SIF Round 4 Discovery – SHARED: Smart Hydrogen and Resilient Energy Decarbonisation

End Point Review

31/08/2025

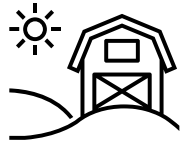
Agenda

Project Overview

What is SHARED?

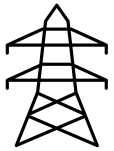
SHARED explores the smart use of low-cost hydrogen production and storage to reduce interruptions and their impacts for worst-served customers in rural communities.

Rural communities tend to be amongst the most poorly served customers due to the type/architecture of electricity infrastructure in place. Due to network topology, they see **a greater impact from network faults**, particularly those caused by extreme weather events.

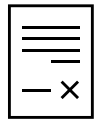


These communities often fall into Ofgem's category of 'Worst Served Customers (WSC)' and the **decarbonisation of these communities could exacerbate these issues** and the impact on these communities.

Due to the nature of rural distribution networks and the location of these customers (mostly supplied by long-distance overhead HV lines), **traditional network reinforcement and resilience improvements** is **cost prohibitive**.



This type of work can also take **a number of years to deliver due to consenting and legal requirements.** Therefore, a solution to improve network performance more quickly is desirable.

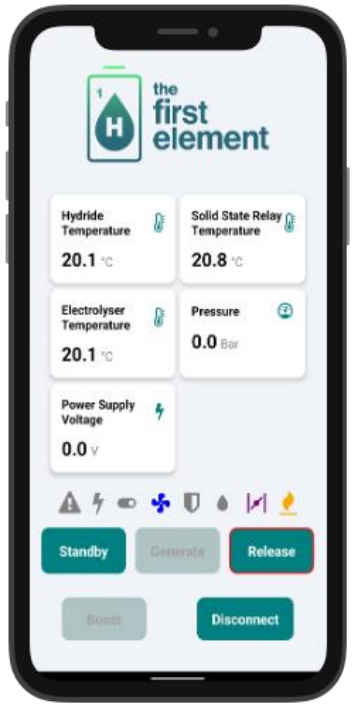


Interruptions can also disproportionally impact vulnerable customers due to higher reliance on electricity, .e.g for medical equipment etc.

Overview of the technology

The Smart Tank

- Generating and Storing Clean Hydrogen at point of use
- Driving a low-cost solution: integrated hydrogen generation and compact hydride storage coupled with compression and integrated safety systems
- Smart Service: Dial home, Central management and AI forecasting
- Automatic shut-off in event of a leak with low cost wireless Smart gas detector (similar to smoke detectors)
- Modular system can scale linearly and quickly
- Can store and release power to provide agile grid back up/resilience.



Detect
by the first element

SHARED Discovery Outputs

Work Package (WP)	Aim	Deliverable		Partner	Due
WP1: Project Management	To deliver the project on time, to budget and ensuring project objectives and learnings are achieved	**D1.1**	Project Plan and Kick Off	UKPN	On time
		D1.2	Discovery Show and Tell	UKPN	On time
		D1.3	Discovery End of Phase	UKPN	On time
WP2: Consumer Prioritisation	Develop a stakeholder engagement plan, for targeted consumer interactions based on analysis of those most at risk, and other stakeholders such as Government, regulators and wider industry	**D2.1**	Consumer prioritisation	CSE	On time
		D2.2	Stakeholder Engagement Map	CSE	On time
WP3: Network Risk Identification	To identify and map communities that could benefit from the solution, plus defining their needs for agreed scenarios to be considered in optioneering exercises	**D3.1**	Network Risk Analysis	FNC	On time
WP4: Technology Assessment	To investigate relevant technological constraints and how the proposed technology might fit with those constraints, and report these findings to the other project partners	**D4.1**	Concept Design	TFE	On time
		D4.2	System specification	TFE	On time
WP5: Implementation Strategy	To plan the roll-out of the solution within UK Power Networks and beyond and identify any barriers to the successful rollout	**D5.1**	Implementation Strategy	FNC	On time

Benefits

Future Network Operation: Resilience and Reliability

- Reduced Customer Minutes Lost (CMLs) / Customer Interruptions (Cis)
- Reduced impact of outages on consumers, including vulnerable / PSR customers

Low carbon generation

- Reduced use of diesel generators

Social benefits

- Improved quality of life for worst served customers, including PSR customers

Project Progress

WP1: Project Management

- Contract signed between all parties
- Weekly team meetings to monitor progress
- Deliverables completed on time and to requirements
- Show & Tell completed

Project Element	Outcome
Finances	Completed and on target to timescale
Project Plan	Updated
Risk management	Updated
Project specific conditions	Completed

WP2: Consumer Prioritisation - Approach

Aims: Develop a stakeholder engagement plan, for targeted consumer interactions based on analysis of those most at risk, in addition to other stakeholders such as Government, regulators and wider industry.

Success criteria: Stakeholders identified and engaged so that a full engagement plan for future phases is developed.

Approach:

WP2: Consumer Prioritisation - Approach

Datasets Used:

Dataset Description	Source
Priority Services Register (PSR) Needs Codes by LSOA	UKPN
Number of households with 2+ people self-reporting a disability (as defined by the equality act)	Census 2021
Number of people on personal independence payments (PIP), disability living allowance (DLA) and attendance allowance (AA)	Department for Work and Pensions (DWP)
Fuel poverty – in England this is measured using the Low Income Low Energy Efficiency (LILEE)	Dept. for Energy Security and Net Zero (DESNZ)
Number of households with annual income less than £30,000	Experian

Four categories of PSR needs codes were created:

1. Medically dependent on electricity
   - CAT 3 needs codes
2. Medically reliant on electricity
   - Implied reliance on continued electrical supply
3. Intervention impact
   - Needs codes that indicate households for whom current outage interventions or processes are suboptimal, and/or an intervention like SHARED would be better suited to them
4. Duration sensitive
   - Needs codes that are comparably worse off in longer outages or may not be typically affected by short outages

