Northern Gas Networks

A22.q - Net Zero Research Village Atypical Major Project

Engineering Justification Paper

Contents

Summary table

Name of Scheme	*Net Zero Research Village Atypical Major Project*		
Investment Driver	*Net Zero*		
BPDT/Scheme Reference Number	*M8.14 BUS / A22.q.NGN*		
Outputs	*A new research facility called the "NeRV Centre"*		
Cost	£16.5m		
Delivery Year	2031		
Applicable Reporting Tables	n/a		
Historic Funding interactions	n/a		
Interactive Projects	1) Futures Close 2) Integrated Transport Electricity and Gas Research Laboratory (InTEGReL) 3) HyDeploy 2 4) Solar PV Farm 5) Battery Energy Storage System (BESS) and Microgrid Systems		
Spend apportionment	**RIIO-GD2**	**RIIO-GD3**	**RIIO-GD4***
	£0.00m	£16.50m	£0.00m

*There will be ongoing running costs beyond RIIO-GD4 but it is expected the project will become self-funded via partner contributions.

1 Introduction

Northern Gas Networks (NGN) are proposing to build a research hub focused on the decarbonisation of homes, networks and transport on their existing research site at Low Thornley. The research hub will be called the Net Zero Research Village (NeRV) Centre. The construction of the NeRV Centre will transform the site at Low Thornley into a leading research and demonstration campus; the UK's first combined whole systems research, development and demonstration facility covering gas, electricity, water, communications and digitalisation.

NGN are requesting £14.9m of funding over the RIIO-GD3 period to cover the Capex required to design and build the NeRV Centre, as well as the Opex required to operate the NeRV Centre and wider Low Thornley Campus throughout the RIIO-GD3 period. This represents 90% of the total cost of £16.5m (with NGN contributing 10%).

1.1. Context

The UK needs to decarbonise 28 million homes[1] within the next 25 years to achieve legally binding Net Zero targets. This is particularly challenging due to the UK's aging housing stock, approximately one third of which was built before 1950[2]. It is essential that a 'whole house' and 'whole system' approach is used in the decarbonisation of homes, networks and transport to ensure a just, fair and equitable transition for all[2].

The NeRV Centre and wider Low Thornley Campus will specifically address the challenge of decarbonising houses, buildings, industry and transport, whilst ensuring that whole system objectives and resilience ambitions are met. This will be achieved through the co-location of a diverse group of leading research facilities, which bring together stakeholders across the energy and decarbonisation value chain, to deliver tested, insightful recommendations to consumers, industry, local authorities and policymakers. The Low Thornley Campus is also aligned with broader UK policy and legislation (for example, Future Homes Standard and the Heat and Building Strategy), as outlined in Section 0.

1.2. Low Thornley Campus

NGN have created a collaborative vision for the Low Thornley Campus, which will bring together partners across the gas, electricity and water utility sectors. The development of the Low Thornley Campus is supported by the Vision and Mission statements outlined below:

Vision*: To accelerate a fair and sustainable decarbonisation for all.*

Mission*:* Establish an ecosystem delivering information to accelerate decisions by stakeholders to drive decarbonisation for people and places.

It is NGN's ambition that the Low Thornley Campus will become internationally renowned for innovation, research and the development of net zero compliant whole systems approaches to energy and water use in the

[1] National Audit Office, *Decarbonising home heating*, May 2024
[2] Ofgem, *Future System Operation,* January 2021

built environment. At present, the Low Thornley Campus comprises disparate research facilities, which are outlined in Section 2.2.

The NeRV Centre will transform the Low Thornley Campus to:

1) serve as a control centre for the individual research facilities;
2) enable additional research projects to be undertaken;
3) accelerate the pace of research and innovation, and;
4) provide an arrival point to engage, educate and inspire stakeholders.

As a result, the NeRV Centre will allow us to incubate and accelerate cutting-edge research and pilot projects, as well as fast-track knowledge transfer and innovation scaling.

The proposed NERV Centre outlined within this document will serve as this central research hub.

1.3. The NeRV Centre

Transforming our energy system to one that is ready for Net Zero necessitates collaboration across a variety of sectors, including gas, electricity, water, heat, transport and communications. The NeRV Centre will provide wider opportunities for partnership with organisations and research institutions across the UK. Potential collaborators, partners and users of the NeRV Centre include:

- Academics
- Industry professionals
- Businesses
- Government
- Local authorities
- Small and Medium Enterprises (SMEs)
- Consumer groups

The enablement of cross-sectoral collaboration will facilitate the generation of new ideas and innovations to solve the complex challenges the UK faces in achieving the legally binding target of Net Zero by 2050.

Co-location of the NeRV Centre with several existing research facilities (refer to Section 2.2), will position the Low Thornley Campus as an enabler of effective collaboration and cross-pollination of ideas. The NeRV Centre will be uniquely positioned to gather data across a range of low and zero carbon solutions for different types of home and occupants using the research facilities within Futures Close. The 'Control Room of the Future' located within the NeRV Centre (refer to Section 0), will enable data from the Futures Close to be combined with the data / inputs / outputs from the other research facilities on the Low Thornley Campus (e.g. BESS, HyDeploy 2, the solar array) and research facilities outside the Low Thornley Campus, and scaled to street level and regional level outputs. This will provide local, regional and national policymakers with the insights needed to drive effective and informed decisions to decarbonise the UK's housing stock.

The NeRV Centre will feature a range of facilities (refer to Section 0) that will enable a breadth of research projects to be undertaken. Data streams from the existing research facilities on the Low Thornley Campus will be collected, collated and archived within the NeRV Centre, and will be made accessible and discoverable by collaborators and partners. Dashboards will be used to test scenarios, calibrate results and view insights in a

holistic and time-effective environment. Datasets will be shared with, and informed by, a wider ecosystem of external partners, such as the Building Research Establishment's (BRE's) English Housing Survey.

1.4. Summary table

A summary of key project details is provided in Table 1.

