Annex 1 – Technical Annex

1 Technical Solutions

The long list of technical solutions that will be considered in the next stage of project development include:

- Ground-mounted solar PV
- Onshore wind
- Green hydrogen production and utilisation
- Battery energy storage
- EV charging infrastructure
- Council depot

A high-level summary of the various technical solutions that could be deployed on site is presented within this report. At this stage, the council is not committing to any specific technical solution or combination of solutions. The next stage of the project will assess the feasibility, viability, and desirability of the long list of technical solutions in order to inform a decision on the specification and coverage of the GEP development (the "what"). The outputs of this work will be used to develop a Strategic Outline Case (SOC) for a 'preferred way forward'[1].

1.1 Ground-mounted solar PV

At Harewood Whin, there are large areas of capped landfill which lend themselves to large scale ground-mounted solar PV. Ground-mounted solar PV is one of the few forms of development which can be compatible with use at a capped landfill site (although these sites are typically more complex and expensive to construct). This is due to the non-intrusive nature of the work which can be achieved via the use of ballast mounted frames (panels on a concrete slab) to secure PV panels without disturbing contaminants beneath the array. Situating a PV solar array on a landfill does, however, require considered assessment of the

[1] HM Treasury (2018). Guide to Developing the Project Business Case. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749086/Project_Business_Case_2018.pdf

depth and age of capping, but initial indications are that this will be more adequate at the Harewood Whin site.

The feasibility study identified that up to 28MW of solar PV could feasibly be installed at the Harewood Whin site. A standalone 28MW solar array could generate up to 28.7GWhs of electricity per annum – the equivalent of 7,363 households' annual energy usage – and result in 5,947 tCO_2e savings per annum. The 28MW solar PV array would be installed on mounting systems situated on the three distinctive 'mounds' of capped landfill that cover the majority of available area on site.

Whilst 28MW of solar PV capacity could be delivered on the Harewood Whin site, a smaller-scale solar PV array could be delivered on site. A small-scale array could be considered, for example, to meet the existing on-site demand from the leaseholder Yorwaste or designed to meet any additional on-site demand from new technologies installed on-site such as EV charging, hydrogen electrolysers, or battery storage.

Significant work has already been undertaken by Yorwaste to explore and progress the 28MW solar PV array opportunity at Harewood Whin. In September 2023, Yorwaste submitted a full planning application for a proposed 28MW solar PV array at Harewood Whin (planning reference: 23/01732/FULM).

Further work will be required as part of the next stage of project development to determine the estimated capital cost of developing a 28MW large-scale solar installation. Based on available cost estimates for UK-based utility-scale solar PV projects, the estimated capital cost of delivering 28MW of solar PV is between £17m – 25m[2].

1.2 Onshore wind

The development of onshore wind follows a similar process to that of solar PV, but with the particular requirements that wind turbines must be located in high wind speed sites to maximise energy production. Furthermore, the size of turbines makes visual effects a particularly important aspect of the environmental assessment.

[2] Cost estimates derived from sources including the Yorwaste feasibility report, WSP, and the Department for Energy Security and Net Zero.

The feasibility study commissioned by Yorwaste contained a high-level assessment of the site's suitability for onshore wind development. The study concluded that the site has a suitable wind profile and could support 4MW of onshore wind. A 4MW wind installation could generate up to 10.51GWhs of electricity per annum – the equivalent of 2,697 households' annual energy usage – and result in 2,178 tCO_2e savings per annum. Based on available cost estimates for UK-based onshore wind projects, the estimated capital cost of delivering 4MW of onshore wind if constructed between 2025-2030 is between £4m - £6m[3].

The feasibility study concluded, however, that due to longer planning timescales and the low likelihood of securing planning approval, onshore wind should only be considered as part of a future phase of development (if planning policy is updated to align with the rules for decision-making on other types of energy projects).

In September 2023, the government updated national planning policy to provide that LPAs should approve planning applications for an onshore wind farm if[4]:

- It is an area identified as suitable in the local development plan (local plan or a neighbourhood plan) or a supplementary planning document.
- The planning impacts identified by the affected local community have been appropriately addressed and the proposal has community support.

In the short term, planning policy is likely to continue to present a potential obstacle to developing onshore wind at Harewood Whin. Nevertheless, the next stage of the project will revisit the feasibility assessment of onshore wind development of site to determine whether this presents a feasible and viable option.

