End of Phase Report – R4 Alpha

SHARED: Smart Hydrogen and Resilient Energy Decarbonisation

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Project Details

Project Name	SHARED: Smart Hydrogen and Resilient Energy Decarbonisation
Project Reference	10179010
Project Phase	Alpha
Project Round & Challenge Area	Round 4, Challenge 3: Embedding Resilience
Project Start Date	01/02/2026
Project End Date	30/08/2026
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Part 1: Executive Summary and Project Overview

Executive Summary

SHARED (Smart Hydrogen and Resilient Energy Decarbonisation) is developing a low-cost, modular device that makes and stores hydrogen and uses it to restore power to rural customers when their supply is cut. Rural customers on long overhead lines are more likely to experience more frequent and longer interruptions. This means they are more likely to be classified as Worst Served Customers (WSC). Network reinforcement is often too slow and costly to address these issues.

The Alpha Phase was a seven-month design and analysis period led by UK Power Networks, Frazer-Nash Consultancy and The First Element, that aimed to:

- Identify user needs
- Develop a concept design
- Identify where the device is most cost-effective
- Establish a commercial model and business case

Key learnings through our stakeholder and user engagement centred around the asset's footprint being a key barrier to rollout given customer consenting and planning permissions. This, paired with the high proportion of overhead line in rural areas, led us to develop a pole-mounted design with a capacity of up to 20kW. When on standby, the unit converts rainwater and solar to generate hydrogen, which is stored within a metal hydride, and is then converted back to electricity via a fuel cell in the event of an interruption.

Based on this design, our siting analysis found that SHARED is the economical option when compared to conventional reinforcement at 722 of 1,197 rural substations assessed (rural, WSC-serving sites). As a result, we successfully achieved the original Alpha Phase project objectives stated above.

We shared findings at the Alpha Phase Show and Tell (22 September 2026), the End of Phase meeting with UKRI (23 September 2026), and will publish key outputs on the ENA's Innovation Portal. We also engaged directly with SGN, Northern Powergrid and National Grid throughout Alpha Phase based on their related projects.

Project Summary

SHARED responds to Round 4, Challenge 3, Embedding Resilience, which seeks novel, replicable and cost-effective approaches to rural decarbonisation. Rural networks typically rely on long-distance overhead lines over rural terrain with no alternative feed, meaning faults can take longer to fix, meaning these customers are among the most poorly served customers. Additionally, reinforcement in these areas can cost up to £150,000 per customer, and while local storage would support resilience, existing technologies such as batteries struggle to deliver the duration needed in a small footprint. Alpha Phase was designed to test whether stored hydrogen can fill that gap.

The project identified 49 design user requirements leading to modular concept designs of a pole-mounted design of up to 20kW and a ground-mounted cabinet design of up to 120kW. Based on these designs, we also completed a hazard study, network simulation tests, siting analysis, establishing a business case, development roadmap and cost-benefit analysis. The siting model is a key innovation of the project, using network data to identify single-fed spurs and estimate the cost of the reinforcement the Distribution Network Operator (DNO) that would

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be required, so resilience options can be compared like for like.

The analysis found SHARED to be the economical resilience intervention at 722 of 1,197 rural substations, with the business case estimates about £20 million of whole-life NPV against reinforcement as a counterfactual. We also compared DNO-owned, investor-owned and community-owned models and identified DNO-owned, resilience-only operation as the strongest route for early deployment. This approach was supported by operating-model analysis, which showed that multi-use would require larger storage and electrolysers, increasing costs and operational complexity. Therefore, our learning moved from Discovery's feasibility study to a modular concept design shaped by DNOs' key concerns about footprint and consent.

Project delivery largely matched the original plan, with all ten deliverables completed and all Alpha objectives were met, although incurred some minor delays because of data gathering and annual leave.