WP2: Consumer Prioritisation - Approach

Data methodology

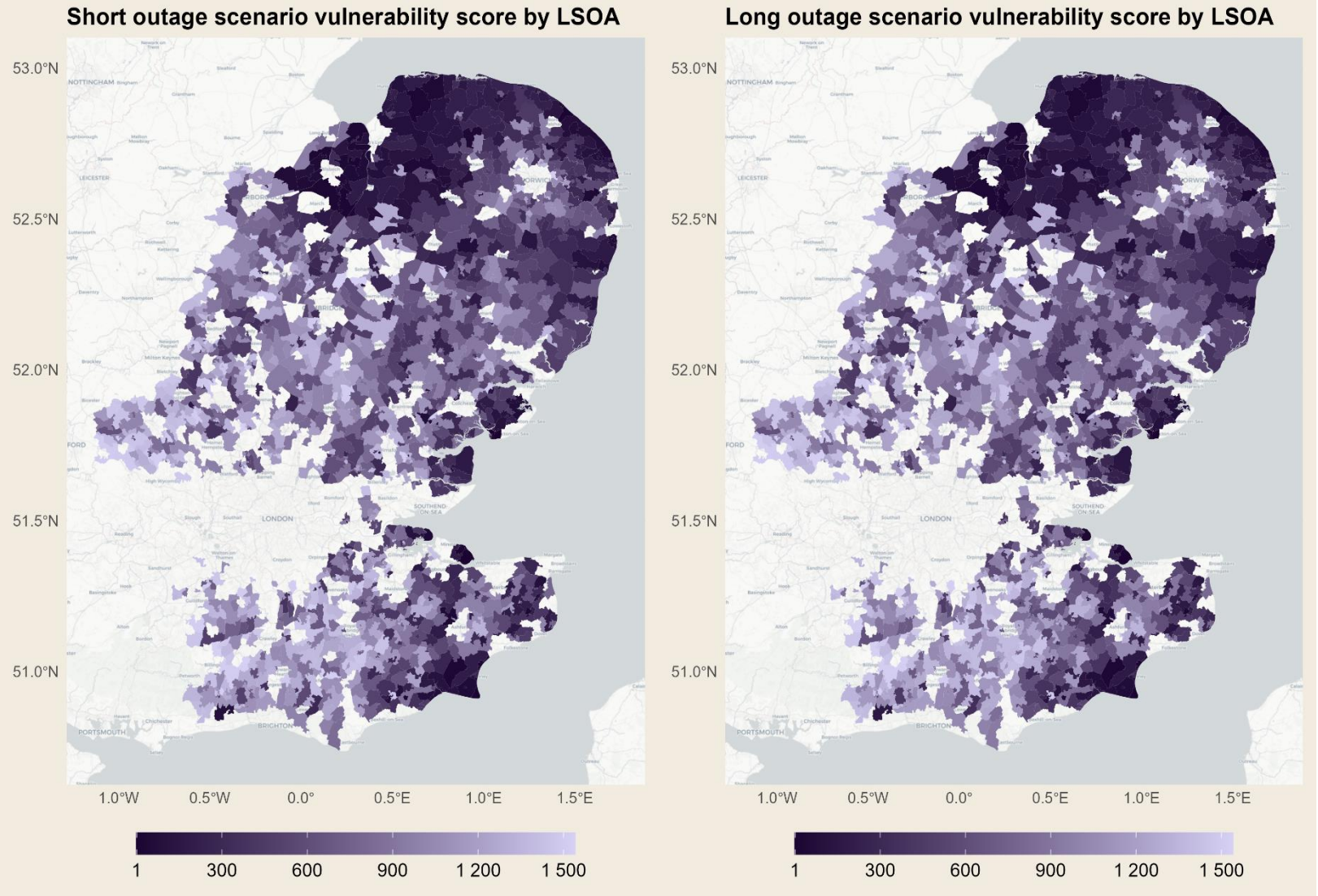
Type	Weight given	Variable	Overall weight (short outage)
PSR needs codes	50%	'Medically Dependent' PSR needs codes	25%
		'Medically Reliant' PSR needs codes	16%
		'Intervention Impact' PSR needs codes	8%
Social	25%	Fuel Poverty	12%
		Households with annual income below £30,000	6%
		Universal Credit cases	6%
PSR gap proxies	25%	2+ householders with self-reported disability	12%
		Personal Independence Payment cases	4%
		Disability Living Allowance cases	4%
		Attendance Allowance cases	4%