1.3 Green hydrogen production and utilisation

The council could consider developing a green hydrogen production, storage, and delivery facility at Harewood Whin. The Yorwaste feasibility study identified that up to 6MW of hydrogen electrolysers and 50,060kg

[3] Costs derived from Yorwaste's feasibility report and the Department for Energy Security and Net Zero. Please note, this does not include costs of obtaining a grid connection.
[4] https://questions-statements.parliament.uk/written-statements/detail/2023-09-05/hcws1005

of storage capacity could be developed at Harewood Whin. The green hydrogen production facility could operate based on Proton Exchange Membrane (PEM) technology with a predicted capacity to supply up to 345,525kg of hydrogen per year. A 6MW hydrogen electrolyser installation would require 23,230 MWh of electricity to operate which could be met by the electricity output from on-site solar PV and/or wind turbines.

The capital expenditure required to develop a 6MW hydrogen refuelling station is estimated to be £6m - £7m[5]. The hydrogen that is produced could be used to provide fuelling for CYC vehicles. Alternatively, the hydrogen produced could be sold to other third party off-takers. Further work will be undertaken as part of the next stage of project development to assess the viability and feasibility of developing a hydrogen production and refuelling station on-site.

1.4 Battery storage

The council could consider installing battery energy storage systems at the Harewood Whin site. Battery energy storage is the fastest growing energy storage technology in Great Britain at present, with 2.5GW currently operational[6].

Batteries can be charged using electricity from either the National Grid or an electricity generation asset. At Harewood Whin, any battery energy storage system could be developed as a standalone grid-connected asset, or alongside a PV array and/or wind turbine. The electricity stored by the battery can be released at a later time in accordance with a selected revenue stream(s). There are a wide range of revenue streams for battery energy storage assets including wholesale power arbitrage, the Balancing Mechanism (BM), grid frequency response services, and the Capacity Market (CM). Many storage assets are looking to participate in, and to optimise and 'stack' across, multiple streams to maximise revenues[7].

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[5] Based on assumption within the Yorwaste feasibility study that the cost of hydrogen fuel station is £1,1132,000/MW (including compressor and storage costs).

[6] Cornwall Insight, DLA Piper (2023). Ready and waiting: Opportunities for energy storage. Available from: https://www.cornwall-insight.com/our-thinking/insight-papers/ready-and-waiting-opportunities-for-energy-storage/

[7] Cornwall Insight, DLA Piper (2023). Ready and waiting: Opportunities for energy storage. Available from: https://www.cornwall-insight.com/our-thinking/insight-papers/ready-and-waiting-opportunities-for-energy-storage/

Alternatively, the council could use battery storage systems in conjunction with large-scale renewable energy generation to store any excess generation for later use on-site. This would help to increase the site's own consumption and generate significant savings on electricity costs rather than earning revenue from exporting to the grid at lower rates.

The overall feasibility and viability of battery energy storage at Harewood Whin will need to be assessed as part of the next stage of the project's development. Understanding the various elements of the revenue stack and potential business models will be crucial for building a business case for battery storage on-site.

1.5 EV charging infrastructure

The GEP feasibility study identified that there may be an opportunity to create a new "Park & Charge" facility in the "front-field" of the Harewood Whin site. Such a site could be developed as a joint EV and hydrogen refuelling station, with the addition of piped hydrogen from Harewood Whin.

Alternatively, the council could consider providing a number of EV charging points for personal vehicles of staff and visitors to the site. Opportunities for developing EV charging infrastructure on-site will be considered as part of the feasibility work to be conducted in the next stage of the project's development.

1.6 Council depot

Looking forward into the future, council services will need to expand to keep pace with housing growth. In responding to this growth, refuse collection services will need to grow and additional depot space will be required to deliver these operational services in an efficient, safe, and effective manner.

Under new legislation, waste collection authorities in England will be required to introduce weekly food waste collections to all households by 31 March 2026, unless they need longer to transition due to a long-term waste disposal contract[8]. It is likely that additional HGVs and depot space will be required to deliver this additional service. The opportunity

[8] https://www.gov.uk/government/consultations/consistency-in-household-and-business-recycling-in-england/outcome/government-response

to relocate the council's depot from Hazel Court to Harewood Whin will be considered as part of the long-list of options at the Strategic Outline Case (SOC) stage.