Name of Scheme	*Net Zero Research Village (NeRV) Centre*
Investment Driver	*Major project to design and build a decarbonisation research facility, which will unlock further benefits from existing research facilities on NGN's site at Low Thornley. Refer to Section 4.3 for further details.*
BPDT/Scheme Reference Number	8.14 BUS
Outputs	*A new research facility called the "NeRV Centre"*
Cost	*Capex: £ 11,989,748* *Opex: £ 4,552,248*
Totex funding request (90% cost)	*Capex: £ 10,790,773* *Opex: £ 4,097,023*
NGN contribution (10% cost)	*Capex: £ 1,198,975* *Opex: £455,225*
Commission Year	*2027*
Applicable Reporting Tables	n/a
Historic Funding interactions	n/a
Interactive Projects	6) Futures Close 7) Integrated Transport Electricity and Gas Research Laboratory (InTEGReL) 8) HyDeploy 2 9) Solar PV Farm 10) Battery Energy Storage System (BESS) and Microgrid Systems

Table 1 NeRV Centre summary table

2 Background information

2.1. Project overview

NGN are proposing to create a campus, the "Low Thornley Campus", dedicated to accelerating the decarbonisation of UK homes and buildings by integrating whole-system energy solutions that support sustainable, low-carbon living. This involves fostering collaboration between sectors, improving energy resilience, and generating practical solutions that benefit all stakeholders—from policymakers to local authorities, industry, and consumers—while ensuring equitable and just access to affordable and energy-efficient housing.

As outlined in Section 2.2, the Low Thornley site contains a variety of existing research and innovation facilities including the Integrated Transport Electricity and Gas Research Laboratory (InTEGReL), the Hydrogen House, Futures Close, HyDeploy 2, a Battery Energy Storage System (BESS) and a solar PV installation. The proposed Low Thornley Campus will bring together academics, industry, professionals, government, Small and Medium Enterprises (SMEs) and the public under a common goal of improving how we live our lives.

Core to the Low Thornley Campus will be a central research hub building called the NeRV Centre. The NeRV Centre will act as the anchor building on the campus, welcoming visitors to the wider site whilst providing a control centre, research / demonstration laboratories, collaboration zones, conferencing facilities, office spaces and multi-purpose spaces.

The funding request outlined in this submission will be used to:

1) Complete the detailed engineering design of the NeRV Centre;
2) Procure and construct the NeRV Centre, and;
3) Operate the NeRV Centre and surrounding Low Thornley Campus throughout the RIIO-GD3 period.

NeRV Centre

To date, NGN have commissioned and completed the following studies related to the NeRV Centre:

1) A concept design report for the NeRV Centre, completed to the standards outlined within Royal Institute of British Architects (RIBA) Stage 2 Plan of Work.[3] Refer to A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project RIBA Stage 2 Concept Design Report for additional information.
2) A budget estimate for the construction of the NERV Centre which includes full Category B fit-out of the building (*n.b.* this is based on the RIBA Stage 2 concept design). Refer to A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Construction Budget Estimate for additional information.

A high-level summary of the main work packages which are yet to be completed, and which relate to this funding request, are given below and overleaf:

1) **Master planning enablement work:** to provide greater certainty around ground conditions, drainage and utilities, in advance of further design works and planning submission.

[3] RIBA Plan of Work, available at RIBA Plan of Work (architecture.com)

2) **Stage 3 design**: developed design for architectural, structural, building services, fire and specialist aspects of the NeRV Centre, preliminary cost and procurement plans, and necessary surveys to support the planning application.
3) **Planning process**: Preparation and finalisation of documentation for the planning submission, and submission of the planning application.
4) **Stage 4 design**: detailed design for architectural, structural, building services, fire and specialist aspects of the NeRV Centre, detailed cost and procurement plan.
5) **Tendering of works packages**: Preparation of tender packs, interviews of potential contractors and / or specialists, negotiation and selection of contractor and specialists.
6) **Construction, commissioning, and handover**: Full construction, commissioning and handover of the completed NeRV Centre.

2.2. Related projects

The Low Thornley site is currently home to several research and innovation facilities, which NGN have delivered throughout the RIIO-GD1 and RIIO-GD2 periods, as outlined below. These existing facilities will be integrated into the NeRV development as part of the Low Thornley Campus. For the avoidance of doubt, the development of these related projects below has already been funded, although their ongoing operational costs are included within this submission.

Integrated Transport Electricity and Gas Research Laboratory (InTEGReL)

InTEGReL is an integrated whole energy systems development and demonstration facility which explores and tests new energy technologies, strategies and processes for transport, electricity and gas. The facility helps to tackle the UK's energy challenges, with teams of academics and engineers working to deliver breakthroughs in the decarbonisation of heat, energy storage and transport. The goal of the research undertaken is to identify the most affordable and practical solutions for providing customers with low carbon and low-cost energy.

The InTEGReL project is led by NGN in collaboration with Northern Powergrid and Newcastle University. The research and innovation delivered by InTEGReL will benefit customers across the UK, by identifying incremental cost and energy savings through harmonization across different energy carriers, systems and utilities.

HyDeploy 2

Building on the success of the Keele trial, HyDeploy 2 reached another significant milestone by injecting hydrogen-blended gas into the Winlaton trial gas network. This marks the first instance of a hydrogen and natural gas blend being transported and efficiently used within a public gas distribution network, supported by a diverse customer base with various appliances and energy suppliers.

The HyDeploy 2 project provides rigorous technical analysis which allows the benefits of leveraging a variety of technical tools to be harnessed in support of evidence generation for hydrogen blending. By proactively designing technical workstreams to include both modelling and physical experimentation, the relative benefits of the conceptual techniques can be captured to ensure robust evidence is generated in support of the exemption application for hydrogen and national roll out of hydrogen blending.

Futures Close (formerly called the Customer Energy Village)

Futures Close is a pioneering project that will help the energy industry discover optimum mix of technologies to deploy for adapting and retrofitting existing UK homes to achieve national Net Zero targets. It consists of nine homes built across different eras that closely replicate the UK's existing housing stock, which contain sensors to capture key metrics such as temperature, humidity, gas, water and electricity consumption. The Futures Close was delivered in partnership with Newcastle University with funding support from the North East Local Enterprise Partnership (LEP).

