to start of project questionnaire provided by CPC	• Submit all deliverables to receive remaining 40% funding: • Prepare and carry out end of project presentation upon DfT request (if DfT require more information or detail than that provided in end of project report)	• Support knowledge sharing activities

Source: SYSTRA Ltd.

Annex C   Survey overview

C.1   Survey content

The online survey was distributed by Innovate UK (IUK) and Connected Places Catapult (CPC) in November 2023 to all successful applicants for CMDC1 through 3, ZEVI and TRIG. The survey was also open to CMDC4 applicants; however, funding had not been allocated at that time. The Hub was excluded, as funding was only given to 1 organisation, and information will be collated through qualitative methods instead.

The survey comprised a 10 to 15-minute self-completion questionnaire, administered through Snap Surveys between late November 2023 and 5 January 2024, with response rates monitored and reminders sent as required. The survey covered:

■   Organisation and role: Key information about roles, project and scheme; project stage, technology readiness levels (TRLs) and commercial readiness levels (CRLs); geographical area of delivery; type of partner organisations and other funding streams utilised.

■   Satisfaction with and attitudes to different aspects of the competition and delivery process: Bid and delivery support, timescales, information and guidance, data and reporting requirements, information sharing; and familiarity with other UK SHORE competitions.

■   Barriers and opportunities around delivery: Challenges with regulation, procurement or suppliers, governance, resourcing, technological limitations, with partners or collaborators, or changes to project scope or scale.

■   Anticipated and early impacts and learnings: Additional employment; pace of delivery and technological development; commercialisation; CO_2 savings generated; follow-on investment; and if, and to what extent, the project may have progressed without the funding.

Data was collected for each scheme via separate survey links, and respondents were asked to provide their organisation name and project reference number, name or ID. Those involved in multiple projects or competitions were encouraged to report for each.

Following careful consideration and exploring the balance of various factors such as response rates, proportionality and the value of data to be collated, the online survey did not cover unsuccessful applicants. Instead, as part of the evaluation, there will be close engagement with DfT, IUK, CPC and the Engineering and Physical Sciences Research Council (ESPRC) to initiate a process to collate quantitative feedback from unsuccessful applicants. This will provide evidence to supplement the qualitative interviews. This data will be used to build a view of the counterfactual (what parties do if they are not successful in being awarded UK SHORE funding) because it will help to identify the extent to which they have been able to secure the progression of projects and technologies without UK SHORE funding and the

decisions they took following their unsuccessful application (including what happened to their partnership organisations). It is anticipated this data will be collected through established monitoring channels as part of later phases of the evaluation.

This survey will be reviewed and updated in spring 2025 before being circulated again.

C.2   Analysis and reporting

All the cleaning and analysis of survey data was undertaken in SPSS. The surveys for each competition were combined for analysis purposes. Frequencies were run for each question in the survey at an overall sample level (portfolio) and for each competition separately. Cross-tabulations and chi-square tests of significance were run for the CMDC competition, which had the largest sample size. Chi-square test results were not reported as the sample sizes were too small for the results to be reliable.

Due to routing and respondents choosing not to provide answers to some questions, the base size for some questions varies from the total sample size. The base number for each question is provided throughout the report. In addition, where percentages do not total 100%, this is due to rounding or the multiple-response nature of the question. Where multiple responses to a question were possible, this is indicated throughout the report by adding 'multiple response' to the heading of the relevant table or figure. No weighting has been applied during the analysis.

C.3   Caveats and data limitations

Although the number of responses from the CMDC competitions was fairly high (38), the number of respondents from TRIG and ZEVI applicants was limited, with 7 responses from each of these competitions (see Table 45). As a consequence, statistical analysis and the conclusions that can be made from this survey are limited. All tables present results in percentages and definite numbers to make it clear to the reader that results in percentages should be interpreted with caution, as the low number of responses means results may appear more extreme than they would have been if the number of responses had been higher. The report also contains results from across the portfolio of competitions. These 'Portfolio' responses are based on a sample of 53 respondents, meaning outliers are less likely to impact the results as much as they would for percentages based on a low number of responses. The evaluation team will continue to work with DfT and their delivery partners to ensure the project teams continue to support the evaluation. Research approaches will be continually reviewed throughout the evaluation to ensure the burden is minimised for participants while maximising quality and existing data sources will be utilised wherever possible.