In FY 2022/2023, the council's fleet used 654,586 litres of diesel and petrol. If developed in conjunction with large-scale renewable generation on-site (i.e., solar PV and/or onshore wind), a depot at Harewood Whin would have a source of renewable electricity to power an electrified fleet. It is estimated that fuel costs could fall by as much as 80% if fuelled by renewable electricity generated on-site. EV charging infrastructure would need to be installed at the Harewood Whin site so that the fleet of electric vehicles could be stored at this new depot location. Guaranteed energy offtake could also bolster the business case for the Green Energy Park.

The council has undertaken work previously to assess the potential benefits of relocating the waste management fleet of vehicles from Hazel Court to Harewood Whin. Relocating the council's waste management fleet to Harewood Whin could reduce journeys travelled by and generate financial and carbon savings. Should the vehicles be stored at Harewood Whin, it is estimated that the total miles travelled would reduce by 15,600 as the final empty trip from Harewood Whin to Hazel Court would no longer be required. Based on an average of 4mpg, removing 15,600 miles would save an estimated 46 tCO_2e, which is equivalent to c.10% of the current total CO_2 emissions from waste trucks, or about 3% of the total fleet CO_2 emissions. This would save an estimated 17,776 litres of diesel fuel.

Previous feasibility work conducted by Yorwaste into potential alternative uses of the Harewood Whin site did not assess the techno-economic feasibility of a new council depot. However, it did conclude that the Harewood Whin site "would not be considered appropriate for an electrified fleet of vehicles belonging to the council or Yorwaste". The reasoning for this was that such vehicles would likely be utilised during the day and not generally available for charging from a PV array which only generates electricity during daylight hours. The feasibility study findings and assumptions will be revisited as part of the next stage of project development.

Developing a new depot alongside any renewable energy generation (i.e., solar PV and/or onshore wind) will significantly increase the scale, complexity, and cost of any resulting project. Further feasibility work will need to be undertaken to determine whether the site is suitable for developing a new depot, and whether this would represent a viable investment for the council.

2 Project Development Approach

2.1 Overview

The business case will be developed in accordance with the Green Book guidance[9], as issued by the HM Treasury, and the "Five Cases" recommended structure[10]. The project development will be undertaken in three stages with the business case approved by the Executive at key decision gateways between each of the stages:

- Stage 1: Scoping the scheme and preparing the Strategic Outline Case (SOC)
- Stage 2: Planning the scheme and preparing the Outline Business Case (OBC)
- Stage 3: Procuring the solution and preparing the Full Business Case (FBC)

Each business case will be developed using the "Five Case Model" which provides a clear decision-making framework to assist local authorities in their decisions around borrowing and investing, taking into consideration the following dimensions:

- Strategic Case – to make the case for change and to demonstrate how it provides strategic fit.
- Economic Case – to identify the proposal that delivers best public value to society, including wider social and environmental effects.

[9] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020

[10] HM Treasury (2018). Guide to Developing the Project Business Case. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749086/Project_Business_Case_2018.pdf

- Commercial Case – to demonstrate that the preferred option will result in a viable procurement and a well-structured deal between the council and its service providers.
- Financial Case – to demonstrate the affordability and funding of the preferred option, including the support of stakeholders and customers, as required.
- Management Case – to demonstrate that robust arrangements are in place for the delivery, monitoring, and evaluation of the scheme.

A prescribed scope of work has been set for each stage of development, with a decision gateway between each of the stages (see Tables 1 and 2). The purpose of the proposed development approach is to obtain the maximum level of certainty and security at the earliest phase of the development, in terms of cost and commitment.

Table 1: Project business case development stages

Project Stage	**Stage 1**	**Stage 2**	**Stage 3**
Stage Outcome	Strategic Outline Case (SOC)	Outline Business Case (OBC)	Full Business Case (FBC)
Stage Activities	Business Case Development: • Scoping the scheme • Making the case for change • Explore the preferred way forward	Business Case Development: • Defining the proposal and delivery parameters • Determine potential value for money (VfM) • Preparing for the potential deal • Ascertaining affordability and funding requirement • Planning for successful procurement	Business Case Development: • Procuring the solution • Contracting for the deal • Ensuring successful delivery
Five Case Model completeness expectation	Strategic: 50% Economic: 40% Commercial: 20%	Strategic: 80% Economic: 70% Commercial: 60% Financial: 60%	Strategic: 100% Economic: 100% Commercial: 100%

