Summative Assessment Report for Cutting the Carbon: Carbon Innovation in flood defence

Revision no: 1.0

Environment Agency

Crossens - Cutting the Carbon
27 October 2022

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Project name: Crossens - Cutting the Carbon

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1. Introduction

Project overview

The Environment Agency (EA) secured a contribution from the European Regional Development Fund (ERDF) to support the delivery of renewable energy infrastructure to transform the way the Environment Agency operates two of its existing strategically important flood risk assets in Lancashire to run more sustainably as part of the 'Cutting the Carbon' initiative in the Cumbria & Lancashire (C&L) area. The assets are the Crossens Pumping Station in Southport, and Hey Cop (previously Red Bridge) Pumping Station on the River Alt.

ERDF's contribution to the project will enable the EA to provide match funding of £840k towards this £2.1m project which will enable 2 critical flood risk management assets which protect homes and communities to be adapted to operate using solar or wind energy.

This is an innovative project not previously attempted within the EA in Lancashire and will provide a robust framework and understanding of costs and limitations so that this example can be applied to new and existing assets currently using unsustainable energy sources.

The project will:

- Provide renewable energy infrastructure at 2 locations for the asset lifespan of 25 years;
- Provide infrastructure for 932kW of solar and 5kW of wind renewable energy production (installed capacity);
- Save 240 tonnes of carbon annually (for a predicted 25 years);
- Generate 865,008 kWh of renewable energy annually; The sites are together are expected to generate 865,008 kWh and consume (demand) 937,386 kWh;
- Allow the 2 sites to achieve a 91% reduction in their overall carbon footprint; and
- Deliver a Community Energy Use Pilot to determine whether the energy generated on site could be further used save carbon locally, this includes the potential provision of electric vehicle charging points.

The project will consist of 6 elements:

1. The construction of 1 new solar field and 1 wind pump, in 2 locations in Lancashire to operate critical public flood risk infrastructure
2. Energy generated will be used onsite during times of operation
3. Energy will be stored within batteries and used on site in both locations
4. Unused energy will be exported to the grid and purchased when required. Each site will use more energy per annum than will be generated
5. Creation of a case study and tool kit as a result of the project so that the Environment Agency are able to apply the learning to other flood risk assets and buildings
6. Creation of a 'Community Energy Pilot Feasibility Study' to enable the project to deliver electric vehicle charging points and to understand how else the energy generated can better serve the local community

Progress to date

The project is currently under construction. Following the approval of the Full Business Case, Aberla Energy Limited was selected as the preferred contractor and the contract was awarded in November 2021. A change in site location and technology type was deemed necessary for the 5kW wind installation as described in section 2.2.2 Hey Cop Pumping Station (Previously Red Bridge Pumping Station).

So far, the following tasks were completed:

- A range of Ecological and Environmental reports was delivered between March 2021 and July 2021, including Wintering Bird Survey and Agricultural Impact Assessment, and an Environmental Action Plan was prepared in August 2021.
- Jacobs delivered a Geotechnical Desk Study & Ground Investigation Scope Report in October 2021.
- Jacobs delivered Assessment Principles Statement for Crossens Depot in November 2021, and a report on Management of sub-standard highways structures in accordance with CS470 in December 2021.
- Planning permission of the scheme was submitted to West Lancashire Borough Council in July 2021 and was received in February 2022.
- Enzygo Ltd was commissioned by Aberla Ltd to produce a biodiversity Construction Environmental Management Plan (CEMP) for the proposed Solar array. They released a summary report in May 2022.
- Buildability Statement was released by Aberla Energy Limited in July 2022. It identifies the assumptions made in the design work completed by Aberla, the anticipated controls and how any unusual residual risk can be managed.
- The site became mobilised in August 2022. So far, Aberla have completed the perimeter fencing and access gates, the access road and drainage, trenching for the power cables over the site back to the pumping station, Base-Plate installations works, installation of the frames for solar panels, power module installation, DC string works and work on inverters.
- Majority of the civil and excavation works, such as trench works or HV cable pull have also been completed with assistance from Wysons and Wrights.

In order for the project to be finalised, the following tasks will need to be completed:

- Civil and excavation works need to be completed, including Solar Substation and BESS Install. Those tasks are scheduled for the end of October, with Factory Acceptance Test booked for 31st November.
- Commissioning Process is expected to be concluded in early December.
- Landscaping activities, such as wild grass planting or hedge row planting are also expected to be completed in January 2022.
- The site is expected to be demobilised in the first week of January.
- The System Performance Review and O&M Creation is expected to take 5 weeks once the site is closed and are expected to conclude in January 2023.

The project is therefore expected to be finished in December 2022 when the new infrastructure will become fully operational. The performance review is expected to be successfully completed and the O&M manuals will be put in place by the end of January 2023. This is ahead of the planned Practical Completion Date which was agreed as 31st March 2023 and the Activity End Date which was agreed as 31st January 2023 via a Project Change Request.

2. Project Overview

2.1 Introduction

This £2.353m (£2.4m) project will install solar and wind pump infrastructure to transform the way the Environment Agency operates 2 of its existing critical flood risk assets to run more sustainably. The project is predicted to save 240 tonnes of carbon annually over the 25-year lifespan of the infrastructure.