The Futures Close facilitates understanding of the challenges of heat decarbonisation by providing data driven insights on the energy solutions best suited to different types of homes. This drives valuable insights on least cost pathways to Net Zero which take account of the UK's varied housing stock. The Futures Close enables testing of different products and training of individuals on how to retrofit a wide variety of house types to understand the performance of various solutions.

Solar PV Farm

The Low Thornley Solar PV Farm has a generator output of 272.5kWp and an annual energy generation of 287,727 kWh. This is enough to support Low Thornley's current annual energy consumption of 175,593 kWh as well as current/upcoming research projects. The solar PV farm consists of 500 PV panels and 2 inverters and has the capacity to reduce CO_2 emissions by over 135t per year. The solar PV farm has been installed and commissioned and is now awaiting energisation, due to happen in early 2025.

In addition to meeting energy demands on site, the solar PV farm will support several research projects including onsite green hydrogen production, energy efficiency projects related to the test homes at Futures Close, the BESS and the microgrid resilience project. The solar PV farm will also enhance future site capabilities via integration with other renewable energy technologies (e.g. wind, biomass and hydro) creating a connected whole energy system.

Battery Energy Systems Storage (BESS) and Microgrid Systems

A BESS collects energy and stores energy from renewable sources or the grid. The batteries discharge to release energy when necessary, such as during peak demands, power outages, or to provide grid balancing service.

The Low Thornley Battery Energy Storage System (BESS) consists of two parallel systems, each with series-connected battery strings. The system's total rated energy storage capacity is 178 kWh, but it is designed to be expandable up to 2 MWh. This BESS is a key infrastructure component for the ongoing Microgrid Resilience Project and is also set to support the upcoming Multiresilience Project. Both projects are spearheaded by Northern Powergrid with collaboration from partners such as NGN, Smarter Grid Solutions (SGS), Turbo Power Systems (TPS), and TurnTide Technology Solutions. Microgrids are known for their speed and resilience, making them applicable across various use cases and facilitating the integration of renewable energy and storage. At the Low Thornley Campus, partners can validate these attributes and more using modern energy assets. The campus will integrate real generators and renewable resources with a microgrid controller to provide unparalleled insights for partners developing their own microgrid solutions.

2.3. Site and surroundings

The Low Thornley Campus lies south of Winlaton village and is approximately 10km from Newcastle. The site is 4.2 hectares in size and is generally sloped with levelled areas from the north to the south. It is situated within the greenbelt zone with woodland to the north and east, and Thornley Woods ancient woodland to the south, which is a Site of Specific Scientific Interest (SSSI). Access to the site is from Thornley Lane, which is connected to the A1 by the A694 to provide national access to the site.

The site is subject to the relevant policies of the Gateshead Council local plan, which designates the land within the green belt under Policy CS19 of the Newcastle Gateshead Core Strategy Urban Core Plan (CSUCP). The neighbouring SSSI is designated under Policy CS18 of the CSUCP.

There are existing buildings on the site which are part of NGN's operational facilities, including a large car park located centrally on the site. NGN's proposal is to use land currently occupied by the car park as the location of the NeRV Centre. A block layout diagram of the site, including the existing research facilities and proposed NeRV Centre, is provided in Figure 1.

Figure 1 Black layout diagram of the Low Thornley Campus

3 Optioneering

The primary driver of the new NeRV Centre is to enable research and innovation in a collaborative environment which delivers insights at the national, regional, community and customer levels, with the ultimate aim of accelerating decarbonisation of homes, transport and industry in the UK. This requires the NeRV Centre to provide workshop and laboratory space for academics and industrial partners to work alongside each other, as well as collaboration space for SMEs to utilise the facility for research, testing and optimization of new products and services across energy, heat and transport networks. These attributes will support the NeRV Centre in achieving the Vision and Mission statements, by providing an ecosystem which accelerates decarbonisation for all. As outlined in Section 0, the site in its current state and the footprint and configuration of the existing building do not enable this vision and mission to be achieved, therefore the development of a new building is deemed necessary.

3.1. Options available to NGN

There are three fundamental options available to NGN regarding the proposed development of the NeRV Centre on the Low Thornley site:

1) **Do nothing**: NGN would incur no additional Capex nor changes to Opex for operating the Low Thornley site.
2) **Repurpose an existing building(s)**: Repurposing or extending an existing building on the Low Thornley site may provide a lower cost solution than developing and constructing a new building.
3) **Design and construct a new building**: Design and construction of a new building for the NeRV Centre to maximise the potential benefits of the Low Thornley Campus.

Do nothing

NGN are not supportive of the option because it will not enable the benefits of accelerated decarbonisation pathways for UK buildings outlined in Sections 4.3 to be realised.

Repurpose an existing building

NGN have explored a variety of potential solutions for repurposing or extending existing buildings on the Low Thornley site to achieve the goals and ambitions outlined in Section 4.3. A justification for why this is not a feasible option is provided below.

The NeRV project team engaged with a wide range of NGN colleagues in the systems control, security and properties departments to review the practicality and feasibility of upgrading and re-purposing the InTEGreL building as a research hub. A basic design intent was created for the upgrade and re-purposing works, covering the following key criteria:

- System Control developments
- Office provisions
- Laboratory provisions
- Meeting suites / collaboration zones
- Visitor centre and welcome zone

- WC provisions
- Disabled access

A range of proposed options for re-purposing the InTEGReL building were created and progressed to feasibility design stage, but none of these fully delivered the requirements of the design intent nor fulfilled the ambitions for the NeRV Centre outlined in Section 2.2.

There were no viable approaches to upgrading the buildings' mechanical and electrical services to the standard required for the system control room and the research laboratories without a full re-design and re-build of the building. In addition, the existing building is not compliant with the Disability Discrimination Act (DDA) in terms of access and sanitary provisions, and design and layout of the existing building makes it particularly challenging to rectify this without significant re-design and expense. Furthermore, the overall condition, layout and size of the building, as well as low ceiling height, make it unsuitable for the research and innovation led capabilities required for the NeRV Centre.

