

NIA Project Registration and PEA Document

Date of Submission

Oct 2026

Project Reference Number

NIA3_NGET0027

Project Registration

Project Title

RecuVolt - Recycled Copper for Offshore HVDC Transmission

Project Reference Number

NIA3_NGET0027

Project Licensee(s)

National Grid Electricity Transmission

Project Start

October 2026

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Muhammad Shaban
box.ng.etinnovation@nationalgrid.com

Project Budget

£169,658.00

Summary

The project will assess the feasibility of using more recycled copper in HVDC cable systems to reduce embodied carbon, reliance on primary materials and improve circularity. It will address limited evidence on recycled copper's ability to meet HVDC electrical, mechanical, thermal and long-term reliability requirements. The desktop study will review technical requirements, global evidence, circular-economy opportunities, supply-chain risks, traceability, qualification and certification pathways, and high-level techno-economics. Findings will inform future procurement, asset management, qualification and sustainability decisions.

Preceding Projects

NIA2_NGET0058 - HVDC Assets Life Cycle Assessment (HVDC - LCA)

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

National Grid is planning significant HVDC infrastructure to support the UK's energy transition and Net Zero ambitions. The use of recycled copper in HVDC cable conductors could reduce embodied carbon and reliance on primary raw materials, but adoption is currently constrained by significant technical, commercial and supply chain uncertainties. HVDC cables must satisfy stringent electrical, thermal, mechanical and reliability requirements over asset lifetimes measured in decades. There is limited publicly available evidence demonstrating that recycled copper feedstocks can consistently achieve the required purity, conductivity, mechanical performance and long-term reliability.

Additional uncertainties exist around feedstock variability, material provenance, traceability, supply availability, processing routes, manufacturing implications, qualification, certification and stakeholder acceptance. The absence of a mature qualification pathway

creates uncertainty for both National Grid and potential cable suppliers. A practical challenge is that HVDC cable manufacturing occurs at kilometre scale, making representative sub scale testing difficult. This creates a barrier between suppliers requiring approval to manufacture recycled content cables and National Grid requiring validated evidence before accepting the technology.

The project addresses this evidence gap by establishing the technical requirements, reviewing global evidence and precedents, assessing circularity and supply chain risks, identifying potential qualification pathways and evaluating the high-level economic implications of adoption.

Offshore HVDC projects are increasing to support the UK's Net Zero ambitions and energy transition. National Grid's HVDC cable Life Cycle Assessment identified recycled copper as a key opportunity to reduce embodied carbon. With major investment planned, and increasing pressure from T3 Environmental commitments and offshore contract obligations, using recycled copper in HVDC conductors could reduce reliance on primary raw materials while supporting sustainability and circular economy objectives. However, adoption remains challenging because HVDC cables must meet stringent electrical, thermal, mechanical and long-term reliability requirements over decades. Evidence that recycled copper can consistently meet purity, conductivity, performance and reliability expectations is limited, while qualification routes remain immature. This creates uncertainty around testing, acceptance criteria and stakeholder approvals. This is not currently a business-as-usual procurement activity because the technical evidence, qualification framework, supply-chain readiness and business case required for adoption have not yet been established.

Method(s)

A structured desktop research and feasibility methodology will be used.

1. Capture National Grid technical, operational, regulatory and commercial requirements.
2. Establish baseline requirements and assessment criteria.
3. Review global industry activity, published research, case studies and comparable applications.
4. Assess the technical implications of recycled feedstock variability, processing routes and material quality.
5. Assess circular economy opportunities across the HVDC cable lifecycle.
6. Map recycled-copper supply chains and associated risks.
7. Review potential qualification, certification and approval pathways.
8. Undertake a high-level techno-economic assessment.
9. Consolidate findings into recommendations and priority actions for future National Grid activity.

The project is explicitly a desktop feasibility study and does not include laboratory testing, physical material characterisation, prototype manufacture or performance validation.