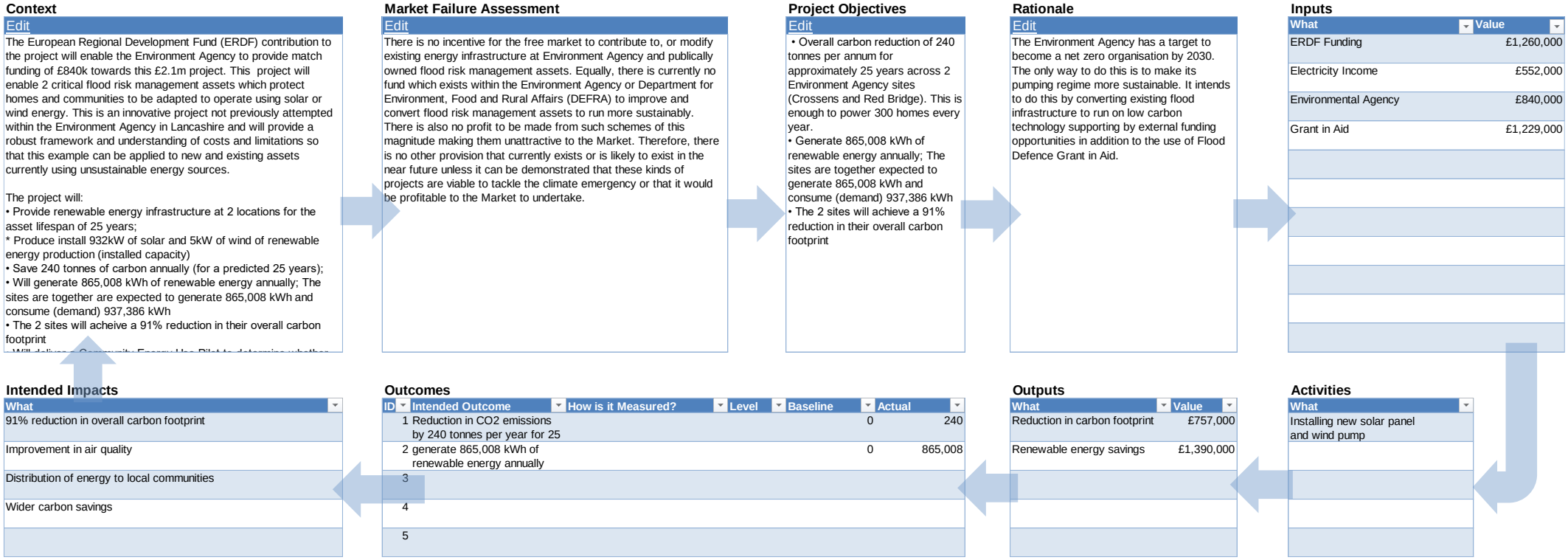
The project will give a total annual generation of 865,008 kWh of renewable energy. The sites together will achieve a gross 91% reduction in their overall carbon footprint in a standard year (2018 was used as the baseline year).

The project will include a community energy pilot study to understand if the energy generated can be used in a better way to benefit the local communities as well as developing a case study and toolkit to roll out the success and learning from this project to other existing and new public flood defence infrastructure.

The flood defence infrastructure which the project is aiming to improve is used to protect homes from flooding during high periods of rainfall. Energy is used to pump the floodwaters and high flows away from homes and land and the local and wider catchments within the floodplain are dependent on the operation of this infrastructure. The assets will continue this function once the project is complete. Energy is consumed at these sites more intensely during the periods of heavy rainfall and flooding. Energy will be generated most likely outside of these times.

The logic model prepared for this project is shown on the next page in Figure 2-1.

Figure 2-1. Logic model



2.2 Overall Context

Currently, none of the Environment Agency flood defence assets across Lancashire are operated using sustainable energy. This project will enable 2 assets at Crossens and on the Fylde (Red Bridge pumping station) in Lancashire to run on either solar power or wind energy, to store energy on site and export unused energy back to the grid. Energy exported to the grid will be used in times of need. There is no net gain in terms of energy generated and consumed at both sites. At each location there will still be a residual import of energy at a cost the Environment Agency but overall, a 91% carbon reduction is expected across both sites.

In October 2019, the Environment Agency set an ambition to achieve Net Zero Carbon in both operational and embodied carbon by 2030. Area departments are responsible for developing plans to achieve local decarbonisation targets. Cumbria & Lancashire area have identified renewable energy as one of their key routes to decarbonisation. To this end, the two sites have been identified which are considered ideal. The Crossens site is one of the Environment Agency's largest (estimated to use 40% of C&L operational assets total energy) and Hey Cop is typical of many small pumping stations; addressing these together will enable the breadth of relevant issues to be considered in one exemplar project.

2.2.1 Crossens Pumping Station

Crossens Pumping Station in Southport is a substantial and critical flood risk management asset owned and operated by the EA sitting within the Crossens catchment area in Southport. The proposed location for the solar array is upstream of the pumping station highlighted in yellow in Figure 2-2 and has an area of 14,057m2. The land is owned by the EA and some of this site area will be required for access routes. Existing access to Three Pools water way will not be altered as part of this project.

Figure 2-2. Location plan for Crossens Pumping Station

2.2.2 Hey Cop Pumping Station (Previously Red Bridge Pumping Station)

Redbridge Pumping Station was initially selected for a small scale (5kW) wind turbine. However, during early design phases it was determined that this would require bird and bat surveys which would delay overall programme and overly impact the business case.

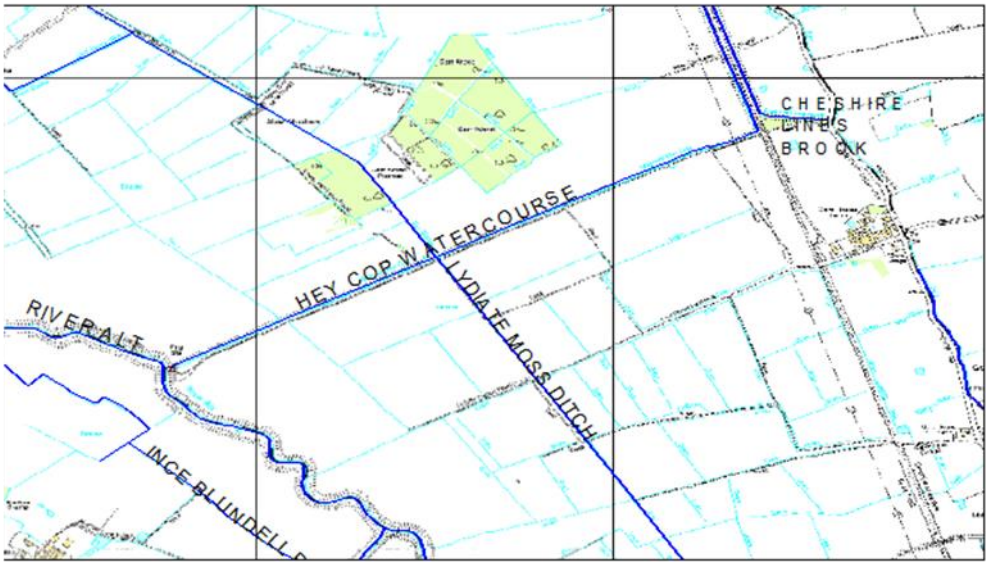
The project team consulted Merseyside Environmental Advisory Service (MEAS) who referred the team to Scottish Natural Heritage guidance concerning 'Mirco renewables and the natural heritage' which recommends siting "mirco wind turbines at least 30m away from potentially suitable bat habitat, especially in landscapes with little suitable habitat". Watercourse and hedgerows are both suitable bat foraging habitats and both features were identified within 30m of the Redbridge site boundary. Therefore Redbridge was not progressed and alternative sites were considered.