WP2: Consumer Prioritisation - Key findings and outputs

Maps by vulnerability score

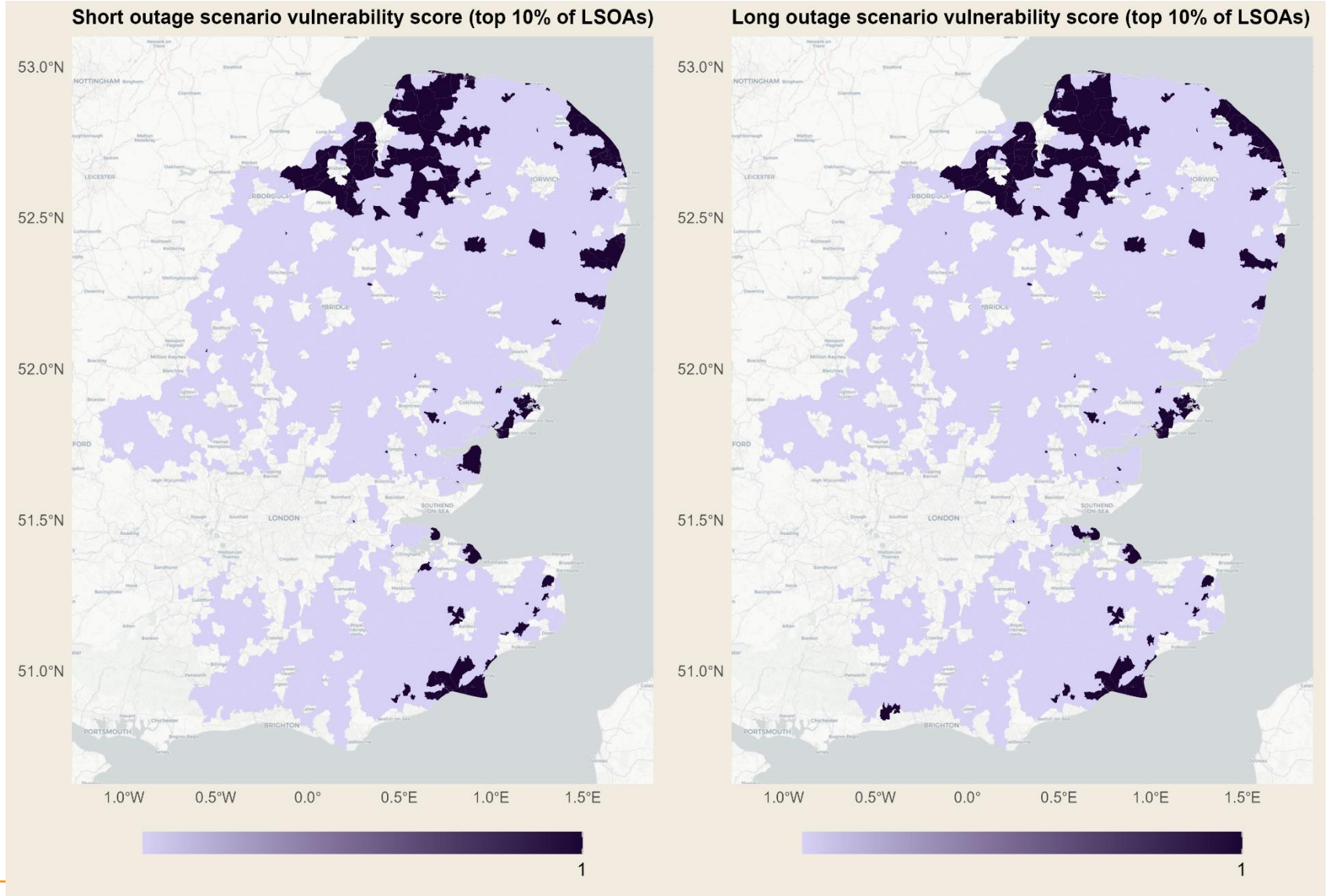
As we are looking specifically at rural communities, any LSOA classified as Urban is not within scope. As a result, these maps focus on Eastern (EPN) and South Eastern networks (SPN).

All results are based on desktop analysis and require further testing for validation



WP2: Consumer Prioritisation - Key findings and outputs

Maps by vulnerability score



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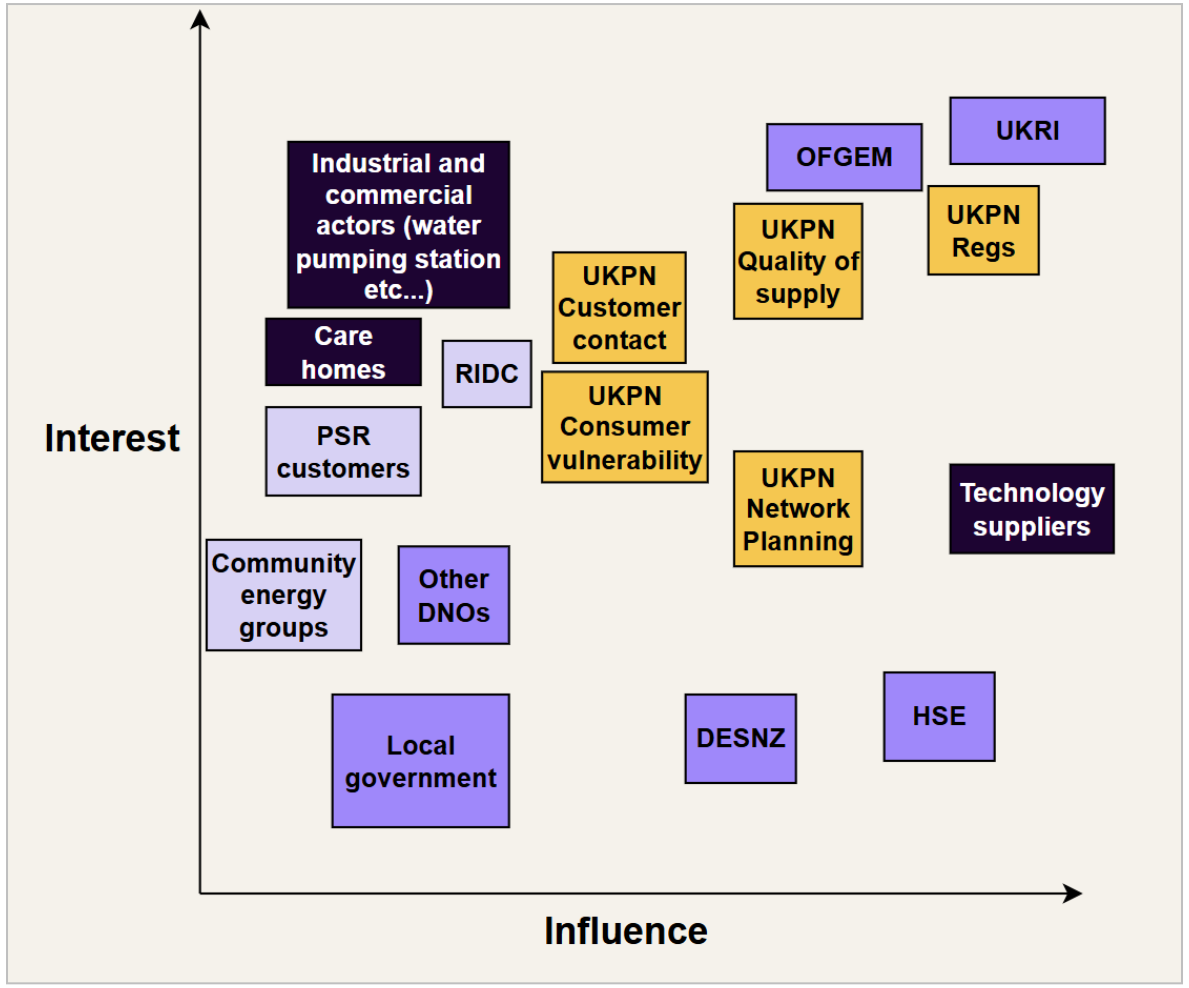
WP2: Consumer Prioritisation - Key findings and outputs