Part 2: Deep Dive

User Needs

The primary users are DNOs. Throughout Alpha, we engaged with key members from Quality of Supply, Network Operations and Control, Regulation, Asset Management and Safety teams at UK Power Networks to understand their requirements and gauge feedback. This was done through a series of 10 design workshops covering design requirements, network and control, hazard identification, as well as concept design review sessions.

Our initial design requirement workshops identified key requirements such as power restoration within three minutes, supply for up to 12 hours, a footprint no larger than 3m x 3m and a maximum height of 2.7m, and hydrogen volumes below the threshold for major-accident regulation.

Internal stakeholders expressed rollout of assets beyond a certain size or weight enter into planning permission difficulties, and customer consenting if on customer land. As a result, the project developed a pole-mounted unit due to high proportion of overhead lines and a lighter planning and consenting burden. As a result, our design has been directly shaped by user needs and feedback. For the DNO, a site is chosen using the siting analysis and the unit is installed at the relevant secondary substation.

The beneficiaries include rural customers, especially Worst Served Customers (WSC) and customers in vulnerable circumstances on the Priority Services Register. For customers, the journey is deliberately invisible: when a fault occurs upstream, supply returns automatically with no action or direct cost. UK Power Networks engaged with 30 customers who experience more interruptions than average. These customers told us that trust in the network has not yet been earned. 89% agreed that technology cutting long power cuts to under three minutes merits investment.

SHARED's approach avoids duplication. It connects to existing UK Power Networks control systems rather than a new platform, reuses the Discovery vulnerability matrix to prioritise sites, and builds on National Grid's and SGN's hydrogen trials rather than repeating them.

Impacts & Benefits

Alpha Phase remained a desktop analysis Phase, so therefore we did not anticipate any

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quantified benefits following Alpha Phase completion.

However, for the SHARED solution under BAU deployment, the key benefits include reduced number and duration of interruptions, reduced stress or disruption for rural customers, avoided network reinforcement, and reduced emissions due to reduction in temporary diesel generation. These benefits have been quantified and refined since the Discovery Phase due to the Alpha Phases' SHARED concept design and siting analysis.

At UK Power Networks sites where SHARED is the suitable alternative to reinforcement, the forecast whole-life NPV is £20m, comprising of:

- **£6m financial benefits**
  - Avoided network reinforcement due to utilisation of SHARED
- **£14m societal benefits**
  - £1.5m in reduced number of customer interruptions (CIs)
  - £5.9m in reduced duration or customer minutes lost (CMLs)
  - £7m in reduced stress and disruption related to interruptions
- **£2k environmental benefit**
  - Reduced emissions and pollution from reduced use of diesel generation, in place of SHARED

When expanded to GB scale, benefits reach £108m NPV.

Additionally, Ofgem's wider ED3 Worst Served Customer definition will increase the number of customers and sites into scope, which we have not yet quantified.

In future phases, other potential revenues would be assessed separately as a sensitivity, and will develop the assessment of wider economic and societal effects of reducing outages. This will include impacts on vulnerable customers, rural economic activity and dependent local infrastructure, including water and communications.

Other unquantified benefits include reduced staff mobilisation, travel, refuelling, monitoring and access requirements during severe weather or multiple concurrent faults. Additionally, where SHARED could be utilised instead of a new overhead line, it would also avoid or defer site-specific habitat disturbance, construction impacts and local disruption.

Risks, Issues & Constraints

The key risks within Alpha were:

Ref	Description	Mitigation
R3	Delays in acquiring necessary data sources	The data requests for relevant UK Power Networks teams were prepared ahead of time to allow more time to prepare. Data acquisition began at project mobilisation and sufficient contingency time was built into the project plan from the outset.
R10	The solution is found to be cost-prohibitive	Alpha was intentionally structured to ensure that the interim concept design (produced based on user requirements) could be used to inform the siting analysis, which then informed the final concept design, to ensure any siting or economic issues could be addressed for the final concept. Additionally, the modular nature of the design means that the asset can be sized to requirements,

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		reducing oversizing and high costs.

Both of these risks were ultimately closed by the end of the phase.