Following desktop review and site visits to two sites, Hey Cop was identified as a potential alternative. Hey Cop Pumping Station is an EA flood risk defence asset located near the River Alt in Merseyside, North West England. The asset is a concrete structure built into the River Alt Eastern Flood Defence bank at the intersection between the River Alt and the Hey Cop watercourse. The asset catchment is 680 acres of agricultural land plus storm sewage water from the 100,000 properties served by Hill House sewage treatment works upstream which accounts for around 90% of the flow pumped by the site. The station has four electric submersible pumps with a total pumping capacity of 3.5 cumecs (3,600m3/hr). Due to the size of site, there are no reception or welfare facilities and site operates unmanned.

However, similar to Redbridge, the site lays within 30m of potentially suitable bat habitats. Therefore, alternative solutions were evaluated. Hey Cop possessed unobstructed roof space suitable for a similar scale solar PV installation which is deliverable within the funding timescales and still provides an example of the EA asset/site types. Therefore, Hey Cop Pumping Station was identified as the second pathfinder site and the technology to be installed at this site has changed from micro wind turbines to solar PV.

The scale and cost of the Hey Cop installation is negligible (less than 1%) in comparison to Crossens, therefore discussion of the combined project with emphasis on Crossens is considered appropriate for the remainder of this report.

Figure 2-3. Location of the Hey Cop site



The project will aim to develop a case study and feasibility analysis to enable the EA to adapt other flood defence assets to run using sustainable energy generated on site. It will enable the EA to improve the power sources at its other critical flood defence assets across Lancashire and will allow the transitioning from diesel to low carbon.

2.3 Market Failures and Economic Context

The funding of flood infrastructure to operate using low carbon technology is currently unfeasible as there is currently no cost benefit to Department for Environment, Food and Rural Affairs (DEFRA) to upgrade EA infrastructure. The costs are high and a funding source does not currently exist. Until there is a way of demonstrating the costs, feasibility, and low carbon benefits of such a move there is unlikely to be funding in

the near future. The case study and toolkit will be used by the EA within Lancashire and further afield so that other critical flood infrastructure can be upgraded.

There is no incentive for the free market to contribute to, or to modify existing public flood defence infrastructure at EA and publicly owned sites. Equally, there is currently no fund which exists within the EA or DEFRA to improve and convert flood risk management assets to run more sustainably. There is also no profit to be made from such schemes of this magnitude making them unattractive to the Market. Therefore, there is no other provision that currently exists or is likely to exist in the near future unless it can be demonstrated that these kinds of projects are viable to tackle the climate emergency or that it would be profitable to the Market to undertake.

The EA as a non-departmental public body has a target to become a net zero organisation by 2030 to help tackle the climate emergency. By 2030, the EA will aim to balance the carbon emissions it produces with those it takes out of the atmosphere so that the EA are no longer contributing to climate change.

This goal is based on the internationally-recognised Science Based Target Initiative methodology and includes the carbon emissions the EA produces (currently 44,000 tonnes a year) and those that are generated through the supply chain (136,000 tonnes a year). By 2050 the Environment Agency's ambition is to become an 'absolute zero' organisation – one that does not produce any carbon emission at all.

2.4 Rationale

In October 2019, the EA set an ambition to achieve Net Zero Carbon in both operational and embodied carbon by 2030. Area departments are responsible for developing plans to achieve local decarbonisation targets. Cumbria & Lancashire area have identified renewable energy as one of their key routes to decarbonisation. To this end, two sites have been identified which are considered ideal. The Crossens site is one of the Environment Agency's largest (estimated to use 40% of C&L operational assets total energy) and Hey Cop is typical of many small pumping stations; addressing these together will enable the breadth of relevant issues to be considered in one exemplar project.

Currently, none of the Environment Agency flood defence assets across Lancashire are operated using sustainable energy. This project will enable two assets, one at Crossens Pumping Station and one at Hey Cop Pumping Station in Lancashire to run on solar power, to store energy on site and export unused energy back to the grid. Energy exported to the grid will be used in times of need. There is no net gain in terms of energy generated and consumed at both sites. At each location there will still be a residual import of energy at a cost the EA but overall a 91% carbon reduction is expected across both sites.

The project will develop a case study and feasibility analysis to enable the Environment Agency to adapt other flood defence assets to run using sustainable energy generated on site. It will enable the EA to improve the power sources at its other critical flood defence assets across Lancashire and will allow the transitioning from diesel to low carbon.

The Outline Business Case (OBC), prepared as part of the process of EA's 5 Case Business Model, compared the proposed option "With Project" with the "Baseline" (i.e. business as usual/continue as existing) and focusses solely on the electricity supply to the pumping station, associated carbon savings, and air quality improvements.

It is important to note the electricity is solely used for flood risk management purposes, with the vast majority being used to remove water from the catchment which otherwise would flood land, people and properties. A small amount is used for ancillary purposes such as lighting of the pumping station. The Full Business Case (FBC) did not examine the economic case for the pumping station as no change to its ability to reduce flood risk is proposed.