Scope

The project will undertake a desk-based feasibility assessment of the potential use of increased recycled copper content within HVDC cable systems. The scope will establish the technical, operational, regulatory and commercial requirements for recycled copper adoption and assess the current evidence base, industry practice, relevant case studies and comparable high-performance applications.

The assessment will consider the potential implications of recycled copper feedstock variability, material quality, processing routes, conductivity, mechanical performance, reliability, traceability and supply-chain availability. It will also assess wider circular economy opportunities across the HVDC cable lifecycle, including recycled content verification, resource efficiency, manufacturing considerations, end of life recovery, closed-loop material flows and potential opportunities to reduce embodied carbon.

The project will assess the supply-chain and adoption considerations associated with recycled copper, including sourcing routes, material availability, supply-chain resilience, market dependencies and the potential qualification, certification and approval pathways that may be required before future deployment.

A high-level techno economic assessment will consider the potential financial implications for electricity transmission, including recycled versus primary copper material costs, processing requirements, supply-chain complexity, qualification and future adoption requirements. This will identify potential areas where recycled copper could reduce exposure to primary raw material costs, improve resource efficiency, strengthen supply-chain resilience and support more sustainable procurement decisions. The assessment will also

identify the costs, uncertainties and dependencies that could offset or limit these potential benefits.

The potential consumer net benefits will be assessed through the relationship between any future transmission cost efficiencies, improved supply-chain resilience, reduced dependence on primary raw materials and potential environmental benefits. Where appropriate evidence is available, the project will identify how these benefits could ultimately contribute to more efficient and sustainable delivery of future transmission infrastructure and therefore support value for electricity consumers.

The project will consolidate the findings into recommendations and priority actions for National Grid's future decision-making regarding recycled copper adoption, qualification activities and circular economy strategies for HVDC cable systems.

The scope does not include laboratory testing, physical material characterisation, prototype manufacture, performance validation, formal qualification or certification, detailed engineering design, detailed lifecycle assessment, detailed investment appraisal or implementation of the recommendations.

Objective(s)

1. Establish and document the technical, operational, regulatory and commercial requirements relevant to the potential use of recycled copper within HVDC cable systems, establishing an agreed baseline for subsequent feasibility assessment.
2. Assess the current state of knowledge, industry practice, relevant case studies and comparable applications to establish the technical feasibility, principal risks, uncertainties and evidence gaps associated with recycled copper use in HVDC cable systems.
3. Assess the circular economy opportunities, challenges and constraints associated with increased recycled copper content across the HVDC cable lifecycle, including sourcing, verification, traceability, resource efficiency, manufacturing, end of life recovery, closed-loop material flows and potential embodied carbon reduction opportunities.
4. Assess the supply-chain requirements, dependencies and risks associated with increased recycled copper adoption, including feedstock availability, material quality, traceability, sourcing routes, processing requirements, supply-chain resilience and market dependencies.
5. Investigate potential qualification, certification and approval pathways for recycled copper use in HVDC applications, identifying relevant standards, stakeholder requirements, evidence gaps and barriers that would need to be addressed before future deployment.
6. Undertake a high-level technoeconomic assessment of recycled copper adoption within HVDC cable systems, considering material costs, processing requirements, supply-chain complexity and qualification requirements.
7. Develop evidence-based recommendations and priority actions to inform National Grid's future decision-making on recycled copper adoption, qualification activities and circular economy strategies for HVDC cable systems.

Consumer Vulnerability Impact Assessment

The project does not have a direct consumer vulnerability intervention because its primary focus is HVDC infrastructure materials and future asset procurement.

The potential consumer benefit is indirect. If recycled copper can subsequently be qualified and adopted without compromising reliability, its use could support lower embodied carbon and more resource efficient infrastructure. The project's techno economic and supply-chain assessments will also help National Grid understand whether adoption could introduce additional costs, risks or dependencies that could ultimately affect consumers.

The project therefore seeks to establish evidence that allows environmental benefits to be considered alongside reliability, safety, supply-chain resilience and consumer cost when future deployment decisions are made.