Design and construct a new building

The design and construction of a new building for the NeRV Centre is NGN's Preferred Option (see Table 2 below). The key features of the Preferred Option are described in Section 3.2, and the key benefits that will be delivered are given in Section 4.3. Additional information is provided in A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project RIBA Stage 2 Concept Design Report.

Summary of options

The site in its current state and the footprint and configuration of the existing building do not enable this vision and mission to be achieved, therefore the development of a new building is deemed necessary.

	Achieve Low Thornley Campus Mission and support accelerated decarbonisation	Operability and compliance with building requirements	Incremental cost
Do nothing	○	n/a	~0
Repurpose an existing building	◔	○	~£ 2m
Design and construct a new building	●	●	£ 16.5m

Table 2 Summary of options. More filled circle represents greater achievement of criteria

4 Preferred option

Features of the NeRV Centre

Some of the key facilities within the Proposed Option for the NeRV Centre are described below in Table 3.

Facility	What it is	What it enables
Innovation hubs and flexible laboratories	Digital labs such as home building energy management systems and microgrid control systems which enables data sharing and collaboration with other research organisations such as the Power Networks Demonstration Centre (PNDC), UK Research and Innovation (UKRI) and Research and Enterprise Network for Universities (RENU).	SMEs and industry partners to experiment with ideas and investigate their options; test new controls; develop new devices, appliances, and applications; integrate storage and renewables; and safely reimagine their operations before implementation
Decision Theatre Space	An immersive space to provide researchers, policy makers and engineers the ability to explore complex problems with real time data visualization from cyber and physical streams.	Dynamic display of data in an interactive environment that will enable users to make informed decisions.
Accessibility Decision Lab	A unique learning space for users to experience the challenges faced by people with disabilities firsthand and explore the creation of digitally accessible solutions.	Ensure that the transformative power of technology and new innovations are usable by everyone
Control Room of the Future	An integrated whole energy system and distributed energy resource management facility, that will use artificial intelligence and digital twinning to develop a virtual operator assistant for future control rooms.	Scenario testing such as system restoration from blackouts, predictive cascade analysis and load forecasting.

Table 3 Key facilities within the NeRV Centre

Design principles

This section provides an overview of the design principles for the NeRV Centre, which support the objectives outlined in Section 2.2. The following design areas are covered:

1) The architectural design
2) The civil and structural design
3) The Mechanical, Electrical and Public Health (MEP) building services design

Architectural design

The layout of the NeRV Centre has resulted from adjacency studies, which specified the need for a clearly visible entrance and landscaped areas / terraces that take advantage of the site's unique views. The adjacency studies identified the need for formal separation of building elements within the structure of the building to act as a secure boundary. This will enable visitors to the building to be screened whilst providing a layer of security for the NGN staff and partners who will be working on sensitive projects within the office and laboratory areas.

Visitors to the Low Thornley Campus will approach the NeRV Centre from the northwest with existing landscaping providing a glimpse of the building. As visitors access the car park and approach the NeRV Centre and the wider views of the site and beyond are revealed, the design and location of the NeRV Centre will help visitors to perceive the NeRV Centre as the gateway to the Low Thornley Campus.

The design of the NeRV Centre is based on a systems approach using six key design principles to underpin the design:

1) **Sustainability**: the building and associated assets are sustainable and adapted for net zero
2) **Technical excellence**: at the cutting edge of whole systems thinking to provide innovative research
3) **Accessibility**: the site is truly accessible and open to all users
4) **Design excellence**: the space stimulates innovation and groundbreaking research initiatives
5) **Biodiversity**: the development promotes nature conservation throughout the site
6) **Collaboration**: there is focused engagement with the wider community and relevant stakeholders

Four overarching initial design proposals were developed for the NeRV Centre which are summarised below, and are covered in further detail A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project RIBA Stage 2 Concept Design Report:

1) **Two Wing Form**: Utilising a split within the floor plate to separate secure and public areas whilst forming some protected areas to the rear of the building.
2) **Overlapped Form**: The lower level is partially submerged into the landscape and the upper level forms a projecting box which hovers over the landscape below.
3) **Conical Form**: Similar to 'Overlapped Form', but with a more natural curvature between the two forms by locating a conical form and central atrium which span two floors.
4) **Curved Form**: Similar to 'Overlapped Form', but with curves to the main wings of the building and a cylindrical form to the centre, whilst incorporating a viewing desk at the top of the atrium.

A blend of these initial design proposals was taken forward to the final Stage 2 design, which best fulfilled the design principles outlined above, and the problem / opportunity statement outlined in Section 2.2.

Civils and structural design

The civils and structural design of the NeRV Centre is somewhat dictated by the overall site topography, which features a downward slope from north-north-west to south-south-east and provides views across the River Derwent valley.

The substructural elements of the building are comprised of a piled raft foundation and a reinforced concrete retaining wall, required due to the varying site topography. The piled raft will consist of a 300mm slab with 600mm diameter piles spread across the footprint of the structure, a ground beam will be required at the southern edge of the base slab to act as a shear key to resist against lateral loads. The extent of the retaining walls required will be rationalised during the Stage 3 and Stage 4 designs to minimise the embodied carbon and costs associated with the substructure.

The superstructure will primarily be a timber frame with cross laminated timber panels spanning between glulam beams to create the floor slabs. The use of timber rather than reinforced concrete or steel will help minimise the embodied carbon of the building. The roof structure will also use glulam timber beams and cross limited timber panels to further minimise the embodied carbon.

Mechanical, Electrical and Public Health (MEP) design

Minimising the operational energy requirements of the NeRV Centre vital to ensuring the first design principle "Sustainability" is satisfied. Passive heating and cooling measures, such as natural shading, orientation and insulation, will be utilised to reduce the requirements for active heating and cooling requirements. All heating and cooling requirements will be satisfied by electrically driven air-to-air or air-to-water heat pump systems, supplying heating via underfloor heating and radiators and cooling via fan coil units.

All systems which serve the 24/7 control centre space will be self-contained to ensure that these systems can operate in isolation during periods when the rest of the building is unoccupied. The multi-purpose space will primarily use operable vents and high and low level with continual monitoring and control activation to deliver natural ventilation. The conference space will use full mechanical ventilation and localised fan coil units to supply fresh air and cooling to provide comfort to the high density of occupants within this space. The remaining spaces on the ground and lower ground floors will utilise mechanical ventilation with fan coil units and radiators/underfloor heating to provide space cooling and heating.