Several points are worth noting:

- If the project was not approved, the Environment Agency was estimated to spend PV £2.957 million pounds over 30 years on electricity from FCERM Grant-in-Aid (revenue) budgets excluding any inflation.
- After the project has been approved, the Environment Agency will spend PV £2.019 million on electricity, a financial saving of £939,000

- Electricity Income is an additional revenue from exporting solar power to other EA sites saving an additional £552,000.

2.5 Project Objectives

The project has the following objectives:

- To reduce the carbon footprint of EA flood risk management assets of Crossens Pumping Station and Hey Cop Pumping Station by the implementation of renewable energy generation on site. Reducing site carbon footprint by 240 tonnes CO2, measured at project completion, and reviewed annually.
- To investigate and implement where feasible, batteries for storage of renewable energy generated on site at Crossens Pumping Station. This objective will be reviewed at two stages 1) contractor design 2) construction completion.
- To investigate the feasibility of a future community energy project at Crossens Pumping Station.
- We have a commitment under the funding agreement to understand how generated energy can be made available/shared/distributed to the benefit of the local community.
- To develop a pathway for implementation of further renewable energy projects at other flood defence assets and sites in the Cumbria and Lancashire area. Captured by a Summative Assessment and lessons learned report at project completion.
- Minimise the embodied carbon of the project design (as carbon reduction is a primary funding goal). By delivering the project to the carbon budget stated in the FBC (2094 tonnes) or better by construction completion.
- No net impact local ecology and habitat by providing environmental enhancement measures where possible/practicable. Increase site biodiversity by a minimum +10% over the project lifetime (30 years).

3. Project Progress

3.1 Introduction and Overview

As mentioned in Section 2.2, the Environment Agency set an ambition to achieve Net Zero Carbon in both operational and embodied carbon by 2030, and renewable energy was identified as one of the key routes to decarbonisation. Provision of renewable energy infrastructure at both The Crossens site and Hey Cop pumping station within one exemplar project will provide the EA with a case study and a toolkit which will help to facilitate similar projects at the other sites, both on large and small scale.

The C&L Partnerships & Strategic Overview team submitted an application for funding to the ERDF, which was approved in April 2020. The ERDF funding covers up to £1.26 million of project costs, presently over 50% of the scheme.

The Strategic Outline Case (SOC) was completed in August 2020, the Outline Business Case (OBC) was approved in December 2020, and the Full Business Case (FBC) was completed in September 2021.

The ERDF funding is primarily concerned with carbon reduction but with additional ambitions including community benefit, innovation, and replicability. From an EA perspective, in addition to these drivers, the project also needs to demonstrate economic benefit over the existing case/business as usual. Therefore, the options have been appraised on the following basis:

- Carbon reduction (including embodied carbon)
- Economic benefit
- Community benefit
- Innovation

The OBC included a long list of options for the Crossens site which were analysed to decide whether they provide viable solutions to the problem. The options were:

- Maintain existing mains electricity supply as the sole source of power for pumping station. This option was rejected as it does not assist in meeting the 2020 net zero carbon target. This option was used as a baseline.
- Install wind turbines to provide green power. While this option would be expected to achieve carbon savings, it was rejected due to the risks associated with obtaining planning permission due to the risk to local wildlife and unacceptable visual and local impacts on the local residents.
- Install solar panel array to provide green power. While this option would provide carbon savings and would reduce energy imports, it was not compliant with ERDF funding requirements.
- **Install solar panel array and electric vehicle charging points and batteries. This is a shortlisted option which has been selected due to potential to achieve carbon savings on the site as well as enabling wider carbon savings, alongside reduced energy import requirements.**

The OBC compared the proposed option "With Project" with the "Baseline" (i.e. business as usual/continue as existing) and focusses solely on the electricity supply to the pumping station, associated carbon savings, and air quality improvements.

It is important to note the electricity is solely used for flood risk management purposes, with the vast majority being used to remove water from the catchment which otherwise would flood land, people and properties. A small amount is used for ancillary purposes such as lighting of the pumping station.

The business case did not examine the economic case for the pumping station as no change to its ability to reduce flood risk is proposed.

The delivery of the project was secured via a tender which has been issued on the Crown Commercial Services Framework – Heat Networks and Electricity Generation Assets (HELGA) and assessed on a price/quality basis. The returns have been reviewed and a preferred bidder has been selected. The construction cost from the

preferred bidder has been used in the cost build up. The contract has been awarded to the preferred supplier, Aberla Energy Limited, following the approval of the FBC.

3.2 Progress towards objectives, including outputs, outcomes and financial targets

From inception to delivery, there were many key stages and timeframes for completion, including investigation, modelling and testing of options, business case development and design, planning, funding applications and other approvals that needed to be in place.

The project is currently under construction. Following the approval of the Full Business Case, Aberla Energy Limited was selected as the preferred contractor.

So far, the following tasks were completed:

- A range of Ecological and Environmental reports was delivered between March 2021 and July 2021, including Wintering Bird Survey and Agricultural Impact Assessment, and an Environmental Action Plan was prepared in August 2021.
- Jacobs delivered a Geotechnical Desk Study & Ground Investigation Scope Report in October 2021.
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- The site became mobilised in August 2022. So far, Aberla have completed the perimeter fencing and access gates, the access road and drainage, trenching for the power cables over the site back to the pumping station, Base-Plate installations works, installation of the frames for solar panels, power module installation, DC string works and work on inverters.
- Majority of the civil and excavation works, such as trench works or HV cable pull have also been completed with assistance from Wysons and Wrights.

In order for the project to be finalised, the following tasks will need to be completed:

- Civil and excavation works need to be completed, including Solar Substation and BESS Install. Those tasks are scheduled for the end of October, with Factory Acceptance Test booked for 31st November.
- Commissioning Process is expected to be concluded in early December.
- Landscaping activities, such as wild grass planting or hedge row planting are also expected to be completed in January 2022.
- The site is expected to be demobilised in the first week of January.
- The System Performance Review and O&M Creation is expected to take 5 weeks once the site is closed, and are expected to conclude in January 2023.

