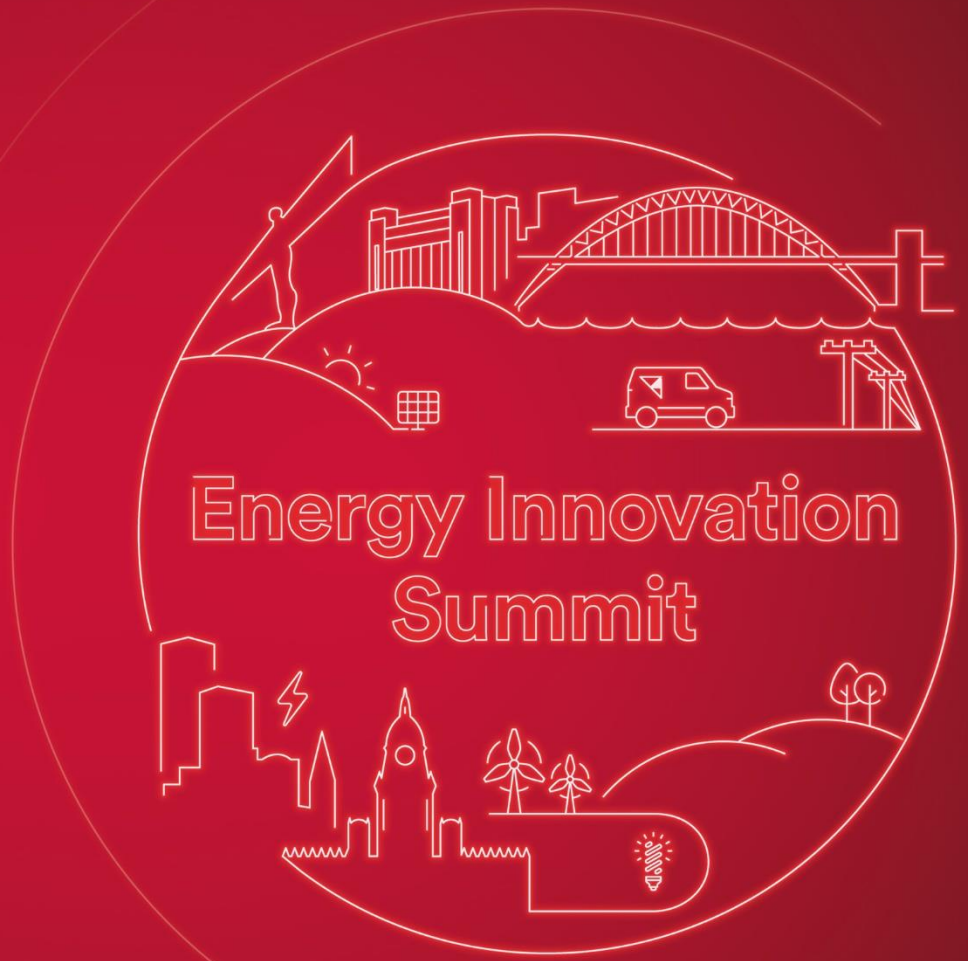
Powering through

Enhancing network resilience and operational response for a future-ready network.



Andrew Webster
Northern Powergrid

Network View

- Guided by our principle of ‘innovation through need’ Northern Powergrid supports projects that address real-world challenges, deliver important network and consumer benefits and accelerate the transition to net zero.
- Network operators need robust strategies to protect customers power supplies from risks including extreme weather events, and the ability to respond quickly and effectively when impacted.
- Collaboration is key and so today, we’re joined by some of our partners to share the learning from three important projects which are contributing to our goals of developing a more resilient, future-ready network and improving our operational response.
- To set the context, for each of the projects, we’ve set out to explain the challenge to address, the solutions we’ve collectively developed, the impact and future next steps.

Presenting

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Smarter Grid Solutions

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NORTHERN POWERGRID

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JUICE IMMERSIVE

Rural Electrification 2.0

Developing future-ready rural networks

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The challenge

Networks prioritise reinforcements that benefit the most customers.