Stakeholder Engagement Plan



Stakeholder	Interest in the technology	Area of expertise
Regulators (e.g. Ofgem, DESNZ, HSE)	Potentially interested in how the technology could contribute to policy goals (e.g. climate reduction, protection of vulnerable consumers etc), as well as ensuring that its deployment complies with the relevant regulations.	Deep understanding of the policy and regulatory environment.
Other DNOs	To understand whether the solution is replicable across their own networks.	Potential for replicability, and insight into possible regulatory, technical and social issues.

WP3: Network Risk Identification - Approach

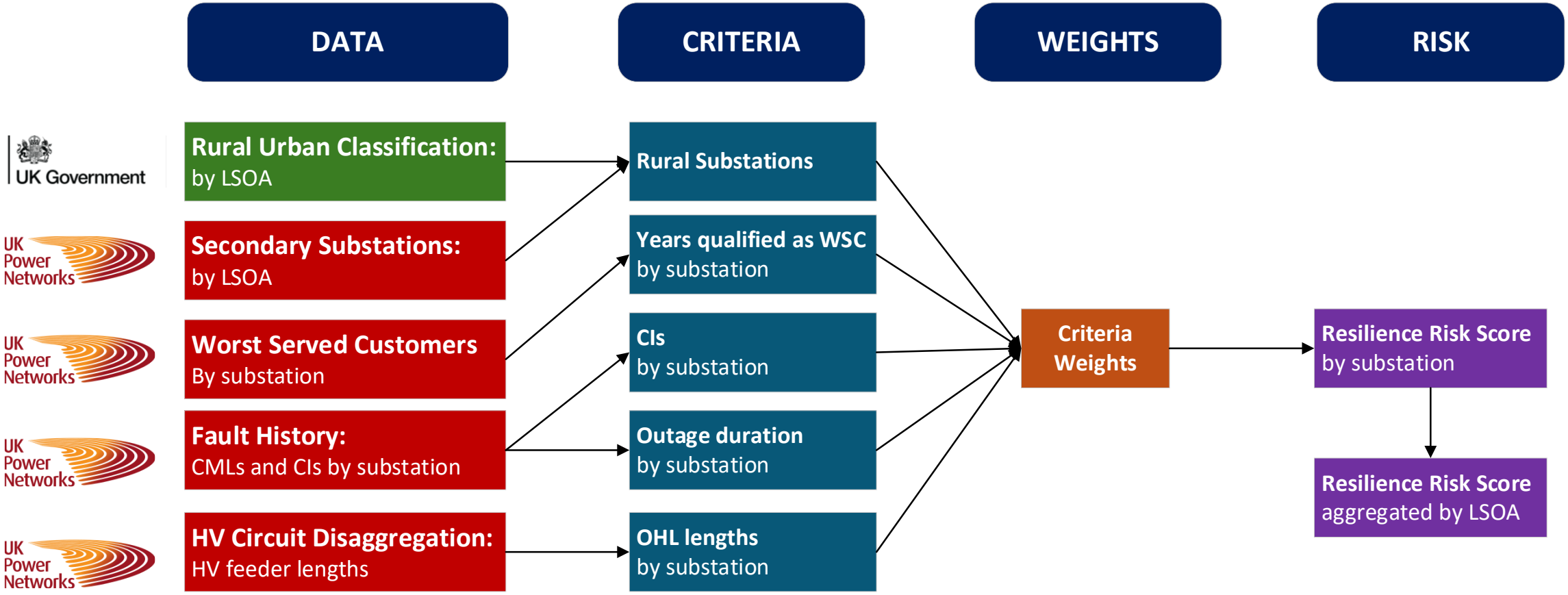
Aims: To identify and map communities that could benefit from the solution, plus defining their needs for agreed scenarios to be considered in optioneering exercises

Success criteria: The solution requirements for specific communities developed so that technical solutions can be sized.

Approach:

WP3: Network Risk Identification - Approach

A multi-criteria decision analysis (MCDA) was used to provide an initial assessment of indicative network locations which are susceptible to outages and resilience risks.
Data from UK Power Networks and rural filters from Government were collated for each substation. A score was then calculated based on the applied criteria weights, before the final scores were aggregated by LSOA.



WP3: Network Risk Identification - Key findings and outputs

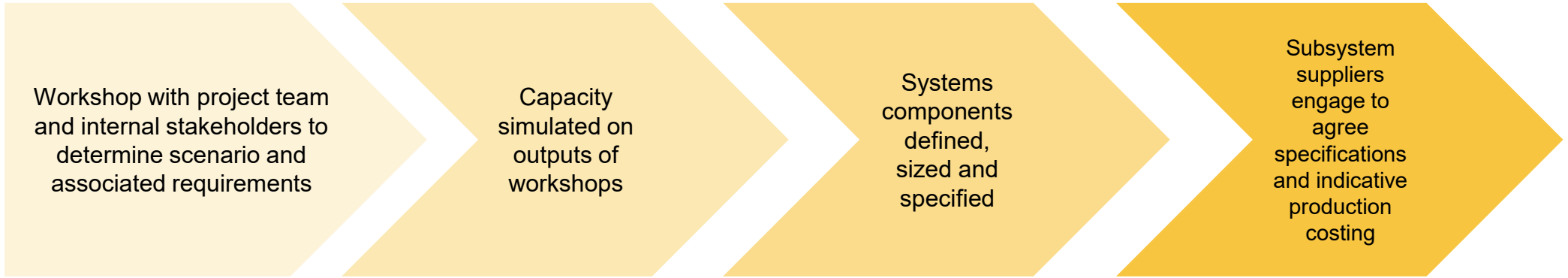
- Secondary substations in UK Power Networks' service area were evaluated and scored, as an estimate of the outage risk posed to each substation.
- These scores were aggregated to LSOA level, and regions were identified as having higher or lower outage risks based on these aggregated results.
- Small clusters of higher risk LSOAs were distributed across the UK Power Networks area.
- Our results paired with the CSE Consumer Prioritisation analysis can be used to understand which areas may be of greatest interest during future phases of the project.