The project is therefore expected to be finished in December 2022 when the new infrastructure will become fully operational. The performance review is expected to be successfully completed and the O&M manuals will be put in place by the end of January 2023. This is ahead of the planned Practical Completion Date which was agreed as 31st March 2023 and the Activity End Date which was agreed as 31st January 2023 via a Project Change Request.

The benefits will only be realised once the infrastructure is put to use, but it is an expectation that all of the benefits will be realised due to successful implementation of the project.

The initial plan for the project included creation of a 'Community Energy Pilot Feasibility Study' to enable the project to deliver electric vehicle charging points and to understand how else the energy generated can better serve the local community. However, instead the project plan has been modified to allow for an EV charging station adjacent to the site for charging future potential EA electric vehicles.

3.3 Financial Targets

A total of £1.26m of ERDF ESIF funding, which represents 51% of the initial overall costs of the project, was secured together with all other funding as shown in the table below. At the time of this evaluation, 100% of the ERDF expenditure has been defrayed, with the final settlement dependant on the completion of the Summative Assessment Report. The original annualised funding profile is shown in Table 3-1.

To date, £1m of the ERDF funding has been drawn down in November 2022, with the remaining £0.26m to be drawn down in December 2022. Therefore the project did not follow the original funding plan shown below, which can be explained by alterations to the timelines implemented via change requests due to unforeseen circumstances.

Table 3-1. Original annualised funding profile

Annualised funding profile (£k)	Yr 0 2019-20	Yr 1 2020-21	Yr 2 2021-22	Yr 3 2022-23	Yr 4+ 2023-24+	Total
Grant in Aid						
(list by function)	25	125	130	949	0	1229
Partnership funding						
ERDF funding	0	0	126	1134	0	1260
Contributions						
(list by name)						
Other sources:						
(list by name)						
Initial project costs	25	125	256	2083	0	2489

The project is expected to be delivered to budget, although during construction the budget was adjusted to accommodate requirements where minor re-design was required and overcome constraints due to Covid restrictions.

Throughout the project, financial aspects were well managed and dealt with appropriately.

Applications to MHCLG were made using the prescribed e-claims to submit ERDF claims with the supporting reports and documentation included.

Applications to the EA were also completed using the FCERM 3 form for interim payments. Appropriate supporting documentation was also provided where appropriate.

Payments to the Contractor were made in accordance with the NEC suite of documents, utilising appropriate templates and pro forma, and the Contractor and Client Project Managers followed NEC Governance throughout.

3.4 Conclusion

The project has performed well and as anticipated in respect of delivering the outputs and expenditure targets.

At the time of this evaluation, all outstanding ERDF claims have been submitted and all of the targets are on track to be achieved. Even though there were delays due to Covid, global supply chain issues and the War in

Ukraine, the project remained on target throughout to spend the allocated budget of ERDF funding (Total £1.26m).

This project is going to be complete in December 2022 and all output objectives as noted in the logic model and plan are expected to be achieved within the budget and timeframes allowed. The performance review is expected to be successfully completed and the O&M manuals will be put in place by the end of January 2023. This is ahead of the planned Practical Completion Date which was agreed as 31st March 2023 and the Activity End Date which was agreed as 31st January 2023 via a Project Change Request.

4. Project Delivery and Management

4.1 Procurement

A procurement strategy has been developed for this scheme in consultation with Ian Lockhart, Defra Group Commercial Manager.

Jacobs were employed under the Collaborative Delivery Framework (CDF) on an option E to assist with the preparation of the ERDF application form. The submission indicated that the CDF will be used for the delivery. It is thought that it would also be acceptable to use another approved framework such as the Operations Framework (NFOF).

Jacobs have been re-employed on an Option E contract under the CDF to provide further advice on the outline design, budget costs and procurement route up to completion of the SOC. An Option C contact on the CDF has been issued to Jacobs in for the appraisal, design and support required to deliver the scheme, including the submission of the FBC.

Ian Lockhart from Defra Commercial has investigated the use of renewable energy specialist frameworks within the wider Defra Group to deliver the works at both sites. This work has concluded that a Crown Commercial Services Framework – Heat Networks and Electricity Generation Assets (HELGA) should be used. This approach has been discussed and agreed with Paul Durkin, the Commercial Services Manager.

Potential routes to market were explored by DCG and Jacobs. This exercise determined that the preferred route was to use an existing government framework though Crown Commercial Services HELGA frameworks. This contractual approach has been discussed and approved with Paul Durkin, the Commercial Services Manager.

The tender has been issued on the HELGA framework and assessed on a price/quality basis. The returns have been reviewed and a preferred bidder has been selected. The construction cost from the preferred bidder has been used in the cost build up. Aberla Energy Limited was contracted as the preferred bidder following the approval of the FBC.

All funding was secured and with all contracts and agreements in place, construction was able to start on site on 8th August 2022.

4.2 Project Management Arrangements and Governance

The project is being delivered and managed by the EA's Programme and Contract Management Service team. The key roles on the project as they currently stand are listed below.

Table 4-1. Key roles

Project Role	Name
Project Sponsor	Ant Swarbrick (Operations Manager)
Senior User	Stephanie Woods (Asset Performance)
Project Executive	Ian Gemmell (PCM)
Project Manager	Stephen Bamber (PCM)
Senior Supplier	Mark Shepard (Jacobs)

The project is being led and delivered by the EA as the Accountable Body. The EA is managing this project through its dedicated PCM team based in Warrington supported by area staff who have been involved in developing the project.

The Environment Agency has robust project management and governance systems and procedures in place to ensure compliance with ESIF requirements. EA also have experience of other ERDF projects and all project management follows the PRINCE2 principles. To ensure consistency with these, a defined organisation structure for the project management team has been agreed. In addition, the project was divided in to manageable and controllable stages. Change control logs, and risk registers have been kept by the Project Manager for the scheme.