The work in Alpha Phase was not constrained by any rules, regulations, policy, contracts or old technology as it was primarily desk-based analysis. Instead, relevant regulations and policy did inform the concept design. For example, hydrogen safety law, including dangerous substances and explosive atmospheres requirements, informed the maximum level of hydrogen that should be stored, as well as G99 requirements informing the connection philosophy. Additionally, planning, consent and site restrictions limit where ground-mounted equipment could go.

We therefore designed the solution around these constraints. The modular, pole-mounted design lightens the burden of planning and consent barriers, and the grid-forming inverter, island switch and G99-compliant protection let SHARED restore supply downstream without exporting to the wider network. Additionally, the use of metal hydride for the hydrogen storage and venting to atmosphere reduces the stored energy (thereby reducing size/weight) and level of safety requirements. Our resulting stored weight is therefore in the magnitude of kilograms, well below the Planning (Hazardous Substances) Regulations 2015 limit of 2 tonnes.

Future phases of work would continue to seek to ensure these regulations are met during asset build and commission.

Working in the Open

We communicated openly about SHARED through several events during Alpha Phase. This included a dedicated poster stand at UK Power Networks' Net Zero Networks event, on 6 May 2026, which is our annual innovation showcase. We also held a public online webinar Show and Tell on 22 September 2026, where learnings were disseminated with interested parties and key stakeholders. Our final outputs will be published on the ENA Innovation Portal and dedicated UK Power Networks' innovation website, with commercially sensitive material redacted or aggregated. We also shared updates through a press release and dedicated social media posts.

With UKRI, we held a virtual kick-off and midpoint meeting to update on our project approach and progress, culminating in an in-person End of hase meeting on 23 September 2026.

We engaged internal stakeholders as a key part of our project plan. As previously mentioned, our design workshops covered requirements, investment decisions, use cases, controls, concept designs and hazards. The project therefore invited challenge throughout, with each concept design reviewed in a dedicated workshop with the above stakeholders, and the hazard study challenged the interim concept design and produced 23 actions which were then addressed in the final concept design.

Externally we engaged with SGN on its H100 Fife project, Northern Powergrid on related resilience projects, MicroResilience and MultiResilience, and National Grid on its trial of a GeoPura hydrogen power unit (HPU) at its Deeside Centre for Innovation.

This engagement validated our compact pole-mounted design approach as National Grid's HPU trial showed that footprint was a key barrier to BAU roll-out. Both H100 Fife and Northern Powergrid's resilience projects provided learnings on how to engage with customers surrounding hydrogen technologies and resilience interventions respectively, which impacted our plans for future Phases.

Finally, engagement with customers confirmed our hypothesis that Worst-Served Customers do

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not trust their network given their lived experience to date, and want to see increased investment in technologies to improve resilience. A history of repeated interruptions have eroded trust in the network, making customers reluctant to electrify their heating and transport.

Costs & Value for Money

The total project spend was £548,541.76, against total project budget of £562,562. Spend by non-licensee partner matched the original budget, while the £14,020.24 underspend was due to UK Power Networks labour. The spending summary can be found in the table below.

Project partner	Total project costs	Partner contribution	SIF funding requested	Total actual costs	SIF funding used
UK Power Networks (Operations) Limited	£122,330.00	£12,233.00 (10.0%)	£110,097.00	£108,309.76	£96,076.76
Frazer-Nash Consultancy Limited	£284,532.00	£28,453.00 (10.0%)	£256,079.00	£284,532.00	£256,079.00
The First Element Group Ltd	£155,700.00	£22,350.00 (14.4%)	£133,350.00	£155,700.00	£133,350.00
Total	**£562,562.00**	**£63,036.00 (11.2%)**	**£499,526.00**	**£548,541.76**	**£485,505.76**
				Variance	**£14,020.24**

For under £500,000 of SIF funding SHARED produced a validated concept design, identified site locations for rollout and established a business case estimating a whole-life benefit of about £108 million against conventional reinforcement. As a result, hazards, siting and cost drivers were established before any capital was spent on a build, reducing risk ahead of any larger Beta Phase investment.