Domestic hot water will be generated by an electric calorifier, which may be linked to a small air source heat pump to increase efficiency. Drainage will be provided to all fixtures as required and will discharge out of the building to a location to be confirmed in the development of the Stage 3 design.

A new electricity connection will be required for the NeRV, given that there is no electricity supply to the NeRV Centre development site at present. It is estimated that a 260kVA connection will be required, inclusive of a 20% uplift for space capacity. It is likely that a new substation and transformer will be required to supply the NeRV centre, but this is subject to revision during the development of the Stage 3 and Stage 4 design.

Critical services and equipment at control room and comms room will be provided with a 'n+1' Uninterruptible Power Supply (UPS) system. There will be an additional two UPSs, each with 10 minutes of battery backup, which will provide support load capability and provide additional resilience for the control and comms rooms. Additionally, the ongoing Microgrid resilience project will lead to the installation and deployment of a BESS at the Low Thornley Campus. The BESS will serve as the primary back-up source for the NeRV Centre, it will also provide backup power to the control and comms rooms in the event of an outage or an unplanned island, guaranteeing business continuity. The BESS will be powered by renewable energy from the Low Thornley Campus solar farm and this will help reduce carbon emissions from fossil fuels.

4.1. Business case

The Preferred Option for the NeRV Centre is described in Section 3.2. It will bring together academics, industry professionals, businesses, government and SMEs working on research projects. It will provide a platform for creative and collaborative interactions, putting public use at the heart of the industry's thinking.

4.2. Business case summary

A summary of the high-level business case for the NeRV Centre is provided in Table 4.

Item	Comment
Option title	NeRV Centre – Proposed Option
Supply and demand scenario description	n/a
Project commissioning date	Q1 2027
Capex	£ 11,989,748m
Opex	£ 4,552,248
Cost estimate accuracy	± 20%
Project operating lifespan	40+ years
Project NPV (2070)	£ 97.8m

Table 4 NeRV Centre business case summary table

4.3. Project benefits

The overarching benefit of the NeRV Centre project is that it will **enable the Low Thornley Campus to accelerate the decarbonisation of UK homes, networks and transport** . This will be achieved through the provision of individual property ***and*** whole energy system insights, which can be used to inform policymakers and decision makers across the local, regional and national spectrum. Energy consumers and households will also be direct beneficiaries of the research and innovation outputs of the NeRV Centre, in the form of improved energy policy, products and real-world insights into the effectiveness of low carbon technologies.

The NeRV Centre will enable the Low Thornley Campus to provide researchers and innovators with access to fully integrated, data-optimised system control facilities to accelerate decarbonisation efforts in the UK's housing stock, energy networks and transport systems. Research and innovation in the gas, electricity, water, transport, housing and built environment sectors is currently conducted in siloes, this can lead to duplication of work and sub-optimal outcomes. Policymakers and decision makers often need to assimilate outputs from different sectoral research projects to enable policies and decisions affecting whole energy systems decisions to be made, a process which can be slow. An integrated approach towards research and innovation with an integrated data-eco system created will be adopted by the NeRV Centre and the wider Low Thornley Campus to connect learning from multiple research studies to remove siloed outcomes. This will accelerate the decision-making process, thereby enabling accelerated decarbonisation of the UK's housing stock and build environment.

Benefits and alignment with NGN Innovation Strategy

The Preferred Option for the NeRV Centre is strongly aligned to NGN's RIIO-GD3 Innovation Strategy. As outlined in Table 5, it satisfies 4 out of 6 of NGN's Innovation Themes across customer vulnerability, energy systems transition and digitalisation

Benefit	NGN Innovation Theme[4]	Commentary
Providing insights to inform national, regional and local planners	**IT2** – long-term solutions supporting a fair transition and ensuring those at most risk are not left behind.	The NeRV Centre will enable the Low Thornley Campus to provide local, regional and national policymakers with high quality whole energy system insights so that they are empowered to make effective and informed decisions regarding the decarbonisation of the UK's housing stock.
Enhancing quality and pace of decarbonisation research	**IT4** – assisting local authorities to establish sustainable communities.	By enabling direct and effective collaboration between co-located research facilities, the NeRV Centre will provide rapid insights into the effect of decarbonisation measures on homes and the whole energy system. Without the NeRV Centre, policymakers would have less certainty regarding outputs of whole energy system research, and the time to make critical policy decision would be slower
Encouraging cross-sectoral collaboration	**IT3 –** enabling decarbonisation through whole energy solutions.	The NeRV Centre will bring together academics, industry professionals, businesses, government and Small and Medium Enterprises (SMEs) from different sectors. This will enable the generation of new ideas and innovations to solve the complex challenges the UK faces in achieving the legally binding target of Net Zero by 2050. Co-located with several existing research facilities (refer to Section 2.2), the NeRV Centre will be uniquely positioned to enable effective collaboration and generation of new ideas and innovations.
Fostering a culture of innovation in homes and building decarbonisation	**IT3 –** enabling decarbonisation through whole energy solutions.	The NeRV Centre will be designed to foster and encourage innovation and new ideas through the breadth of research projects that will be undertaken in the building's facilities. Data streams from the existing research facilities on the Low Thornley Campus will be collected, collated and archived within the NeRV Centre, and will be made accessible and discoverable by collaborators and partners. This open approach to data sharing will serve to foster an innovation culture across all collaborators, partners and stakeholders.
Utilising the power of data to enhance decision making	**IT6 –** maintain and improve existing digital infrastructure to increase efficiency.	Each home in the Futures Close contains a variety of sensors to capture operating parameters within the home. The NeRV Centre will provide real-time access to

[4] NGN, RIIO-GD3 Innovation Strategy, 2024

		this data within the central management area and the 'Control Room of the Future'.
Educating consumers and stakeholders	**IT4** – assisting local authorities to establish sustainable communities.	Local stakeholders will benefit from access to leading research and collaboration facilities, which will focus on the most pertinent whole energy systems and energy transition topics.