Any changes to the project in terms of outputs, programme, cost etc. were raised by the Project Manager and logged at the relevant board meeting. If these were minor issues or changes to the project, within a set tolerance, then they were dealt with by the Project Manager; otherwise, they were escalated as appropriate to the Project Board.

The Project Manager together with the project team coordinated and/or attended project meetings and working groups as required during the lifetime of the project. These meetings covered technical, financial, commercial and management elements and minutes of the meetings were distributed and kept as a record on file for any future audit.

Regular project meetings (monthly) allowed the discussion and review of items such as the project risks, development programme and financial position throughout the development. Any relevant issues highlighted were then be reported to the Project Board as appropriate with any agreed corrective actions or decisions cascaded to the project team via the Project Manager. Regular updates were provided to the relevant MHCLG officer in line with claim requirements, quarterly reporting and as part of the Summative Assessment and Logic Model as required.

An Environment Agency detailed risk assessment has been undertaken and a copy of the current risk register for the project can be provided if requested. This identifies risks by category, likelihood, impact, score, and outlines mitigation measures. The risk register was maintained and updated by the Project Manager who was also responsible for undertaking actions to mitigate risks that do not need to be escalated to the Project Board. Regular project meetings allowed for review of the risk register and the assignment of risks to project partners for management.

To ensure the accuracy of information and data as well as project updates, the project board met monthly and received scheme updates as required. The roles and responsibilities for those attending and on behalf of their organisations were clear. Systems were put in place through Environment Agency (DEFRA) finance teams to monitor programme delivery and spend. Feedback from previous projects and audits was also applied as necessary.

The project provided all revenue costs as an in-kind contribution. Staff was provided from existing budgets to work on the project. No EA Staff costs are considered eligible or claimed for.

4.3 Project Delivery

The construction phase is being well managed and the works are expected to be successfully delivered by the end of December 2022.

The project is expected to be completed on schedule and within budget tolerances, although during construction these did change to accommodate requirements where minor re-design was required and to overcome constraints due to Covid restrictions. The project timeline was delayed due to planning and further environmental surveys being required. A project Change Request to vary the program was issue by the Project Manager and accepted by the board (PCR reference Number 007293). Throughout the project these adjustments were considered and approved by the Project Board and where additional funding was required, it was secured from sources other than ERDF.

The PCR mentioned above was required to reflect the changes in the delivery timescales . As a result of this the spend profile has been revised to reflect the revised start date. This is the second PCR for the project. Another PCR submission was issued during December 2021 due to a slight increase in scheme costs and delays due to statutory overwintering bird survey requirements.

There have been regular meetings to ensure effective communications from Project Board to the delivery team and the delivery team worked closely on site to overcome any issues and ensure daily progress.

Representation from the EA Asset Performance and Field Teams, as “end users” were included on the delivery team to ensure that any potential problems are identified and resolved before completion. This effectively reduced the issues that could have been identified as problems requiring consideration on completion of the project.

The main issues during construction were Additional Solar Panels added due to best utilisation of available space. Additional (increased) spend was necessary due to inflation costs, this being due to COVID, world supply

chain shortages and the war in Ukraine. Additional costs associated with these impacts were funded from sources other than ERDF.

5. Project outputs, outcomes and impacts

5.1 Overview

The project is expected to be completed by the end of 2022 with an official opening event taking place on February 2023. All objectives (outcomes and impacts) as noted in the Logic Model and Plan are on track to be achieved within the allowable budget and timescales.

Project objectives and outputs identified in the Logic model include:

• Overall carbon reduction of 240 tonnes per annum for approximately 25 years across 2 Environment Agency sites (Crossens and Red Bridge).

• Generation of 865,008 kWh of renewable energy annually; The sites are together expected to generate 865,008 kWh and consume (demand) 937,386 kWh.

• 91% reduction in the overall carbon footprint across the 2 sites.

As this project relates to just the energy supply to an FRM asset(s) and hence looks at carbon saving, sustainability and value for money rather than reducing flood risk, the conventional FRM Do Nothing and Do Minimum options have not been used as the baseline. The baseline is 'Continue as existing'. This is the same (in terms of energy supply) as an option to "sustain the standard of service of the asset" as described in the FCERM Appraisal Guidance. Use of other baselines (e.g. Do Nothing) would widen the business case in looking at flood risk, whilst this baseline gives a clear baseline against which cost and carbon savings and compliance with EA and other relevant policies etc. can be measured.

The outputs were calculated using the following methodology:

5.1.1 For Solar (Crossens)

Standard estimation method to forecast each output (deliverable) has been used. The Microgeneration Certification Scheme (MCS) is an industry led certification scheme for microgeneration products and installation services. The MCS has developed the Standard Estimation Method with the purpose of a standardised procedure is intended to prevent miss-selling and overestimation of PV systems – such that all customers will receive a system performance estimation completed to a standardised procedure.

The procedure from MCS is as follows:

1. Establish the electrical rating of the PV array in kilowatts peak (kWp)
2. Determine the postcode region
3. Determine the array pitch
4. Determine the array orientation
5. Look up kWh/kWp (Kk) from the appropriate location specific table
6. Determine the shading factor of the array (SF) according to any objects blocking the horizon - using shade factor procedure.

The estimated annual electricity generated (AC) in kWh/year of installed system is then be determined using the following formula:

Annual AC output (kWh) = kWp x Kk x SF

As part the feasibility study local suppliers were approached for their initial assessments of the site. One supplier Ryse Energy responded gave an assessment using the midlands zone and an inclination of 15°, suggesting a kWp of 977 annual AC output of 797,215 kWh/year, the results also may deviate due to the quality of solar of panels proposed for installation.

Following these assessments, Jacobs undertook further detailed assessment of the solar resource at site. This included analysis of PVGIS data for the location and modelling array size and output for three scenarios (medium, budget, and premium) solar panels. This was to illustrate the range of kWp and kWh/year that could reasonably achieved at site. This analysis allowed an approximate number of solar panels, inverters, and cabling to be identified and also allowed hourly site demand data to be mapped against hourly solar output in order to understand the amount of energy that could be self-consumed, exported off site, and the residual import requirements. This help further understand the likely grid connection requirements and the likely costs associated with this.