Each partner worked in its area of expertise, and previous Discovery outputs, existing network data and UK Power Networks' expertise were utilised.

Finally, partner contributions came to 11.2%, above the minimum 10% compulsory contribution, and were all labour in kind as set out in the application.

Special Conditions

All seven Project Specific Conditions were met, as per the table below

No.	Condition	How it was met
1	The Funding Party must not spend any SIF Funding until contracts are signed with the Project Partners [...] for the purpose of completing the Project.	No SIF funding was spent until contracts were signed with the Project Partners
2	The Funding Party must report on the financial contributions made to the Project as set out in its Application. Any financial contributions made over and above that stated in its Application should also be reported and	Partner contributions of £63,036 (11.2%), all labour in kind, were reported as set out in the Application

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	included on the Innovation Funding Service (IFS).	
3	The Funding Party must make reasonable endeavours to participate in all meetings related to the Project that they are invited to by Ofgem, UKRI and Department for Energy Security and Net Zero during the Alpha Phase.	The project consortium took part in all meetings it was invited to by Ofgem, UKRI or the Department for Energy Security and Net Zero.
4	The Project will be allowed a flexible start date and duration within the 8-month period from the date the Project Direction is issued. The Project must tell the monitoring officer the start date and end date of the Project.	The Project started and ended within the eight-month window from the Project Direction, with Monitoring Officer informed of start and end dates.
5	Prior to the end of Phase meeting, the Funding Party must provide to the Monitoring Officer a consumer engagement plan. This must include a clear approach to capturing and incorporating consumer experience and behavioural insights. The plan must also set out how learning from relevant hydrogen trials, including H100 Fife, has been considered.	In-person End of Phase meeting with UKRI Monitoring Officer held on 23 September 2026, with materials sent two days in advance. End of Phase slide pack contained proposed consumer engagement plan for future Beta Phase; 1. Understanding customer baseline views of hydrogen devices 2. Identifying potential trial communities 3. Participation satisfaction tracking before, during and after trial Evidenced engagement with H100 Fife and shared learnings from use of community forums, surveys and a community liaison group. Confirmed with UKRI that SHARED represents a materially different proposition, with very limited customer impact under BAU, unlike infrastructure change required within H100. Level of engagement proposed is therefore reflective of this.
6	Prior to the end of Phase meeting, the Funding Party must provide to the Monitoring Officer a summary of the proposed safety assurance, monitoring arrangements, and emergency response protocols for future trial activities.	In-person End of Phase meeting with UKRI Monitoring Officer held on 23 September 2026, with materials sent two days in advance. End of Phase slide pack contained of summary of safety assurance across a staged route, throughout Beta Phase, with a dedicated work package. Emergency response details also provided.
7	Prior to the end of Phase meeting, the Funding Party must provide to the Monitoring Officer: • a summary of the key outputs, findings, and lessons learned from the Project, together with a plan outlining how these will be disseminated openly to support replication and learning across GB electricity networks, as is required in the end of phase report;	In-person End of Phase meeting with UKRI Monitoring Officer held on 23 September 2026, with materials sent two days in advance. End of Phase slide pack contained full findings and lessons learned from each work package in Alpha. Dissemination plan provided above in response to 'Working in the Open'.
	• a statement setting out how learning from the Alpha Phase informs future scalability and application of the solution, including applicability to different rural network	End of Phase slide pack contained BAU development roadmap for SHARED solution, detailing scalability and integration of solution.

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	conditions and integration into business-as-usual resilience planning;	
	• a summary demonstrating where the SHARED solution is cost competitive when compared to alternative options, including diesel generators, battery storage, and network reinforcement.	End of Phase slide pack contained cost-benefit analysis results of the SHARED solution against diesel generation, traditional resilience reinforcement, and battery storage. SHARED found to have positive NPV against each counterfactual for rural Worst Served Customer sites.

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