	Financial: 30% Management: 10%	Management: 50%	Financial: 100% Management: 100%
Gateway Review	1: Business justification	2: Delivery strategy	3: Investment decision

Table 2: Indicative project plan for development stages of the Harewood Whin GEP scheme

Stage	Start Month	Finish Month
Stage 1 – Scoping the project and preparing the SOC	Jan 24	Oct/Nov 24
Project launch - appointment of Project Team	Jan 24	Mar 24
Feasibility work	Mar 24	Jul 24
Preparation of SOC	Mar 24	Sep 24
Gateway Review 1 – Business Justification	Oct/Nov 24	
Stage 2 – Planning the scheme and preparing the OBC	Nov 24	May/Jun 26
Initial design work	Nov 24	Feb 25
Pre-planning	Nov 24	Feb 25
Grid connection application	Feb 25	May 25
Community engagement	Feb 25	May 25
Planning surveys and assessments	Feb 25	Jul 25
Planning application submission	Oct 25	Jan 26
Preparation of OBC	Nov 24	Apr 26
Gateway review 2 – Delivery Strategy	May/Jun 26	
Stage 3 – Procuring the solution and preparing the FBC	Jun 26	Mar 27
Procurement of contractors	Jun 26	Oct 26
Preparation of FBC	Jun 26	Jan 27
Gateway review 3 – Investment Decision	Feb/Mar 27	

2.2 Stage 1: Scoping the scheme and preparing the Strategic Outline Case (SOC)

This is the scoping phase of the report, which results in the production of the Strategic Outline Case (SOC). The purpose of this stage is to reaffirm the strategic context of the project, make the case for change, and determine the 'preferred way forward', supported by the outputs of detailed feasibility work.

2.2.1 Project Feasibility

The council will use some of the £243,500 revenue funding from the Net Zero Fund to procure technical consultants to undertake detailed feasibility work for the Harewood Whin GEP project.

A detailed site appraisal and techno-economic feasibility assessment of the long-list of potential technical solutions will be undertaken to determine the most suitable technical solution(s) based on the site characteristics. Financial and commercial modelling will also be undertaken in order to understand the cost implications, revenue streams, affordability, and viability of the various technical solutions. Initial design work will also be completed to develop conceptual designs for the GEP scheme.

Significant work has already been undertaken by Yorwaste with the support of consultants to assess the techno-economic feasibility of a standalone 28MW solar PV installation at the Harewood Whin site. The outputs of this work including cost estimates and financial calculations will be reconsidered and updated where necessary as part of this next stage of feasibility work.

2.2.2 Strategic Outline Case (SOC)

Upon completion of the detailed feasibility work, it is proposed that the council develops an SOC for approval by the Executive at the next decision gateway (Gateway Review 1). The findings from the techno-economic feasibility will be used to develop the five cases within the SOC.

The purpose of the SOC will be to provide a recommendation on a preferred way forward for the next stage of project development. The Executive will be presented with an accompanying decision report summarising project progress, outcomes, expenditure, and risk management, with the intention to seek guidance and ongoing support for the project to proceed with further development. Detailed information will be provided within the SOC and decision report to enable the Executive to formulate a view on whether to proceed with the project.

2.3 Stage 2: Planning the scheme and preparing the Outline Business Case (OBC)

This is the planning phase of the project, which results in the production of the OBC. The purpose of this stage is to revisit the preferred way forward and shortlisted option(s) identified in the SOC; identify the option which optimises public value (the 'preferred option') following more detailed appraisal; and to set out the potential commercial deal while confirming affordability and putting in place the management arrangements for the successful delivery of the project.

2.3.1 Grid connection

Securing a viable grid connection agreement will be an essential requirement of the project and will enable the export and import of electricity to and from the Harewood Whin GEP and the local electricity distribution network. In order to secure a grid connection agreement for the GEP, a G99 application will be submitted to the Distribution Network Operator (DNO) Northern Powergrid.