Table 5 NeRV Centre key benefit categories

The benefits of the NeRV Centre outlined above culminate in the **enablement and delivery of an accelerated reduction in carbon dioxide emissions across the UK's homes, energy networks and transport systems.**

Alignment with Ofgem's strategy and policy

The NeRV Centre will be a key enabler of 'whole house' and 'whole system' energy research. The UK needs to decarbonise 28 million homes[5] within the next 25 years to achieve its legally binding Net Zero targets. This is particularly challenging because of the UK's aging housing stock, approximately one third of which was built before 1950[2]. It is essential that a 'whole house' and 'whole system' approach is used in the decarbonisation of homes, energy networks and transport systems to ensure a just, fair and equitable transition for all.

The proposed NeRV Centre and Low Thornley Campus are aligned with Ofgem's mandate to support the Government in meeting its legal obligation to achieve net zero by 2050[6]; they have been developed to align with the wider UK energy and decarbonisation policy landscape.

Alignment with UK policy and legislation

The NeRV Centre is strongly aligned with national policy and legislation regarding energy use and decarbonisation, and can deliver a positive impact, as highlighted in Table 6.

UK Policy / legislation	NeRV Centre's impact
Net Zero 2050 Target[7]: The Climate Change Act 2008 (2050 Target Amendment) commits the UK to achieving net zero emissions by 2050. This is legally binding and forms the basis for the UK's entire climate strategy.	Retrofitting homes and advancing low-carbon technologies like heat pumps directly contributes to the UK's ability to meet this target.
78% Emissions Reduction by 2035[7]: The Sixth Carbon Budget sets an interim target of reducing emissions by 78% by 2035 from 1990 levels. This budget guides the UK's decarbonization efforts and outlines key sectors, including residential homes, for emissions cuts.	Acceleration of home decarbonization, particularly through innovations in energy efficiency and heating solutions, aligns with the 2035 emissions reduction goal.
Energy Performance Certificate (EPC) Band C by 2030[8]: The UK Government requires that as many homes as possible reach EPC Band C by 2030. This applies especially to the private rental sector and social housing.	Helping scale retrofitting initiatives that bring homes up to EPC Band C, ensuring compliance with this important efficiency target.

[5] National Audit Office, *Decarbonising home heating*, May 2024
[6] Ofgem, "Ofgem welcomes Energy Act getting Royal Assent, available at: https://www.ofgem.gov.uk/press-release/," 2023
[7] Climate Change Act 2008
[8] Minimum Energy Efficiency Standards 2018

Future Homes Standard (2025)[9]: The Future Homes Standard mandates that all new homes built from 2025 must be zero-carbon ready and heated using low-carbon systems, such as heat pumps.	Testing and proving low-carbon heating technologies, along with building fabric improvements, ensures that future homes meet the energy efficiency and decarbonization targets.
Clean Power 2030: Provide advice on clean power for Great Britain by 2030	Focus on demand side response to manage peak demand and lower costs.
Heat and Buildings Strategy[10]: The Heat and Buildings Strategy outlines how the UK will decarbonize heating in homes, with a focus on phasing out gas boilers by 2035 and transitioning to heat pumps and hydrogen-ready systems.	Developing scalable heat pump technologies and testing new heating systems directly supports the goals of the Heat and Buildings Strategy.
Warm Homes: Social Housing Fund[11]: This supports upgrades to the energy efficiency of social housing, aiming to help homes meet the EPC Band C by 2030.	Partner with social housing authorities to apply these funds to retrofit homes, using proven low-carbon technologies to meet regulatory requirements.

Table 6 NeRV Centre alignment with UK policy and legislation

RESP Integration

NeRV aligns closely with the aims of the UK's upcoming Regional Energy Strategic Plans (RESPs), positioning it as a critical asset in supporting regional energy coordination. The RESP initiative, designed to enhance localised energy strategies and accelerate the national transition to net zero, seeks regional input and collaboration across local governments, industry, and energy networks. As a central research and innovation hub, NeRV can directly support the RESP framework through its data integration capabilities, which will provide valuable insights from live projects like the Customer Energy Village and advanced energy storage systems. By analysing and sharing this data, NeRV can help ensure that RESPs are informed by evidence-based research. NeRVs established network of collaborators—from academics to local authorities—mirrors the RESP's collaborative vision, fostering an environment where innovative technologies and strategies can be tested, validated, and scaled. Through its resources and partnerships, NeRV is positioned to advance the RESP goals by driving effective, regionalised energy solutions that align with both local needs and national net-zero targets.

Cost benefit analysis

As discussed above, the overarching benefit of the NeRV Centre is the acceleration of decarbonisation in UK homes. This is enabled by accelerating decision and policy making at all levels of the decarbonisation value chain (*i.e.* from individual consumers, up to regional and national policy and decision makers), and by developing and proving technology solutions for real-life applications.

In terms of quantifying that benefit, we model that the current trajectory of UK home-based emissions can effectively be "shifted to the left" through the acceleration of home decarbonisation. This results in incremental emissions savings and an NPV over time as defined in Table 7 (refer to A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project CBA for the full CBA).

[9] Approved Document L, 2021; and Approved Document F, 2022
[10] Heat and Building Strategy, 2023
[11] Warm Homes: Social Housing Fund, 2024

Year	Cumulative carbon savings ($ktCO_2e$)	NPV
2035	175	£ 28.8m
2040	426	£ 84.8m
2045	774	£ 97.9m
2050	1,207	£ 97.8m
2060	1,207	£ 97.8m
2070	1,207	£ 97.8m

Table 7 CBA summary table

This has been calculated assuming that the NeRV Centre will improve the research outcomes of Futures Close such that it will increase the rate of decarbonisation of homes by 10%. The homes in Futures Close are representative of approximately 15% (circa 3.3m homes) of the UK housing stock. Assuming that the fuel switching rate of representative houses from gas to electric heating is 1% per year (circa 33,000 homes per year), the NeRV Centre will enable the research from Futures Close to unlock an additional 0.1% of representative houses to fuel switch (circa 3,300 homes per year).