WP4: Technology Assessment - Approach

Aim: To investigate relevant technological constraints and how the proposed technology might fit with those constraints, and report these findings to the other project partners.

Success criteria: Final concept designs and system specifications developed for desktop analysis in Alpha Phase.

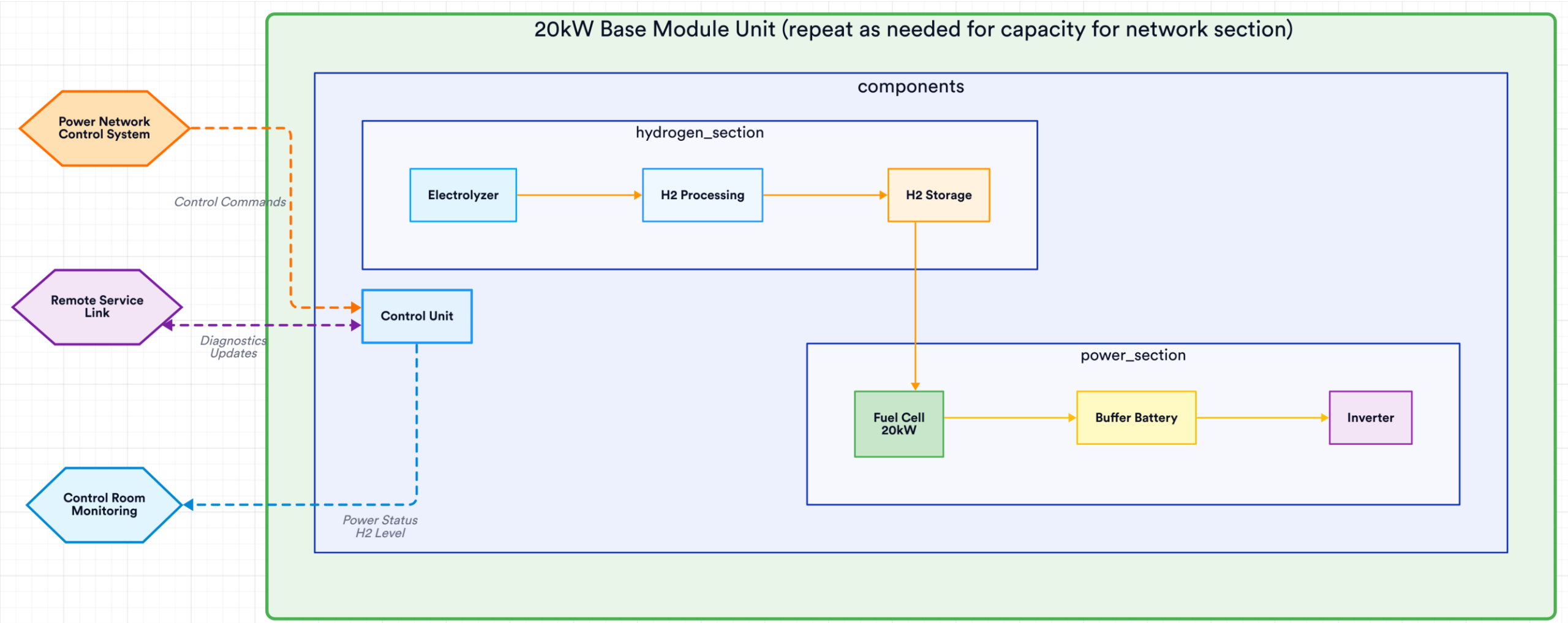
Approach:



WP4: Technology Assessment - Approach

- Capacity simulated for scenarios from project workshops;
  - 5 homes, 3-hour outage
  - 50 homes, 8-hour outage
- System components defined, sized and specified
- Subsystem suppliers engaged to agree specifications and indicative production costing

WP4: Technology Assessment – Key findings and outputs



WP4: Technology Assessment - Key findings and outputs

- System can be scaled to fit both scenarios effectively

Characteristic	5 home scenario	50 home scenario
Chassis	2m cube	ISO container chassis
Peak power output	19kW	190kW
Energy delivered	57kWh	750kWh

- Most cost effective - use modular units of capacity to load a given chassis with the right capacity for the part of the network backed up.

WP5: Implementation Plan - Approach

Aims: To plan the roll-out of the solution within UK Power Networks and beyond and identify any barriers to the successful rollout.

Success criteria: A full implementation plan including (Social, Technological, Economic, Environmental, Political, Legal, and Ethical) STEEPLE analysis, a roadmap and cost benefit analysis are delivered

Approach:

WP5: Implementation Plan - Approach

Two capacities of the hydrogen energy storage system have been defined for our assessment, a “Low Scenario” and a “High Scenario”, the specifications for which are described in D4.2.