No direct quantified benefit to vulnerable consumers is claimed at this feasibility stage.

Success Criteria

The project will be considered successful if:

- National Grid obtains an evidence-based understanding of the current state-of-the-art, relevant industry precedents and principal technical risks associated with recycled copper adoption.

- National Grid gains a clear understanding of the broader circularity implications of recycled copper adoption and potential opportunities to improve material circularity across the HVDC value chain.
- National Grid gains visibility of key supply chain risks, dependencies and barriers associated with recycled copper adoption.
- National Grid obtains a clear understanding of the qualification landscape and evidence requirements associated with recycled copper adoption.
- National Grid receives an evidence-based assessment of the economic and environmental benefits associated with recycled copper adoption.
- A practical roadmap to support future decision-making, investment planning and adoption of recycled copper within HVDC applications

Project Partners and External Funding

The project will be delivered by the Manufacturing Technology Centre (MTC) for National Grid. National Grid will provide subject matter expertise, requirements, relevant specifications and supporting information, participate in workshops and review project outputs. No other external funding or network licensee collaboration is identified in the current proposal. Any additional network participation or external funding should be confirmed before submission.

Potential for New Learning

The project will generate new learning for National Grid regarding the feasibility and potential adoption pathway for recycled copper within HVDC cable systems. Learning will include the current state of the art, relevant global precedents, technical requirements, material variability, supply-chain dependencies, circular economy opportunities, qualification requirements, evidence gaps and economic implications. The work will also identify where further laboratory testing, material characterisation, prototype manufacture or formal qualification activity may be required. The learning will support future National Grid procurement, asset-management and sustainability decisions and provide a structured evidence base for future project development.

Dissemination and adoption of learning: In addition to generating new technical and commercial evidence, the project will include a structured dissemination approach to ensure that learning can be accessed and applied by National Grid, other Network Licensees, cable manufacturers, material suppliers and wider industry stakeholders. Learning will be shared through project reports, interim updates, NIA reporting, technical workshops, conference presentations, ENA dissemination channels and stakeholder engagement activities. Outputs will be made available through established NIA dissemination mechanisms, subject to confidentiality and intellectual property requirements.

The project will generate evidence on the technical feasibility, circular-economy opportunities, supply-chain considerations and qualification requirements associated with recycled copper within HVDC cable systems. This learning will help National Grid and other Network Licensees better understand the benefits, risks and barriers associated with increased recycled content in strategic transmission infrastructure. In particular, the findings will identify evidence gaps, material-performance considerations, supply-chain dependencies, traceability requirements and potential qualification pathways that could support future adoption decisions.

The project outputs will be translated into practical recommendations and an adoption roadmap identifying future testing, validation and qualification activities required before deployment could be considered. This will support informed decision-making regarding future procurement specifications, asset-management strategies and embodied-carbon reduction initiatives.

The findings are expected to be directly relevant to future HVDC developments, including offshore transmission systems, interconnectors and other cable-intensive infrastructure projects where copper conductors are a significant contributor to embodied carbon. The learning may also be relevant to wider electricity-transmission applications that rely on copper-based components and conductor systems.

To maximise sector-wide benefit, learning will be disseminated through National Grid innovation channels, NIA annual and completion reports, technical workshops, conference presentations and ENA knowledge-sharing platforms. This will allow other Network Licensees, regulators, manufacturers, suppliers and researchers to apply the findings when considering recycled-material adoption within critical energy infrastructure and support a more consistent approach to evaluating circular-economy opportunities across the GB transmission sector.

Scale of Project

A desktop research and feasibility project covering recycled-copper application in prioritised HVDC cable or associated asset categories. No physical cable manufacture, laboratory testing or deployment is included. Outputs will be applicable to NGET’s future HVDC portfolio and capable of informing other GB transmission licensees, subject to their specifications and operating requirements.

The scope covers recycled copper within HVDC cable systems and associated conductor materials.