This reduction in carbon emissions is quantified (in terms of economic value) as per the 'Carbon Price (base case)' values for the price of carbon, which is contained within the RIIO-GD3 Cost Benefit Analysis template. This carbon price does not represent a direct financial benefit to NGN or its customers, or any other stakeholder of the Low Thornley Campus.

There are additional outcomes which NeRV Centre is likely to unlock from Futures Close, but which have not quantified nor included within the CBA calculations. These include:

1) Delivering energy and cost savings for consumers
2) Improving health and comfort of building and home occupiers
3) Improving national energy security
4) Creating jobs and economic growth
5) Reducing peak energy demands and network reinforcements

It should be noted that Futures Close is only one of several research facilities on the Low Thornley Campus which will benefit from the opportunities created by the NeRV Centre. It is also possible that the benefits and outcomes from the Low Thornley Campus would extend beyond just the housing stock represented by those on Futures Closes. Therefore, the values presented in Table 7 may be conservative in their estimate of the overall benefit in terms of cumulative carbon savings and NPV which the NeRV Centre will generate.

5 Cost

Individual works packages for the design and construction of the NeRV Centre are based on quotations and robust estimates from suppliers under framework agreements with NGN and ratified with NGN's experience in delivering capital projects. All costs have been thoroughly checked and scrutinised by the relevant departments within NGN. Throughout the delivery of the project, individual works packages will be competitively tendered and / or procured through framework agreements which themselves have been competitively tendered. Section 5.3 set out how NGN will ensure that costs are efficient and that the project delivers value for money.

5.1. Cost summary

NGN are requesting £14.9m of funding over the RIIO-GD3 period to cover 90% of the Capex required to design and build the NeRV Centre, as well as 90% of the Opex required to operate the NeRV Centre and wider Low Thornley Campus throughout the RIIO-GD3 period. The remaining 10% of the Capex and Opex will be funded by NGN. Refer to Section 6.4 for detailed breakdown and cost profile.

5.2. Basis of costs

Drivers

The key drivers behind are outlined in Table 8.

Cost Element	Cost drivers
Capital Cost: NeRV Centre	The primary driver of the costs are the remaining work packages, as described in Section 6.4. These in turn are driven by: • Site complexity and condition • Design requirements and decisions • Framework agreement rates • NGN procurement approach and outcomes • NGN commercial management of contractors • Competitive environment in market • Other supply chain factors
Operating Costs: Low Thornley Campus	Operating costs are driven by factors which would be typical for Opex across the NGN operating landscape, including labour market and wages, energy prices, NGN operational decisions, supply chain environment, and NGN procurement approach and outcomes

Table 8 Overview of cost drivers

Scope

Cost Element	Scope
Capital Cost: NeRV Centre	Refer to the description of the Preferred Option in Section 3.2 and the key work packages described in the Project Plan in Section 6.3.
Operating Costs: Low Thornley Campus	All costs related to the operation of the Low Thornley Campus site, as referenced in Section 6.4. These include: • Personnel and contractors • Utilities • Materials • Professional fees

Table 9 Overview of project scope

5.3. Efficient cost

The budget for the design, construction and operation of the NeRV Centre building uses robust data, assumptions and benchmarks to ensure that costs are efficient. The design of the NeRV Centre is progressed to RIBA Stage 2 ("Concept Design") and the cost data presented in this submission and detailed cost information included within A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Construction Budget Estimate and A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Project Cost Sheet is based on this stage of design. As outlined within this section, NGN will continue to ensure that the principles of cost efficiency are maintained throughout the ongoing design, construction and operation of the building.

As the design progresses through RIBA Stage 3 and Stage 4, value engineering will be used within the design of the building to reduce construction and installation costs where appropriate and necessary. This will ensure that maximum value for money is achieved on the construction and fit out of the NeRV Centre. No contingency is included within the cost breakdown (refer to Section 6.4). It is expected that as the design progresses from the current RIBA Stage 2 design to the Stage 5 ("Manufacturing & Construction) design, value engineering will provide a cost buffer that will be utilised as the cost contingency for the project.

There are a range of potential procurement structures available to NGN for the NeRV Centre, as outlined in Table 10.

Procurement structure	Pros	Cons
Design & build	• Client requirements fully defined • Single point of responsibility for delivery • Design and programme risk transfer to contractor • Quick start on site • Overlap of design and construction	• Novation of professional team may be problematic • Potential loss of control over quality • High cost to incorporate post contract changes • No early contractor engagement – unless two-stage
Traditional	• Client requirements fully defined • Client retains control of quality and design changes • Direct contractual links • Maximum cost and programme certainty • Main contractor responsible for management and delivery of the contract works • Post contract changes priced at tender rates	• The technical documents defining the requirements must be robust • May nurture a culture of claims and compensation • Design risk held with client • No early contractor involvement • Longer to start on site
Management contracting	• Encourages team working and collaboration • Suitable for fast-track projects • Overlap of design and construction • Flexible to make changes • Fully pre-designed but in stages	• There is a small pool of potential contractors • Contractor takes very limited risk; the client carries most of the risk • Client has a reduced ability to recover damages / losses • Cost uncertainty until last package is procured • Programme uncertainty until late in the process • Overall responsibility for quality may be diluted • Contractor takes very limited risk / liability
Construction management	• Encourage team working and collaboration • Client direct control over trade contractor selection • Greater control over quality • Quick start of site • Suitable for fast-track projects • Overlap of design, planning and construction	• Programme and cost risk left with client • No single point of responsibility • Client takes project interface risk • Liabilities can become fragmented • Client has increased contract administration workload • Reduced cost and programme certainty

Table 10 Potential procurement structures

NGN will decide which procurement structure to use based on the overall risk profile for the project as the design matures during the RIBA Stage 3 and Stage 4 processes (refer to Section 0 for further information). Established

procurement processes and framework agreements with relevant suppliers will be used to ensure both value for money and quality are achieved.

At all times, the appropriate internal checks and balances, in line with NGN's stage gated capital approvals process, will be used to ensure the consumer achieves value for money from the project.

6 Deliverability

6.1. Key business risks

There are no risks related to NGN's core business activities resulting from this project.