C.4   Respondent Composition

The response rate to the survey is outlined in Table 45.

Table 45   Survey response rate by competition

Scheme	Number of responses	% of total successful applicants
CMDC (1, 2, 3)	38	36%
TRIG	7	27%
ZEVI	7	70%

Source: Online survey.
Note: No responses from CMDC4.

The distribution of organisation type for the respondents is outlined in Table 46, separated by competition. The definite number is provided in parenthesis after the percentage of projects within a competition category.

Table 46   Distribution of organisation type by competition

Scheme	CMDC	TRIG	ZEVI
Academic institution	5% (2)	0	0
Private business (SME < 250 employees)	74% (28)	86% (6)	86% (6)
Private business (Large)	16% (6)	0	0
Public sector organisation	5% (2)	0	14% (1)
Other	0	14% (1)	0

Source: Online survey.

The geographical distribution of regions where projects are delivered is outlined in Table 47. Each project was able to select multiple regions of delivery, where applicable. Definite numbers are provided in parentheses after the percentage.

Table 47   Geographical distribution of project delivery by competition

Scheme	CMDC	TRIG	ZEVI
East Midlands	11% (4)	14% (1)	0
East of England	8% (3)	0	0
London	8% (3)	0	0
North East	16% (6)	29% (2)	29% (2)
North West	3% (1)	0	0

Scheme	CMDC	TRIG	ZEVI
Northern Ireland	11% (4)	0	14% (1)
Scotland	16% (6)	0	14% (1)
South East	42% 16)	43% (3)	43% (3)
South West	21% (8)	14% (1)	29% (2)
West Midlands	0	0	0
Yorkshire and The Humber	8% (3)	0	0
Wales	8% (3)	0	14% (1)
UK-wide	0	29% (2)	0

Source: Online survey.

The distribution of survey respondents by their role in the project they were basing their survey response on is presented in Table 48, disaggregated by competition. Definite numbers are provided in parentheses after the percentage.

Table 48   Distribution of project role by competition

Scheme	CMDC	TRIG	ZEVI
Involved in bid, but not delivery	0	0	0
Involved in delivery, but not bid	5% (2)	0	14% (1)
Involved in both bid and delivery	95% (36)	100% (7)	86% (6)

Source: Online survey.

Table 49 summarises whether the respondent represented a lead, or a collaborator, organisation in their project. Definite numbers are stated in parentheses.

Table 49   Distribution of lead and collaborator organisations by competition

Scheme	CMDC	TRIG	ZEVI
Lead organisation	53% (20)	100% (7)	71% (5)
Collaborator organisation	47% (18)	0	29% (2)

Source: Online survey.

The distribution of projects by project stage is outlined in Table 50. As before, definite numbers are provided in parentheses.

Table 50   Distribution of project stage by competition

Scheme	CMDC	TRIG	ZEVI
Mobilisation	3% (1)	0	33% (2)
Delivery	24% (9)	0	67% (4)
Complete	74% (28)	100% (7)	0

Source: Online survey.

Annex D   Technology and commercial readiness levels (TRLs and CRLs)

Table 51   Definition of TRLs

TRL	Definition
1	Basic principles have been observed or formulated
2	Developing hypothesis and experimental designs
3	Specifying and developing an experimental proof of concept
4	Proof of concept demonstrated in test site or initial evaluation of costs and efficiency produced
5	Technology or process validated in relevant environment
6	Technology or process validated in operational environment
7	System complete and qualified
8	Product, technology in manufacture or process being implemented
9	Produced, service on commercial release or process deployed

Source: UK SHORE.