It includes technical requirements capture, review of existing evidence and precedents, technical feasibility assessment, circular economy assessment, supply-chain mapping, qualification and certification pathway assessment and high-level techno-economic analysis. The project will consider material sourcing, traceability, processing, resource efficiency, end-of-life recovery and potential embodied-carbon reduction opportunities. Excluded activities include laboratory testing, physical trials, prototype manufacture, detailed engineering design, formal certification or qualification programmes, detailed supplier audits, commercial negotiations and a full lifecycle assessment.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The project is a desktop feasibility/evidence study. There are no physical trials, laboratory testing, prototype manufacture or testing at a substation in scope.

Revenue Allowed for the RIIO Settlement

No funding currently allowed within the RIIO-3 settlement is expected to become surplus to requirements as a result of this project. The value is therefore assessed as £0.

Indicative Total NIA Project Expenditure

The total project expenditure is £169,658 (**NIA contribution, 90%: £152,693**). Costs are distributed across the work packages as follows:

- Project Mobilisation £37,248
- Completion of WP1 - Requirements and Baseline Assessment £28,601
- Technical and Circular Economy Feasibility Assessment £28,600
- Completion of WP3 – Adoption Pathway Assessment £18,267
- Completion of WP4 – Recycled Copper Qualification and Adoption Framework £11,442
- NGET internal costs for NGET employee time £24,000
- NGET indirect costs £21,500
- Total Project Cost **£169,658**

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The project supports the energy-system transition by investigating whether recycled copper can be introduced into future HVDC infrastructure without compromising electrical performance, mechanical integrity, reliability or safety. Increased recycled content could reduce embodied carbon, dependence on primary copper and exposure to material-supply risks across the growing offshore transmission portfolio. However, adoption is constrained by limited evidence on technical performance, feedstock consistency, traceability and qualification. The project will establish the evidence gaps, risks and practical route towards future validation and adoption. It does not target consumers in vulnerable situations directly but could support longer-term consumer value through more sustainable and resilient infrastructure investment.

How the Project has potential to benefit consumer in vulnerable situations:

The project has no direct vulnerable-consumer intervention. Any consumer benefit would arise indirectly through potential future reductions in embodied carbon, improved resource efficiency and informed procurement decisions, subject to successful qualification and subsequent adoption.

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved

n/a

Please provide a calculation and/or description of the expected benefits of the solution

The project has potential to deliver net benefits by reducing uncertainty before National Grid makes future investment or procurement decisions concerning recycled copper in HVDC cables.

Potential benefits include:

- Potential reduction in embodied carbon associated with future HVDC infrastructure if recycled copper is successfully qualified and adopted.
- Improved material circularity
- Improved understanding of supply chain risks
- Avoidance of inappropriate or premature technology adoption
- Better informed procurement decisions
- Improved understanding of qualification requirements
- Identification of potential future economic opportunities and constraints.

The project will not claim a quantified annual financial benefit at this stage because the proposal only provides a high-level techno economic assessment and explicitly excludes detailed business case development and investment appraisal.

Please provide an estimate of how replicable the Method is across GB

The underlying learning is potentially applicable across GB electricity transmission networks where HVDC cable systems are considered. The technical requirements, qualification challenges, material traceability considerations and supply-chain issues identified through the project could inform future HVDC procurement and asset management activities.

The precise level of replication will depend on the results of the feasibility assessment, future HVDC project specifications, cable manufacturers, material suppliers and applicable qualification requirements. Given the strategic role of HVDC infrastructure in future GB network reinforcement and offshore transmission development, any validated approach to recycled copper adoption could potentially be replicated across multiple future transmission projects.

Please provide an outline of the costs of rolling out the Method across GB.

A reliable GB rollout cost cannot be established within the current project because this phase is limited to feasibility and de-risking. The project will instead develop a high-level understanding of material costs, processing requirements, supply-chain complexity and qualification implications.