2.3.2 Planning application

In September 2023, Yorwaste submitted a full planning application for a proposed 28MW solar PV array at Harewood Whin (planning reference: 23/01732/FULM). However, if other technical solutions are identified as part of the preferred way forward at the SOC stage, a further planning application may need to be submitted for these additional components. Specialist planning consultants would need to be procured to undertake detailed planning surveys and assessments and support the council to develop the documentation required to support a full planning application. The specific assessment and surveys that are prepared will depend on the technical solution(s) that the council decides to proceed with. The planning consultant will also progress the formal consultation and engagement exercises required to ensure that all statutory requirements are adhered to.

2.3.3 Community engagement

It is proposed that the council develops a community engagement and communications plan for the project and ensures it engages with the local community regularly throughout the project's development and delivery.

2.3.4 Technical Design

A design layout for the preferred technical solution(s) will need to be developed to support a full planning application. The design will be developed by specialist planning consultants to maximise energy generation, enhance biodiversity, and consider the various constraints at the site including topography, access, landscape and visual impacts, existing ecology, drainage, and the landfill cap construction. The design will continue to evolve throughout the planning and community engagement process in response to stakeholder feedback and requirements.

2.3.5 Outline Business Case (OBC)

Once both a grid connection and planning permission for the preferred scheme have been secured, it is proposed that the council builds on the SOC to prepare an OBC for Executive approval at the next decision gateway (Gateway Review 2).

The OBC will provide a recommendation to the Executive on a ‘preferred option’ to take through to the Full Business Case (FBC) stage. Agreement will be sought to proceed with procuring potential service providers to deliver the scheme in the next stage.

2.4 Stage 3: Procuring the solution and preparing the Full Business Case (FBC)

This is the procurement phase for the project, which results in the development of an FBC, following negotiations with potential service providers prior to the formal signing of the contract(s).

2.4.1 Procurement of contractor(s)

There are a range of different procurement routes, contract options and delivery models that could be considered for the potential project. Table 3 presents the potential delivery structures which represent points along a spectrum, ranging from fully council led to fully private sector led.

Table 3: Potential delivery models for the Harewood Whin GEP project.

No.	Description
1	Council funds, builds, operates, and owns the GEP with no involvement of private sector.

2	Council owns and finances the GEP, entering into a partnership agreement with private sector contractor(s) to design, build, operate, and maintain the asset with a strong element of risk and revenue reward sharing.
3	Fully council owned delivery vehicle (i.e., council SPV) with design and build (D&B) of GEP and some other functions outsourced to private sector delivery partner(s).
4	Public-public partnership/JV with joint development and financing – D&B and some other functions outsourced to private sector.
6	Public-private partnership/JV with joint development, delivery, and financing responsibilities.
7	Private sector led development and delivery with council involvement in elements of the project (e.g., council commits to long term PPA offtake; provision of grant funding etc.)
8	Full private sector development, delivery, and financing (i.e., council provides the site to a private sector developer and asset owner in return for a lease payment).

At this stage the council is not committed to any particular delivery model – this will be explored throughout the business case development during the preparation of the OBC. How the risk and income is shared in any arrangement will be a key factor in taking the project forward and will be outlined within the commercial case.

There are a range of different procurement routes and contract options that will be considered. A procurement strategy will be created, in collaboration with the council's Commercial Procurement team showing the available options including use of frameworks, dynamic purchasing systems, and Invitation to Tender (ITT) options (i.e., Open or Restricted process). Any proposed works or services will need to be commissioned via a compliant procurement route under the Council's Contract Procedure Rules and where applicable, the Public Contract Regulations 2015. As such all tenders will need to be conducted in an open, fair, and transparent way to capture the key principles of procurement.

Given the highly complex technical nature of the works, an external technical advisor will be appointed to advise on a suitable procurement approach and contractual arrangements and support the council to develop a detailed specification of requirements.

2.4.2 Full Business Case (FBC)

The purpose of the FBC is to revisit and update the conclusions of the OBC and document the outcomes of the procurement, prior to the formal signing of the contract(s). The FBC will identify the option which offers the “most economically advantageous offer” (MEAT) and shows clear value for money whilst maintaining quality assurance throughout the lifetime of the contract. In addition, the FBC will record the contractual arrangements for the delivery, monitoring and post evaluation of the project. Final costings, based on the outcome of the formal procurement process will be presented within the FBC.

At the conclusion of the third and final project development stage, assuming the final FBC is acceptable, the Project Team will request authorisation from the Executive to proceed to implementation and appoint the preferred contractor (Gateway Review 3).