Table 52   Definition of CRLs

TRL	Definition
1	Knowledge of applications, use-cases and market constraints is limited and incidental or has yet to be obtained at all
2	A cursory familiarity with potential applications, markets and existing competitive technologies or products exists
3	A more developed understanding of potential applications, technology use-cases, market requirements or constraints, and a familiarity with competitive technologies and products allows for initial consideration of the technology as product
4	A primary product hypothesis is identified and refined through additional technology-product-market analysis and discussions with potential customers or users. Potential suppliers, partners and customers are identified and mapped in

TRL	Definition
	an initial value-chain analysis. Any certification or regulatory requirements for product or process are identified
5	A deep understanding of the target application and market is achieved, and the product is defined. A comprehensive cost-performance model is created to further validate the value proposition and provide a detailed understanding of product design trade-offs. A basic financial model is built with initial projections (for example, near- and long-term sales, costs, revenue and margins)
6	Market or customer needs and how those translate to product needs are defined and documented (eg in market and product requirements documents). Product design optimisation is carried out considering detailed market and product requirements, cost and performance trade-offs and manufacturing trade-offs
7	Product design is complete and supply and customer agreements are in place. All necessary certifications or regulatory compliance for product and production operations are accommodated. Comprehensive financial models and projections have been built and validated for early stage- and late-stage production
8	Customer qualifications are complete and initial products are manufactured and sold
9	Widespread deployment is achieved

Source: UK SHORE.

Annex E   Theory of change

Underpinning a robust evaluation is the need for a theory of change. This section presents a validated theory of change, summarised in a logic model, for the UK SHORE portfolio and the 4 individual schemes. A logic model is a visual, linear depiction of a policy or programme's theory of change. It typically progresses from left to right and describes how a policy intends to deliver impacts through its activities, outputs and outcomes.

The logic models for the UK SHORE portfolio and the 4 individual schemes are shown in Figure 86, Figure 87, Figure 88, Figure 89 and Figure 90.

Figure 86   UK SHORE portfolio-wide logic model

INPUTS

ACTIVITIES

OUTPUTS

UK SHORE PORTFOLIO OUTCOMES

Short-run | Medium-run | Long-run

PORTFOLIO IMPACTS

FUNDING
- £229m of funding split across various schemes
- Leveraged matched funding, varies by scheme

PROJECT TEAM INPUTS
- Time, skills, knowledge and expertise
- Existing resources e.g. infrastructure, technology, other investments.

OTHER UK SHORE / DELIVERY PARTNER INPUTS
- Staff time, skills, knowledge and expertise
- Funding guidelines and administrative infrastructure
- Insights from other UK SHORE funding schemes

OTHER INPUTS
- Maritime and Coastguard Agency (MCA) time and expertise
- Expert advisory group input, including Clean Maritime Council
- Partner country inputs

UK SHORE SCHEMES:
- Design, implementation, and operation of all UK SHORE schemes
- UK SHORE and delivery partner monitoring and support of those schemes
- MCA regulation activity

Increasing TRL level:
TRL 1
TRL 9

TRIG
EPSRC Clean Maritime Research Hub
ZEVI
CMDC:
Round 1
Round 2
Round 3
Round 4

+ Other schemes, including IGCF and C-SMART

Portfolio wide activities e.g. conferences, networking

Creates new projects for other UK-SHORE schemes

Used to inform the design of future schemes

TECHNOLOGY OUTPUTS:
- Proof of concept reports
- Feasibility studies
- Pre-deployment trials
- Demonstrations
- Deployment trials
- Market-ready technologies

OUTPUTS FOR EACH SCHEME:
- Project reports
- Real world data collected
- Increased collaboration
- Learnings e.g. via monitoring data

UK-SHORE aims to:

Overcome barriers to investment and improve information flows across markets

Provide **proof of concepts** and understand which technologies are or are not viable

Facilitating collaborations and partnerships to advice technology (with and without government support)

Support and accelerate market development of clean maritime technologies

Crowd-in **further investment**

Develop capabilities in the clean maritime space

New business and employment opportunities in UK maritime

Increase high-skilled employment opportunities in coastal areas

Further **emission abatement** as new technologies, not directly supported by UK-SHORE, are rolled out

Overcome market barriers projects face to **increase TRL and commerciality of projects**