Costs associated with future rollout would depend on the proportion of recycled copper adopted, cable manufacturing requirements, material availability, qualification/testing requirements, supply chain arrangements and any required modifications to procurement specifications.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- ☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- ☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- ☐ A specific novel operational practice directly related to the operation of the Network Licensees system
- ☐ A specific novel commercial arrangement

Involve Research, Development or Demonstration - Please select all that apply

- ☐ A specific piece of new equipment (including monitoring, control and communications systems and software)
- ☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- ☒ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- ☒ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- ☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- ☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

Because all GB transmission owners face increasing pressure to reduce embodied carbon and improve material circularity, the evidence generated by this project is expected to be transferable beyond National Grid. Other Network Licensees could use the findings to inform conductor-material strategies, procurement requirements, qualification activities and future circular-economy initiatives involving critical electrical infrastructure.

n/a

Is the default IPR position being applied?

☒ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed. Networks must explicitly mention similar projects that they have considered and how these differ.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

National Grid has not identified any previous NIA, NIC or SIF projects specifically focused on establishing the feasibility, qualification pathway and circular-economy case for recycled copper within HVDC cable systems. While recycled copper and circular-economy initiatives exist in other sectors, the specific technical, qualification and long-term reliability requirements associated with HVDC cable applications create a distinct evidence gap. The project therefore builds upon existing knowledge of recycled materials and HVDC systems rather than duplicating previous network-innovation activity. A review of relevant innovation portfolios published studies and international initiatives will be undertaken during the project to ensure findings complement, rather than duplicate, existing work.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

Not applicable.

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

The innovation lies not in recycled copper itself, but in establishing whether recycled copper can be adopted within high-reliability HVDC cable systems where qualification, performance assurance and long operational life requirements create barriers that are not present in many conventional copper applications. The project addresses an immature evidence and qualification landscape and seeks to establish the technical, supply-chain, circular economy and qualification conditions required for future adoption. The proposal identifies limited publicly available evidence, limited relevant case studies and uncertainty around qualification and certification pathways. It therefore provides a structured de-risking step before any future physical qualification or deployment activity.

Relevant Foreground IPR

Expected foreground IP is primarily associated with the project deliverables, including the structured requirements baseline, assessment outputs, supply-chain mapping, qualification pathway assessment, circular-economy assessment and techno economic assessment. The project is not expected to develop a physical cable product or proprietary manufacturing process because physical prototype manufacture, laboratory testing and detailed engineering design are outside scope. Background IP used by MTC will remain with the originating party. The MTC proposal identifies that foreground IP contained within the deliverables will be owned by the customer, while improvements to MTC background tools and methods remain with MTC.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click 'Contact Lead Network'. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at <https://www.nationalgrid.com/uk/electricity-transmission/innovation>
- Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

Please identify why the Network Licensees will not fund the project as a part of it's business and usual activities

The project addresses an early-stage innovation and evidence gap rather than a defined BAU operational requirement. National Grid does not currently have sufficient evidence to establish whether recycled copper can meet HVDC technical requirements or what qualification and approval pathway should be followed. Undertaking the work through BAU would require National Grid to commit internal resources to a research activity involving technical uncertainty, supply-chain uncertainty and uncertain future commercial outcomes. The project is intended to generate evidence before a decision is made to proceed to physical testing, qualification or procurement. Its outcomes may determine whether further activity is justified, meaning that the investment is exploratory rather than a routine operational activity.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks (e.g. commercial, technical, operational or regulatory) associated with the project

NIA support is required because the project involves technical, commercial, supply-chain and regulatory uncertainty associated with a potential new application of recycled copper within HVDC cable systems. Key risks include uncertainty over electrical and mechanical performance, material variability, long-term reliability, supply availability, traceability, qualification requirements, certification pathways and economic implications. The project is deliberately positioned before physical testing and deployment so that National Grid can establish whether further investment is justified. Without innovation funding, the risk is that National Grid either lacks sufficient evidence to progress the opportunity or commits resources to qualification and procurement before the key uncertainties have been adequately understood.

The NIA therefore provides a proportionate mechanism for generating evidence and reducing uncertainty before subsequent investment decisions.

This project has been approved by a senior member of staff

☒ Yes