Rural communities are often at the end of long stretches of the network.

Increasing interest in generation through renewable sources in rural areas.

Government targets look to decarbonise the agricultural industry.

Which leads to...

Poor past performance

The rural network is not futureproofed

Which means...

A plan needs to be in place to prepare for the future of energy in rural areas.

The objective of Rural Electrification 2.0 is to explore the future of energy in rural areas and define pathways to ensure customers are brought along in the energy transition.

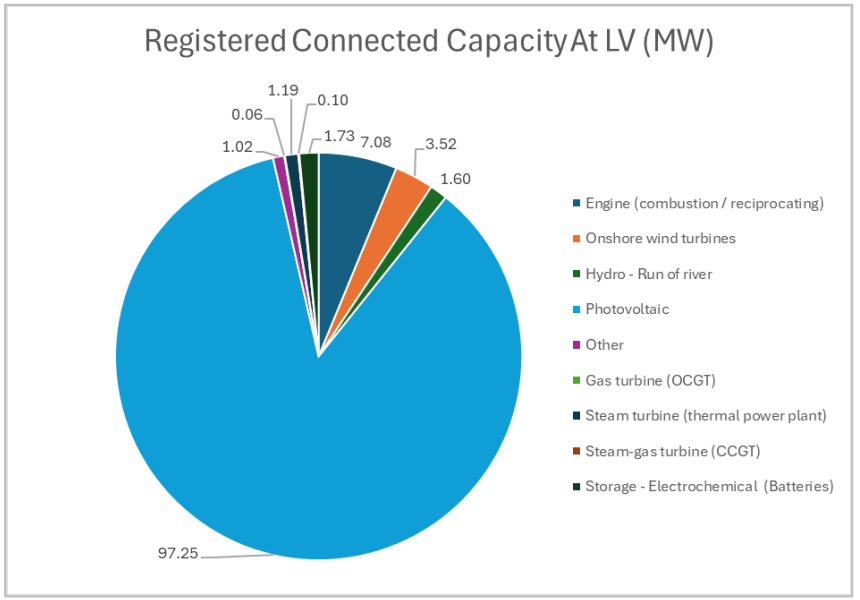
The challenge

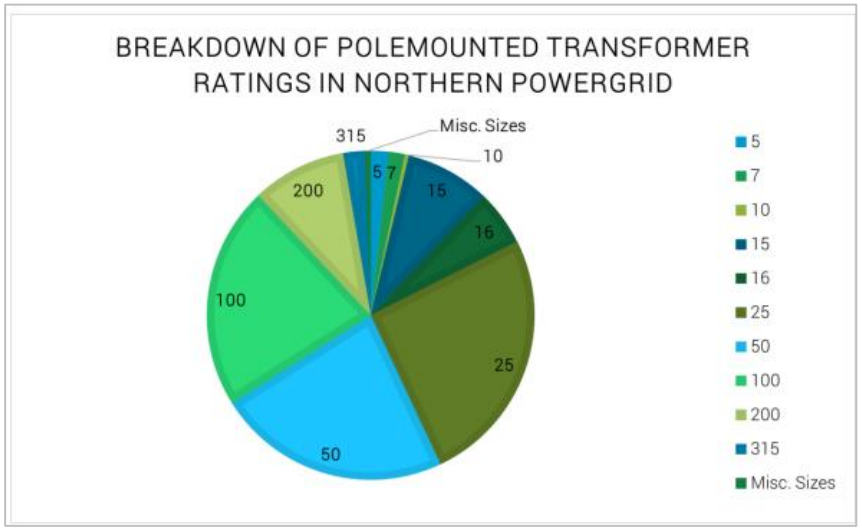
Underlying questions:
The avenues explored for this project

- What is the present energy demand?
- What's the cost to the customer?
- What LCTs are applicable for this project?
- What's the cost to the network?
- Will all vehicles be electrified?
- What pathways seem most feasible?
- What other energy sources are suitable?
- What do rural customers want?
- Does rural electrification include grid connections?
- What timescales are feasible?