The system requirements for the two options have been defined as:

Low Option

- Peak power of 19 kW
  (equivalent to up to 5 homes)
- Total energy of 57 kWh
  (to cover outages of up to 3hrs)

High Option

- Peak power of 190 kW
  (equivalent to up to 50 homes)
- Total energy of 1,520 kWh
  (to cover outages of up to 8hrs)

Both Options

- Risk Score (as defined in WP3) > 50th percentile
- Vulnerability Score (as defined in WP3) > 50th percentile

Market for Low Option is **751** substations in the UK Power Networks’ region, scaled up to **3,501** for the whole of GB

Market for High Option is **2,785** substations in the UK Power Networks’ region, scaled up to **12,984** for the whole of GB

All results are based on desktop analysis and require further testing for validation

WP5: Implementation Plan - Key findings and outputs

	Societal	Technological	Economic	Environmental	Political & Legal	Ethical
Enabler	Positive Public Perception to Low Carbon Technologies	Integrated smart sensors and controls allow the system to detect outages and automatically ramp up output, improving response time and reliability. Controlled via central system.	By improving network resilience, the solution can help avoid financial penalties linked to customer minutes lost and customer interruptions.	The solution produces no carbon emissions during operation, supporting decarbonisation goals.	International trade agreements may improve access to affordable electrolyser technology and supply chains.	Improved network resilience can protect vulnerable PSR customers during outages
Barrier	Public knowledge and understanding of hydrogen as a fuel is low	Low TRL solution carries technological and financial risk and may require investment prior to deployment.	The CBA indicates the solution would not consistently be economically viable, but depends on the characteristics of the substation	The system requires land area for siting, which may impact the immediate local environment and raises concerns about land availability.	Regulations may restrict network operators from using the solution for commercial purposes, limiting its value.	Sourcing of components must adhere to supplier transparency and environmental requirements

Lessons learned & barriers

Discovery SHARED Lessons Learnt

Discovery Phase has identified where in UK Power Networks' license area the proposed technology would be most likely to benefit, in terms of improving quality of supply in rural locations, as well as focusing on consumers who may be more at risk during an outage.

Outputs from Discovery show that the technology will be designed in a scalable, modular way, and has been confirmed to suit two scenarios which, although general, are quite representative of typical outage scenarios experienced in rural locations.

However, the cost-benefit analysis has shown that the applicability of this technology is not consistent, and is dependent on a case-by-case basis, where costs are lower than other preventative action.

As well as economic viability, there are other significant barriers that would need to be overcome for the technology to provide reliable resilience, including supply chain maturity and technology availability.

Discovery SHARED Barriers, risks, issues that were identified and overcame

Throughout the project, we navigated data sharing processes and had to ensure we were following best practice. As this project concerns rural substations that often have less than 5 customers downstream, all location data was anonymised, and only internal substation references were used. Reporting was done at LSOA level for publication. In future phases, we will need to ensure this is continued.

We also identified that this solution, in its current specification, is not cost effective against every substation in our cost benefit analysis. We also plan to design the future stage in a way that investigates this further, including further refinement of the specification, supply chain assurance, as well as understand commercial and operational framework options. Work will also be undertaken to understand what characteristics of the network make this solution cost-effective and allows for optimal investment planning by UK Power Networks.