5.1.2 For Wind (Red Bridge), now Hey Cop

Domestic wind turbine options were reviewed and initially screened against site space constraints and to minimise potential planning barriers. A similar approach to solar was then taken whereby the performance curves of the turbines were mapped against the local hourly wind resource (NOABL and PVGIS-SARAH databases used) to determine hourly generation output for indicative purposes. This hourly output was then compared to hourly site demand. The turbine which best met the demand requirements was recommended as the option to take forward. Assessment by local supplier was also undertaken and the results cross compared. However, as described in previous sections of the report, wind was not a viable option due to bats habitation, so a Solar based alternative was constructed instead.

5.2 Economic Benefits

In respect of the ERDF funding we have been granted, it is primarily concerned with carbon reduction but with additional ambitions including community benefit, innovation, and replicability. From an Environment Agency perspective, in addition to these drivers, the project also needs to demonstrate economic benefit over the existing case/business as usual. Therefore, the options have been appraised on the following basis:

- Carbon reduction (including embodied carbon)
- Economic benefit
- Community benefit
- Innovation

The economic benefits of each option have been extracted from the preferred Contractor's tender response and are in-line with Consultant estimates provided at OBC stage:

- 2020 half-hourly electricity consumption data which indicates 1,507,593 kWh/year consumption at Crossens a unit rate of c. 10p/kWh
- Estimated energy generated by the solar array – 929,884 kWh/year.
- Generated power that will be stored and used on site and therefore offset imports – 505,615 MWh/year at 10p/kWh saving.
- The generated power that will be exported with revenue generated via the Smart Export Guarantee (SEG), sleeving, or similar – 424,234 kWh/year (assumes 7.23p/kWh, based on top 10 SEG rates)

The economic costs of each option have been taken from the preferred Contractor's tender response:

- The EPC turnkey cost provided by the preferred Contractor was £1,586,274 and closely matches the OBC cost estimate. The next preferred bidder was within 5% of this value.
- O&M costs are estimated to be c. £10k/year again based on the preferred Contractor's tender response and matches OBC cost estimates.

5.3 Contributions

All of the funding for the project was from public sources, including ERDF (£1,260k) and Grant in Aid (£1,229k). No private sector contributions were secured.

5.4 Other Impacts and Additional Benefits

In addition, an appraisal of the carbon and air quality improvement value in accordance with HM Treasury Greenbook suggests the following benefits for Crossens over the 30- year project lifetime:

• £757k of carbon value – using carbon prices over the 30-year asset life; and

• £43k of air quality value – using values for National Average Electricity over the 30-year asset life.

6. Value for money

6.1.1 Summary of financial appraisal

Table 6-1 shows the breakdown of the costs of the project, showing the cost of the development of the business case, the core projects costs, and risk level priced into the project.

Table 6-1. Breakdown of project cost

Project Summary (£k)	Project cost (approval)
Project development costs	25
a) to SOC	68
b) SOC to OBC	55
c) OBC to FBC	235
Post approval project costs	1816
Risk	302
Inflation	n/a
Initial project costs	**2489**

Table 6-3 shows a more detailed breakdown of the project cost.

Table 6-2. Breakdown of project cost – additional detail

Annualised spend profile (£k)	Yr 0 2019-20	Yr 1 2020-21	Yr 2 2021-22	Yr 3 2022-23	Yr 4+ 2023-24+	Total
Internal staff costs		30	38	30		98
External consultant fees						
Jacobs (CDF supplier)	25	95	183	20		323
Principal Designer			5	10		15
ECC PM			10	35		45
Cost Advisor				24		24
Supervisor				24		24
Project Manager			20	52		72
Project implementation costs (construction/services/goods)						
Construction				1586		1586
Environmental/Technical				Inc above		
(list by type & name)						
Other:						
(list by name)						
Risk contingency				302		302
Inflation		(%)				0
Initial Project costs	**25**	**125**	**256**	**2083**	**0**	**2489**
Future costs (if applicable):						
revenue					281	281
capital					Inc above	

Annualised spend profile (£k)	Yr 0 2019-20	Yr 1 2020-21	Yr 2 2021-22	Yr 3 2022-23	Yr 4+ 2023-24+	Total
future risk/optimism bias						
Project whole life costs	25	125	256	2083	281	2770

6.1.2 Funding sources

Table 6-1 shows the breakdown of the funding sources, as well as the original plan for the funding draw down. The project did not follow the original funding plan shown below, which can be explained by alterations to the timelines implemented via change requests due to unforeseen circumstances. However, with the ERDF funding drawdowns planned for November and December 2022, all of the ERDF funding will be collected by the end of year 2022/23, as initially planned.

Table 6-3. Funding sources

Annualised funding profile (£k)	Yr 0 2019-20	Yr 1 2020-21	Yr 2 2021-22	Yr 3 2022-23	Yr 4+ 2023-24+	Total
Grant in Aid						
(list by function)	25	125	130	949	0	1229
Partnership funding						
ERDF funding	0	0	126	1134	0	1260
Contributions						
(list by name)						
Other sources:						
(list by name)						
Initial project costs	**25**	**125**	**256**	**2083**	**0**	**2489**

During the project development, the project team have been in contact with Adam Stephenson and Boaz Sadeh from the FCRM Programming team for Cumbria & Lancashire area, who have confirmed that the EA funding for this project is from GiA under the 'Local Choices Capital Over-programme' as also approved by Keith Ashcroft, Area Director. They have also confirmed that funding for the construction phase in 2022-23 is included in the programme refresh for 2021.

Although the project has no flood risk objective, all electricity produced will be used for flood risk management purposes. The vast majority of such will be satisfying the energy requirements of the two strategically important flood risk management pumping stations. The savings in electricity costs after the initial payback period will reduce the amount of revenue FCERM GiA needed by the two pumping stations.