Early **emission abatement** from high TRL projects, such as ZEVI and CMDC

Further **emission abatement** as ZEVI and CMDC projects rolled out more widely

Further **emission abatement** from lower TRL schemes, such as TRIG and the Hub

Develop **green corridors**

Develop MCA understanding of technologies funded via UK SHORE schemes

Develop a better **understanding of the state of clean maritime** technology and timescales

Informed **changes to the regulatory environment** based on technology development

ECONOMIC
- Increase maritime sector output and UK GDP
- Sector-wide jobs supported and created
- Supply chain impacts supporting and creating jobs
- Spill-over benefits to maritime and other sectors

SOCIAL
- Support and create jobs in deprived regions and coastal areas, contributing to levelling up

ENVIRONMENTAL
- Reduce CO_2 emissions within the maritime sector
- Reduce CO_2 emissions in other sectors e.g. via UK Government's Hydrogen strategy
- Support technology which will allow a trajectory to achieving net-zero in maritime by 205

ENERGY SECURITY
- Reduce reliance on other countries for energy

INTERNATIONAL RELATIONS
- Facilitate bringing countries together for bilateral and multilateral engagement
- Green corridors increase bilateral agreements

Source: Frontier Economics.

Figure 87   CMDC logic model

INPUTS → **ACTIVITIES** → **OUTPUTS** → **CMDC OUTCOMES** → **IMPACTS**

CMDC OUTCOMES columns: Short-run (Until 2025) | Medium-run | Long-run

INPUTS

FUNDING

Government funding of £129m to support projects across 4 rounds
First round of funding prior to UK-SHORE set-up

Leveraged matched private funding up to £46m across CMDC rounds 1-3. CMDC4 leveraged funding TBC

PROJECT TEAM INPUTS

Time, skills, knowledge and expertise

Existing resources e.g. IP, infrastructure, technology, other investments

OTHER UK SHORE / INNOVATE UK INPUTS

Staff time, skills, knowledge and expertise

Funding guidelines and administrative infrastructure

Insights from other UK SHORE funding schemes

OTHER INPUTS

MCA time and expertise

Expert advisory group and Clean Maritime Council input

ACTIVITIES

ASSESSMENT

Competition applications assessed

Funding decisions and funding disbursed

COMPETITION AWARD ACTIVITIES

Round 1: £23m allocated and 55 projects set up for feasibility and collaborative R&D projects

Round 2 £12m allocated and 31 projects set up for feasibility studies / plans for real-world demos

Round 3 £60m allocated to develop and deploy 19 real world operational demonstrations

Round 4 £34m to be allocated to real world operational demos, CR&D trials and studies

MONITORING & WIDER UK SHORE / INNOVATE UK SUPPORT

IUK monitoring officer assigned

Monitoring data collected, reported and shared

Regular meetings with project teams

Used to inform the design of future schemes

OUTPUTS

CMDC ROUND OUTPUTS

Round 1
Technical and economic feasibility of GHG reduction options and detailed plans for future demo projects

Round 2
Feasibility of on-vessel technologies or shoreside infrastructure; collaborative R&D

Round 3
Two strands (i) vessel or infrastructure demos (ii) vessel and infrastructure combined demos

Round 4
Three strands (i) vessel or infrastructure; (ii) vessel and infrastructure; (iii) feasibility studies and pre deployment trials

MONITORING OUTPUT

Monitoring data to inform project leads, industry and government

CMDC OUTCOMES

Round 1

Short-run: IP enables project partners/ industry to inform decisions on tech with reduced risk

IP enables government to identify / address remaining barriers (e.g. regulatory changes)

Medium-run: Evidence on potential market opportunity and propensity for further development

Change in regulatory effectiveness to facilitate innovative tech development

Round 2

Short-run: Evidence leads to increased confidence in tech potential, and supply chain innovation potential

Increased confidence in scale of market potential and route to commercial market

Medium-run: Leverage private sector investment and engagement in the tech development

Change in market and supply chain opportunities associated with the potential future investment in this technology

Round 3

Short-run: Increased confidence in real world operational potential of the technology

Increased confidence in barriers to be addressed and how to support operationalisation