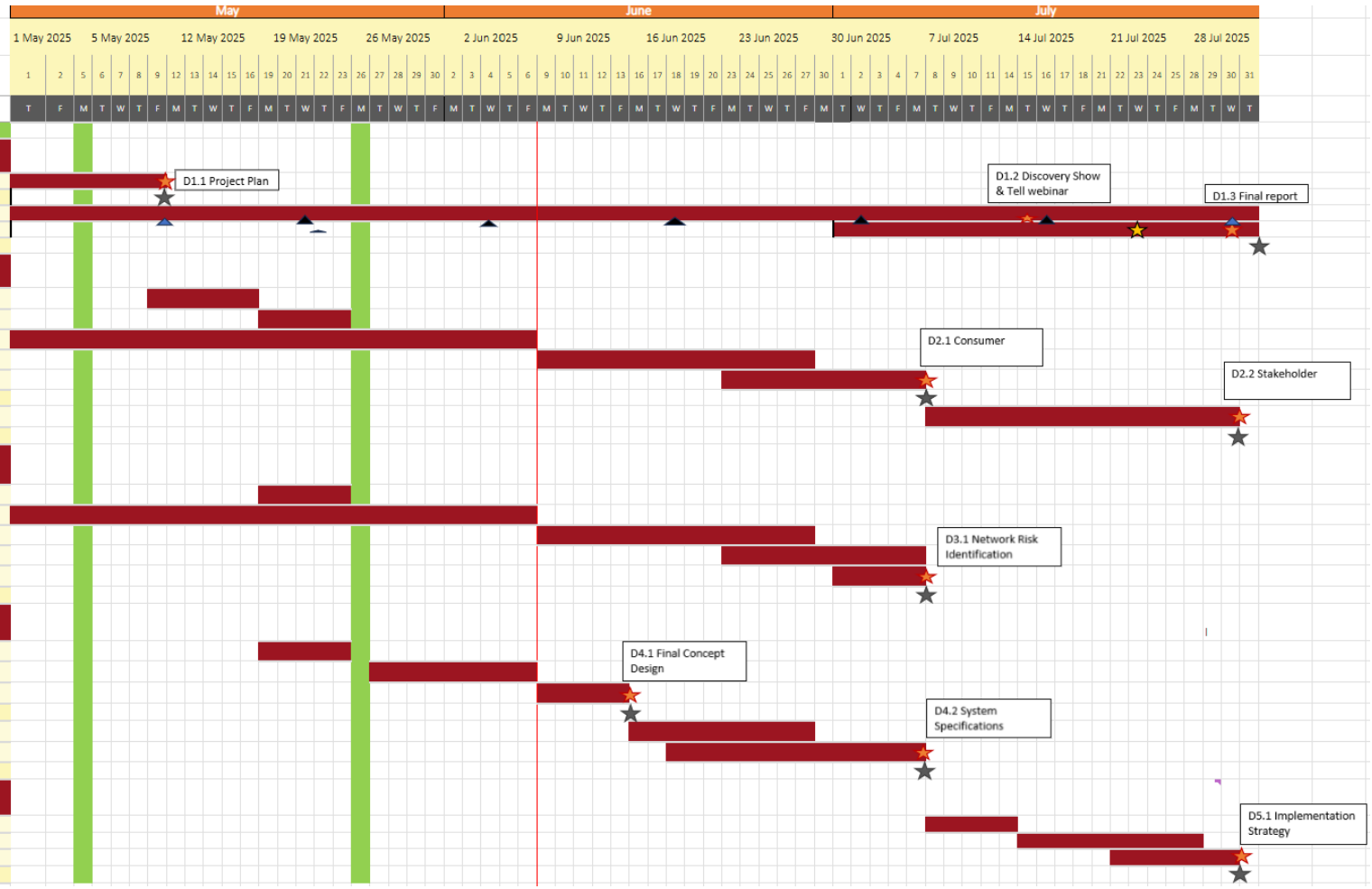
Project Plan Update

Project Plan

SIF4: SHARED Smart Hydrogen And Resilient Energy Decarbonisation

PUBLIC HOLIDAYS

WP1:	**Project management**	**Lead**
1.1	Plan (identify and agree on key milestones under each workstream, risks, dependencies, and review process)	*UKPN*
M1.1	**Milestone: Project kick-off**	**UKPN**
1.2	Monitor progress and learning with fortnightly team meetings, Show & Tell webinar and end of phase meeting with Innovate UK	*UKPN*
1.3	Produce end of phase reporting	*UKPN*
M1.2	**Milestone: End Point Report**	**UKPN**
WP2:	**Consumer Prioritisation**	**Lead**
2.1	Scenario Planning - define two outage scenarios for use case testing	*UKPN*
2.2	Consumer prioritisation criteria definition - define the criteria to be attributed to consumers for prioritisation	*CSE*
2.3	Data acquisition - obtaining data associated with the consumer prioritisation criteria	*CSE*
2.4	Geospatial analysis - assess the rural areas with the greatest need for the solution	*CSE*
2.5	Consumer Prioritisation - Identify the consumer types most at risk	*CSE*
M2.1	**Presentation of Consumer Prioritisation**	**CSE**
2.6	Stakeholder Engagement Planning - generate a plan for targeted stakeholder engagement during Alpha Phase	*CSE*
M2.2	**Stakeholder Engagement Plan**	**CSE**
WP3:	**Network Risk Identification**	**Lead**
3.1	Network resilience risk characterisation criteria definition	*FNC*
3.2	Data acquisition - obtaining data associated with network resilience	*FNC*
3.3	Geospatial analysis - assess the rural areas with greatest risk of resilience related issues	*FNC*
3.4	Network risk assessment - identify the network areas with the highest risk	*FNC*
3.5	Scale of need - estimate the scale of solution rollout required to mitigate at risk network areas and high priority consumers	*FNC*
M3.1	**Presentation of Network Risk Assessment**	**FNC**
WP4:	**Technology Assessment**	**Lead**
4.1	Concept design - subsystem drawings	*TFE*
4.2	Technology assessment - appraisal of the different available technologies for each subsytem, including specifications and costs	*TFE*
4.3	Technology down-selection - select most suitable technologies for each subsystem	*TFE*
M4.1	**Final concept design**	**TFE**
4.4	Sizing simulation - simulation of system behaviour for each of the two scenarios	*TFE*
4.5	Controller requirements - capture requirements for controller interface with the network, for example fault predication and detection	*TFE*
M4.2	**System specifications and costs**	**TFE**
WP5:	**Implementation Strategy**	**Lead**
5.1	STEEPLE Analysis - assessment of macro-environemental barriers and enablers	*FNC*
5.2	Cost Benefit Analysis	*FNC*
5.3	Implementation Roadmap	*FNC*
M5.1	**Implementation Strategy**	**FNC**



Key Risks

Please see Project Management Book for full list of Discovery Phase risks – only a small number of key risks have been highlighted below.

Ref	Risk Description	Likelihood (Low/Medium/High)	Impact (Low/Medium/High)	Mitigation	Status
R1	**Stakeholder unavailability** Key internal stakeholders might be unavailable or unidentifiable for user research sessions, delaying the understanding of user needs and requirements	Medium	High	Stakeholder engagement was conducted in the early phases of Discovery to ensure input from engagement. Contacts were acquired as early as possible and engagement was implemented throughout the project.	Closed
R10	**Delays in acquiring necessary data sources** Cause delays in geospatial analyses putting the project behind schedule.	Medium	High	Data request for UK Power Networks was prepared ahead of project start to allow more time to prepare and data acquisition began at the outset of the project.	Closed

Project Specific Conditions

Condition	Description	Update
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.	Complete
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 included within the Project costs template.	Complete
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 DESNZ during the Alpha Phase.	Complete
4	The Discovery phase will last for a period of up to five months from the date the Project Direction is issued; the Project will be allowed a flexible start date within the five-month period. The Project must provide the monitoring officer with the start date of the Project and must be completed before the end of the five-month period.	Complete
5	Prior to the end of the Discovery Phase, the Funding Party must provide an initial assessment to the Monitoring Officer of the cost of hydrogen produced by the solution.	See following slides (as agreed over email)
6	Prior to the end of the Discovery Phase, the Funding Party must evidence to the Monitoring Officer how the proposed solution aligns with the current GB policy direction on hydrogen	

Project Specific Condition 5 – Cost of Hydrogen Produced

Based on the specifications designed, we have found the below value for the cost of hydrogen:

Item	Value	Notes
H_2 per charge	42 kg	
Electricity in per charge	2.333 MWh	60% Electrolyser Efficiency LHV
Charges per year	4	
Annual electricity use	9.333 MWh/yr	4x2.3
Electricity price	£72/MWh	Ofgem wholesale indicator [Ofgem]
Annual electricity cost	£672/yr	9.333×729.333x72
Annualised CapEx (20 y straight-line)	£5,000/yr	100000/20
OPEX	£4,100/yr	
Total annual cost	£9,771.93/yr	£5,000 + £4,100 + £671.93
Annual H_2 output	168 kg/yr	
Levelised Cost of Hydrogen Produced	£58.17 per kg H_2	£9,771.93/168

Howevr, it should be noted that hydrogen is produced internally and converted back to electricity, and a result, this figure is less relevant for the solution in comparison to other hydrogen projects.