A project designers risk register is included within A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Risk Register. Project deliverability risks are categorised into the areas outlined in Table 11. There are no red flag risks at this stage of the development of the NeRV Centre project.

Risk category (deliverability)	Description
Planning	Robustness of overall project plans and contingency measures, specifically related to: • Unexpected site ground conditions • Unknown services buried in ground • The planning process with the Local Authority
Capacity	Sufficiency of available personnel within NGN to manage the project, and availability of suitable contractors for the design and construction.
Capability	Experience and proficiency of the project delivery team (NGN and supply chain) to ensure the overall quality of the project delivery and end result.

Table 11 Project delivery risk categories

Supply chain capability and capacity

The design and construction of the NeRV Centre building is a relatively standard project, which will be procured through established supply chains. The works do not require significant portions of specialist or niche capability from the UK construction supply chain, nor does it require novel or new approaches. There is a large pool of contract resource that could undertake such a project. NGN have a depth of experience in delivering similar capital projects and have robust Stage Gate and DoA procedures and protocols in place to ensure that risks are managed at all stages of the project lifecycle.

6.2. Assets delivered during the RIIO-GD1/GD2 periods

There are no assets on Low Thornley site that were intervened on the during the RIIO-GD1 and RIIO-GD2 periods which relate to the NeRV Centre.

6.3. Project plan

A simplified project plan for the design, planning and construction of the NeRV Centre is provided in Table 12. The construction period itself will take around 18 months and is expected to begin in Q3 2026, on the assumption that the master planning enablement work begins in January 2025. A breakdown of key workstreams for each activity is provided in Table 13.

	2024	2025				2026				2027				2028	
Activity	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Masterplanning enablement work															
RIBA Stage 3 design															
Planning preparation, submission and determination															
RIBA Stage 4 design															
Tender period															
Construction period															
Commissioning and handover															

Table 12 Simplified project plan for the NeRV Centre design, planning and construction

Activity	Key workstream
Master planning enablement work	Review existing masterplan design Establish utility requirements (power, water, draining) Engage with statutory providers Conduct ground investigation surveys Report and plan for next stages
RIBA Stage 3 design	Developed design of: • Architecture • Structure and civils • MEP services • Fire • Specialists (daylighting, acoustics, etc.) Preliminary cost plan Procurement plan Various surveys required for the planning application
Planning preparation	Preparation of planning deliverables
Planning submission	Submission of planning application and supporting documentation
Planning determination	Determination of planning application by Local Authority
RIBA Stage 4 design	Detailed design of: • Architecture • Structure and civils • MEP services • Fire • Specialists (daylighting, acoustics, etc.) Detailed cost plan Procurement plan Preparation of tender pack
Tender period	Tender reviews and interviews
Construction period	Full construction of the NeRV Centre building
Commissioning and handover	Commissioning of the buildings systems and services, and handover to NGN as the primary tenant.

Table 13 Breakdown of activities by key workstreams

6.4. Project spend profile

An annualised project spend profile is provided in Table 14.

	2026	2027	2028	2029	2030	2031	GD3	Comments
Capex								
Master planning	£37,750							Quote: Civils and geotechnical survey
Stage 3 design - Architecture		£125,000						Estimate: 1.5% of total build costs
Stage 3 design – Structural, mechanical, electrical and public health		£75,000						Estimate: 1.5% of services costs for MEP, and 1% of structural costs
Stage 4 design - Architecture		£1525,000						Estimate: 1.5% of total build costs
Stage 4 design – Structural, mechanical, electrical and public health		£75,000						Estimate: 1.5% of services costs for MEP, and 1% of structural costs
Construction – Cat A		£3,541,197	£3,541,197					T&T estimate (split 50% / 50% between '25 and '26)
Construction – Cat B (fit out)			£1,330,202					T&T estimate (100% 2026)
Construction – External works		£1,594,702	£1,594,702					T&T estimate (split 50% / 50% between '25 and '26)
Subtotal	**£37,750**	**£5,485,898**	**£6,466,100**				**£11,989,748**	
Opex								
Personnel		£725,181	£801,017	£801,017	£892,020	£892,020		Combination of actual and estimate
Contractors		£11,750	£14,100	£14,100	£16,921	£16,921		Combination of actual and estimate
Materials		£73,440	£73,440	£73,440	£73,440	£73,440		Combination of actual and estimate
Subtotal		**£810,371**	**£888,557**	**£888,557**	**£982,381**	**£982,381**	**£4,552,248**	
Total	**£16,541,996**							

Table 14 Annualised project spend profile

7 Conclusion

NGN are proposing to build a research hub focused on the decarbonisation of homes, networks and transport on their existing research site at Low Thornley. The research hub will be called the Net Zero Research Village (NeRV) Centre. The construction of the NeRV Centre will transform the site at Low Thornley into a leading research and demonstration Campus; the UK's first combined whole systems research, development and demonstration facility covering gas, electricity and water.

The primary driver of the new NeRV Centre is to enable research and innovation in a collaborative environment which delivers insights at the national, regional, community and customer levels, with the ultimate aim of accelerating decarbonisation of homes and buildings in the UK.

8 Glossary of terms

Term	Definition
BESS	Battery Energy Storage System
BRE	Building Research Establishment
CEV	Customer Energy Village
CSUCP	Core Strategy Urban Core Plan
InTEGRaL	Integrated Transport Electricity and Gas Research Laboratory
MEP	Mechanical, Electrical and Public Health
NERV	Net Zero Ecosystem Research Village
NGN	Northern Gas Networks
PNDC	Power Networks Demonstration Centre
RENU	Research and Enterprise Network for Universities
RIIO-GD3	Revenue = Incentives + Innovation + Outputs – Gas Distribution
SSSI	Site of Special Scientific Interest
UKRI	UK Research and Innovation
UPS	Uninterruptible Power Supply

9 Appendices

Appendix reference
A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village – Atypical Major Project RIBA Stage 2 Concept Design Report
A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Construction Budget Estimate
A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Project Cost Sheet
A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project Risk Register
A22.q NGN RIIO-GD3 Investment Decision Pack - Net Zero Research Village - Atypical Major Project CBA