Medium-run: Leverage private sector investment and engagement in the tech development

Change in market and supply chain readiness for this technology

Round 4

Short-run: Increased confidence of how to make technology commercially ready

Increased confidence in addressing barriers and exploiting economies of scale

Medium-run: Leverage private sector investment and engagement in the tech development

Change in market and supply chain ability to exploit opportunities associated with the innovation

Long-run:

Increased confidence in technologies to move towards real-world demonstration (Round 3)

Increased confidence in technologies to move to real-world demonstration in operational settings (Round 4)

Increased confidence in technologies to further invest in to advance TRL (later CMDC rounds)

Increased confidence in technologies to further invest in to advance TRL (later CMDC rounds)

Projects flow outside the CMDC schemes into external funding for future investment

IMPACTS

ECONOMIC
- Increase maritime sector output and UK GDP
- Sector-wide jobs supported and created
- Supply chain impacts supporting and creating jobs
- Spill-over benefits to maritime and other sectors

SOCIAL
- Support and create jobs in deprived regions and coastal areas, contributing to levelling up

ENVIRONMENTAL
- Reduce CO_2 emissions within the maritime sector
- Reduce CO_2 emissions in other sectors e.g. via UK Government's Hydrogen strategy

ENERGY SECURITY
- Reduce reliance on other countries for energy

INTERNATIONAL RELATIONS
- Facilitate bringing countries together for bilateral and multilateral engagement

Source: Frontier Economics.

Figure 88   ZEVI logic model

INPUTS	ACTIVITIES	OUTPUTS	ZEVI OUTCOMES	IMPACTS

ZEVI OUTCOMES: Short-run (Until 2025) · Medium-run · Long-run

FUNDING
- Government funding of £80.2m (up to £20m per project)
- Leveraged matched private funding up to £77m

PROJECT TEAM INPUTS
- Time, skills, knowledge and expertise
- Existing resources e.g. infrastructure, technology, other investments

OTHER UK SHORE / INNOVATE UK INPUTS
- Staff time, skills, knowledge and expertise
- Funding guidelines and administrative infrastructure
- Insights from other UK SHORE funding schemes

OTHER INPUTS
- MCA time and expertise
- Expert advisory group and Clean Maritime Council input

ASSESSMENT
- Grant applications assessed
- Funding awarded and disbursed

DEMONSTRATION PROJECT ACTIVITIES
- **Strand 1** BEVs and charging points
- **Strand 2** Shore power technologies
- **Strand 3** Alternative fuels and refuelling infrastructure
- **All strands:** MCA engagement to approve technology use

MONITORING / WIDER UK SHORE SUPPORT
- IUK monitoring officer assigned
- Monitoring data collected, reported and shared
- Regular meetings with project teams

PROJECT LEVEL OUTPUTS
- **Strand 1** Fully battery electric vessels developed. Zero emission auxiliary equipment developed
- **Strand 2** Scalable vessel technology developed. Power technologies developed on shore and vessel side. Infrastructure made accessible to other operators
- **Strand 3** Scalable vessel technology developed. Alternative fuels and fuelling infrastructure developed. Infrastructure made accessible to other operators
- **All strands** End of project report developed. MCA informed

MONITORING OUTPUT
- Technical data which can be shared across the sector
- Project level monitoring data e.g. number of jobs created

ALL PROJECTS
- **Technology operationalised** in real-world setting
- **Intellectual property** including patents generated
- **Improved industry/ policy understanding** of practical requirements of deploying the technology in operational settings
- **Reduced commercial and financial barriers** to further development as market barriers are addressed
- Other operators use infrastructure to develop other technologies not directly supported by ZEVI
- Information used to support commercial success of technologies
- **Develop MCA understanding** of ZEVI technologies

- Early deployment of project technology leads to a **reduction in CO_2 emissions**
- **Proof of demand** for technologies de-risks investment
- **Further public and private investment** crowds in as success is proven.
- Change in funding level for post-2025 unfunded demonstration period
- **Identifying operational barriers** to deployment of technology
- Change in commercial opportunities from innovations