6.1.3 Savings by project

The OBC compared the proposed option "With Project" with the "Baseline" (i.e.business as usual/continue as existing) and focused solely on the electricity supply to the pumping station, associated carbon savings, and air quality improvements.

It is important to note the electricity is solely used for flood risk management purposes, with the vast majority being used to remove water from the catchment which otherwise would flood land, people and properties. A small amount is used for ancillary purposes such as lighting of the pumping station. The FBC did not examine the economic case for the pumping station as no change to its ability to reduce flood risk is proposed.

The main findings, which can be found in Table 6-4, include:

- Through the approval of the project, the Environment Agency is expected to spend PV £2.019 million on electricity, a financial **saving of £939,000**

- Electricity Income is revenue from exporting solar power to other EA sites **saving an additional £552,000**

Table 6-4. Comparison of project implementation against the baseline scenario

	Baseline (A)	With project (B)	Saving by project (A-B)
Financial Costs			
1. Project cost inc. risk & optimism bias		£2,489k	
2. Electricity cost	£2,957k	£2,019k	+£939k
3. Maintenance cost		£178k	
Financial Income			
4. Electricity income		-£552k	
5. ERDF contribution		-£1,260k	
6. Net cost (1+2+3+4+5)	£2,957k	£2,874k	+£83k
Additional Economic Savings			
7. Carbon Cost	£2,275k	£1,518k	£757k
8. Air Quality Benefits		-£43k	
Net cost with Additions (6+7+8)	**£5,232**	**£4,349k**	**£883k**

7. Conclusion

7.1 Conclusion

This Summative Assessment recognises that there is clear evidence to support the case for the delivery of renewable energy infrastructure to transform the way the Environment Agency operates two of its existing strategically important flood risk assets in Lancashire and that the project development, business case and rationale employed also strongly supports this.

The robust process followed throughout the conception, development and delivery stages of this project have enabled the successful delivery of outputs, outcomes and impacts as anticipated. This has included the assurance at National Project Approval Board (NPAB) through the adoption of the EA's 5 Case Business Model. An additional benefit of this approach is that all parties understand what the investment and delivery expectations are, which has contributed to efficient and collaborative working.

The project is expected to be completed on schedule and within budget tolerances, although during construction these did change to accommodate requirements where minor re-design was required and overcome constraints due to Covid restrictions. The project timeline was delayed due to planning and further Environmental surveys being required. A project Change Request to vary the program was issue by the Project Manager and accepted by the board (PCR reference Number 007293). Throughout the project these adjustments were considered and approved by the Project Board and where additional funding was required, it was secured from sources other than ERDF.

The construction phase is being well managed and the works are expected to be successfully delivered by the end of December 2022. The project is expected to deliver all of the benefits outlined in the Business Case and is considered to be a success. All contractual targets are expected to be met and the payment claims were submitted in a timely manner. The project was delivered through very difficult times, and the positive approach to partnership working through these unprecedented times is a testament to the project team, the workforce and others involved through the supply chain.

The use of established best practise, approved and adopted processes, including FDGiA Appraisal, 5 Case Business Case Model, procurement and use of the HELGA Framework, are all fundamental to the success of the project. However, the expertise, knowledge and experience of those involved with the project has also significantly contributed to its success.

7.2 Lessons learned

There will be as part of the closedown of the project a post project evaluation. This is to verify that all objectives have been met, the intended benefits are realised and lessons learnt during the life of the project are captured and shared with the Project Board. This will include:

- Check that project outcomes have been delivered in sufficient quality and that project objectives are met.
- Assess project performance against indicators outlined in the Project Initiation Document.
- Ensure that ongoing support arrangements are provided for and formally handed over.
- Assess lessons learned and share with colleagues so that they can replicate successes and avoid pitfalls.
- Write end of project and lessons learned report.
- Meet with sponsor to confirm that all deliverables have been delivered, that objectives have been met, and to secure formal sign-off.
- Undertake post-project implementation review 12 months after closedown to understand whether the benefits of the project have been fully realised.
- The Summative Assessment of the project prepared for ERDF to conclude the funding is separate to internal post project evaluation

7.3 Project strength and weaknesses

7.3.1 Project Strengths

The main project strengths were identified as:

- The project used an experienced contractor in this field of work which allowed for successful delivery of the infrastructure to the specified timelines and budget;
- The EA used a Project Manager with extensive electricity generation and distribution experience. The sector specific knowledge allowed the manager to better understand the requirements of the project and the expected outcomes and impacts which the project aims to deliver. It also facilitated clear communication with the contractor;
- The project support team consultants appointed for this project had previous experience with similar types of developments which facilitated better understanding of the support required by EA;
- The project has gained internal support within EA at all levels of management;
- The EA were able to support all other aspects of the project (including BDNG, landscaping etc.) using in house resources. This facilitated quick communication between the different teams and provided opportunities for the wider group of EA employees to gain experience which hopefully, following successful implementation of this project, can be applied to other sustainable infrastructure projects; and
- The Project has gained general support of the local community.

7.3.2 Project Weaknesses

The main project weaknesses were identified as:

- Initially this project was a new subject matter for the EA and it did not have the internal resource required to deliver it identified at the time of inception.
- The project was impacted by the Covid Pandemic resulting in the process being drawn out and fragmented due to the Covid lock down being an unknown period.
- The EA secured external funding but were unaware/ inexperienced of what the funding providers required to allow release of the funding until late on in the project.

7.4 Recommendations

The recommendations below are based on the way this project has been developed and delivered with due regard to the research required to compile this Summative Assessment and also the Lessons Learned that have been recorded. The recommendations should be considered by anyone considering delivering a similar project.

Recommendation 1: Keep the learning experience of the project team together to use on other similar projects and make the wider EA aware that such a team exists as the EA is progressing other PV projects.

Recommendation 2: Early engagement with a Specialist Contractor.

Recommendation 3: Create a Project Bank account in the event that external funding is available to capture any expenditure defrayed. This will make the process far easier when submitting claims to draw down in the future.