Project Specific Condition 6

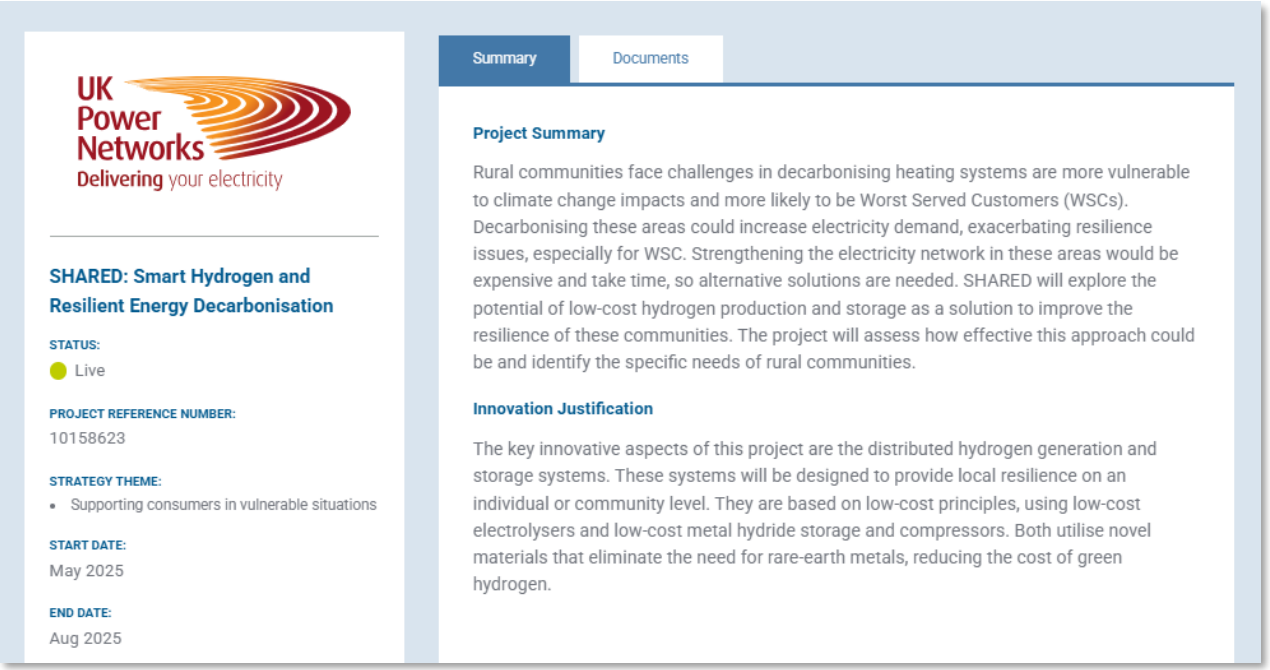
Alignment with GB Hydrogen Policy Direction

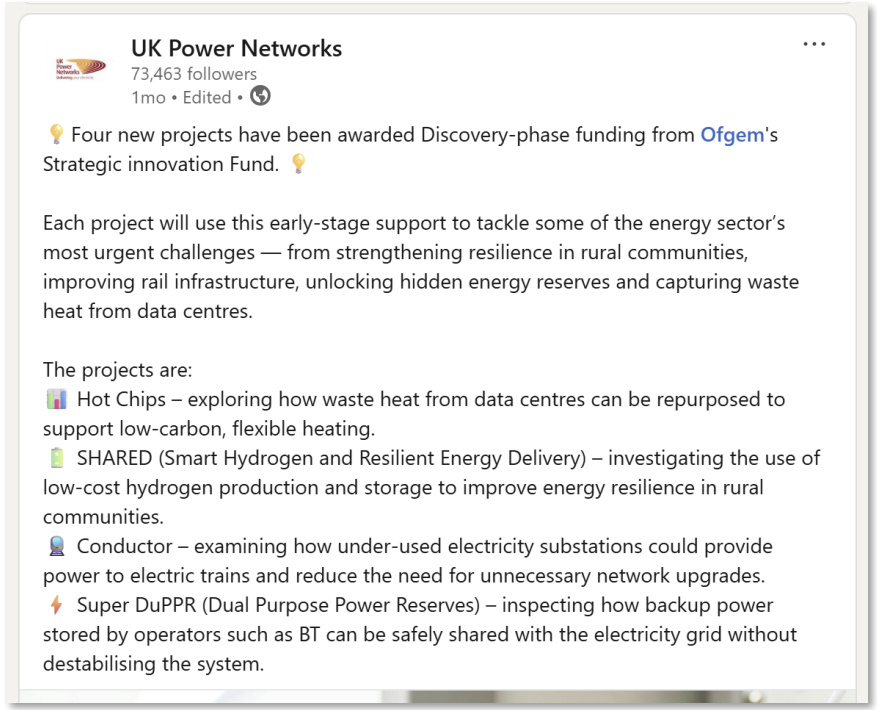
- Aligned with and contributes to UK Energy Security Strategy: Low Carbon Hydrogen Capacity (UK) 10 GW by 2030, with at least 5 GW from electrolytic (“green”) hydrogen (doubled from 5 GW).
- However, the UK hydrogen policy direction presents a risk for this solution, as any future repeal on hydrogen could slow or prevent potential development and rollout due to impacts on supply chain.
- However, it should be noted that this is not a hydrogen ecosystem component as hydrogen is produced and used internally – as such it is agnostic of UK hydrogen policy.

Next Steps

Communication and Dissemination

UK Power Networks have provided details on the ENA Portal, online and used social media channels to promote the project.





We held a Show and Tell in September as a virtual session to share learnings

Next Steps

The project partners are currently developing a proposal for Alpha Phase. The following steps are required to prepare for an Alpha submission, ahead of preparing the bid:

1. **Engage with internal business owners to ensure alignment of project activities**
2. **Finalise scope and activities for next stage**

Questions