STRAND 3 SPECIFIC (ALTERNATIVE FUELS)
- **Prove business models** for alternative fuels
- **Proof of demand** for alternative fuels generated

- **Economies of scale** and cost reduction of technology and fuels
- **Wider deployment** of zero emission technology and alternative fuels among vessel owners/operators
- Adoption of technology and fuel in other sectors
- **Larger-scale reduction in CO_2 emissions**
- **Development of green corridors**
- **New business opportunities** involved in UK maritime, including in associated supply chains
- **Increased high-skilled employment** including in coastal areas

ECONOMIC
- Increase maritime sector output and UK GDP
- Sector-wide jobs supported and created
- Supply chain impacts supporting and creating jobs
- Spill-over benefits to maritime and other sectors

SOCIAL
- Support and create jobs in deprived regions and coastal areas, contributing to levelling up

ENVIRONMENTAL
- Reduce CO_2 emissions within the maritime sector.
- Reduce CO_2 emissions in other sectors e.g. via UK Government's Hydrogen strategy

ENERGY SECURITY
- Reduce reliance on other countries for energy

INTERNATIONAL RELATIONS
- Facilitate bringing countries together for bilateral and multilateral engagement

Source: Frontier Economics.

Figure 89   The Hub logic model

INPUTS

ACTIVITIES

OUTPUTS

HUB OUTCOMES

IMPACTS

Short-run | Medium-run | Long-run

FUNDING
- Government funding of £3.7m from UK SHORE until March 2025
- Government funding of £3.7m from EPSRC April 2025 to March 2027
- £1.85m of funding from research organisations
- £9.7m of leveraged funding and in-kind contributions, expected to increase over the Hub's lifetime
- Flexible funding of £1.5m which can be reallocated to new emerging areas

RESEARCH TEAM INPUTS
- Time, skills, knowledge and expertise
- Existing knowledge base
- Existing resources e.g. research infrastructure

OTHER UK SHORE / EPSRC INPUTS
- Staff time, skills, knowledge and expertise
- Funding guidelines and administrative infrastructure
- Insights from other UK SHORE funding schemes

OTHER INPUTS
- Expert advisory group input (including MCA)

ASSESSMENT
- Competition applications assessed
- Funding decisions and funding disbursed by Hub

HUB LEVEL ACTIVITIES
- Academic research into:
  - marine fuel scale up and safety
  - power and propulsion systems
  - port and vessel support systems
  - vessel design and efficiency
  - digitisation, maritime operations, and finance
- Understanding current state of technology to set research agenda
- Host conferences
- Hold outreach events, secondments and fellowships

MONITORING & WIDER UK SHORE / EPSRCSUPPORT
- Monitoring data collected, reported and shared.
  - RAG quarterly review
  - ResearchFish
  - Annual repots
  - Mid-term review
- End of funding review 2027

- Academic hub managed by universities and co-created with industry

PRIMARY OUTPUTS
- Peer-reviewed academic research

SECONDARY OUTPUTS
- One-off landscape report on current state of technology
- Fellowships, secondments and outreach to secondary schools and colleges
- Knowledge dissemination
- Capital research facilities (dependent on Hub decisions/bidder demand)
- White papers and policy recommendations

ACADEMIC OUTCOMES
- Research outcomes shared on early TRL technology to inform further research
- Increase **collaboration** between universities involved in the Hub
- Increase **collaboration** between academia and industry
- **Skills development** for academics through fellowships & secondments
- Scientific knowledge which can **support future projects**
- **Promote clean maritime careers** within academia and industry
- Create a **'clean maritime cluster'**, with the UK recognised for research excellence
- Change in opportunities for UK to present research on the world stage

TECHNOLOGY OUTCOMES
- **Develop fundamental science** in clean maritime and **increase TRL** of concepts
- Provide industry with confidence and direction
- Create **a pipeline of technology** for higher TRL UK-SHORE schemes, MaRI-UK, Catapults and private investment
- Crowd-in **investment**
- Benefits achieved via **increased clean maritime technology** (via other UK-SHORE schemes and private investment)

POLICY OUTCOMES
- Provide an **understanding** to support clean maritime policy-making
- Short-term **evidence-backed policy changes** in clean maritime
- Longer-term **evidence-backed policy changes** in clean maritime

ECONOMIC
- Increase maritime sector output and UK GDP
- Sector-wide jobs supported and created
- Supply chain impacts supporting and creating jobs
- Spill-over benefits to maritime and other sectors

SOCIAL
- Support and create jobs in deprived regions and coastal areas, contributing to levelling up

ENVIRONMENTAL
- Reduce CO$_2$ emissions within the maritime sector
- Reduce CO$_2$ emissions in other sectors e.g. via UK Government's Hydrogen strategy
- Learnings to support regulatory and policy changes
- Support technology which will allow a trajectory to achieving net-zero in maritime by 205

ENERGY SECURITY
- Reduce reliance on other countries for energy

INTERNATIONAL RELATIONS
- Facilitate bringing countries together for bilateral and multilateral engagement
- Green corridors increase bilateral agreements

Source: Frontier Economics.

Figure 90 TRIG logic model

| INPUTS | ACTIVITIES | OUTPUTS | TRIG OUTCOMES | | | PORTFOLIO IMPACTS |

INPUTS

FUNDING
Government funding of £400k to 13 projects (100% government funded) each year (2021, 2022, 2023 and potentially more) Funding in 2021 was prior to the established of UK-SHORE

PROJECT TEAM INPUTS

Time, skills, knowledge and expertise

Existing resources e.g. infrastructure, technology, other investments.

OTHER UK SHORE / CATAPULT INPUTS

Staff time, skills, knowledge and expertise

Funding guidelines and administrative infrastructure

Insights from other UK SHORE funding schemes

Insights from other experts informally

ACTIVITIES

ASSESSMENT
Competition applications assessed

Funding decisions and funding disbursed

PROJECT LEVEL ACTIVITIES
2022 TRIG included demonstrators/trials across three groups:

Smart Shipping

Small and medium harbours, ports and marinas

Deep sea vessels

2021 TRIG included demonstrators/trials across all technology types

MONITORING & WIDER CATAPULT / INNOVATE UK SUPPORT
IUK monitoring officer assigned

Monthly project tracking including of activities next steps, challenges and additional support needed.

Monitoring data collected, reported and shared

Regular meetings with project teams

Wrap around support e.g. networking, Coffee Connect

OUTPUTS

Development of concepts which would otherwise not have been tested, both for financial and other reasons

Prove whether or not technology works

Concepts which can feed into other UK SHORE interventions

TRIG OUTCOMES

Short-run | **Medium-run** | **Long-run**

ALL PROJECTS

Understand which concepts do and do not work

Leverage **further private investment** for successful projects

Develop successful projects into higher TRL levels

Increase TRL of concepts, or move projects up within their TRL band

Leverage **investment from other UK SHORE interventions** for successful projects

Increased clean maritime technology

2021: ALL TECHNOLOGY TYPES

Support projects not big enough to received funding via CMDC

2022 GROUP 1: SMART SHIPPING PROJECTS

Ensure UK-SHORE support coverage of smart shipping before the introduction of C-Smart

Projects ready to be inputs into higher TRL C-Smart schemes

2022 GROUP 2: SMALL AND MEDIUM HARBOURS, PORTS AND MARINAS

Provides support to smaller-scale opportunities to address barriers in access to finance

2022 GROUP 3: DEEP SEA VESSELS

Ensure research coverage is comprehensive by addressing current evidence gaps. Currently not funded via CMDC because of requirements for UK-flagged vessels and the UK's focus on smaller vessels

PORTFOLIO IMPACTS

Note: Impacts likely to be small due to the small £ of funding under this scheme

ECONOMIC
- Increase maritime sector output and UK GDP
- Sector-wide jobs supported and created
- Supply chain impacts supporting and creating jobs
- Spill-over benefits to maritime and other sectors

SOCIAL
- Support and create jobs in deprived regions and coastal areas, contributing to levelling up

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ENERGY SECURITY
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INTERNATIONAL RELATIONS
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Source: Frontier Economics.

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