Facts about rural networks and customers

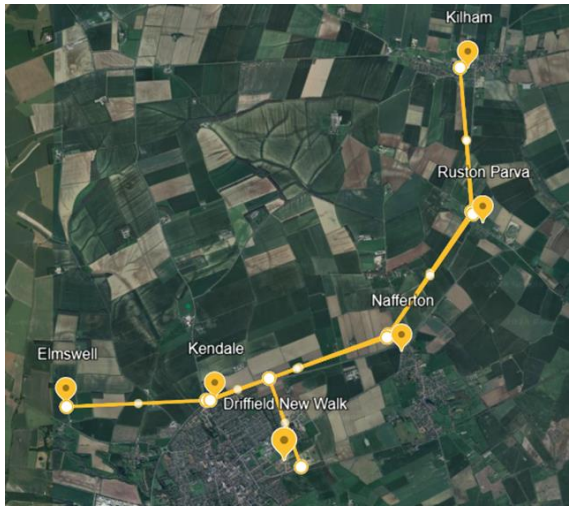
- Rural feeders can stretch for considerable distances, to the point they already experience voltage issues.
- Solar power far outstrips every type of other generation at LV, we're unsure if wind will catch up.
- This is across all areas, the feeders modelled had almost no LV generation registered.
- Many farms and villages are connected to LV transformers that would not have the capacity to deal with small LCT connections.
- There is interest (and financial need) to modernise farms, however there's little information on how this can be done effectively.
- Farmers have no incentive to work with networks and are not in a collaborative mindset.

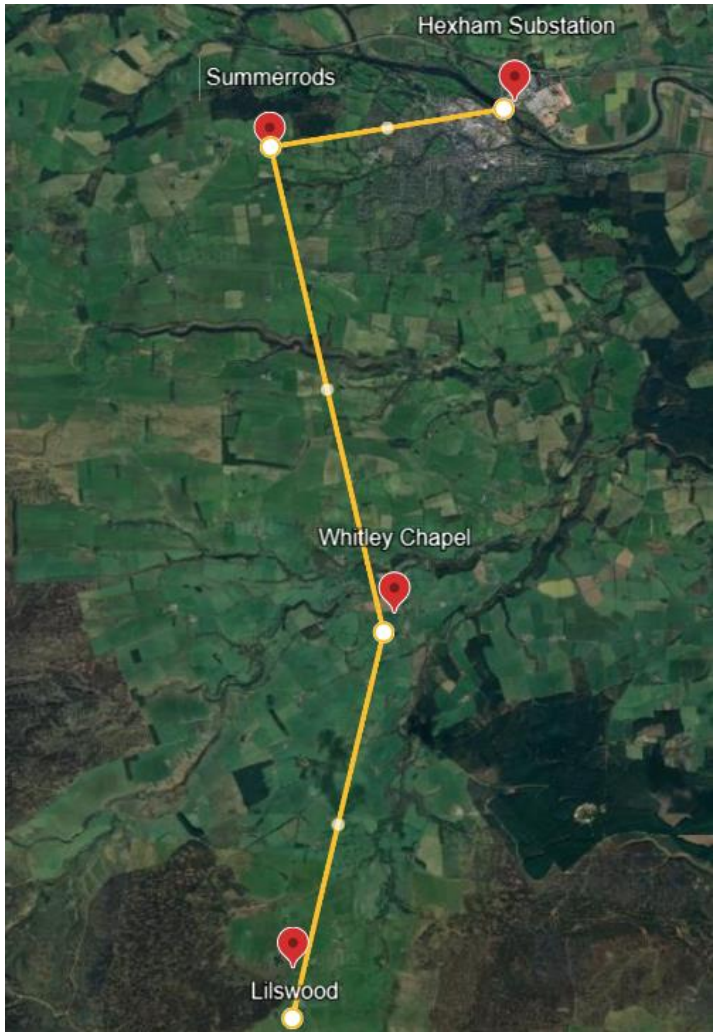




Networks of study

- One feeder fed by substations in:
  - Driffield
  - Denwick
  - Hexham
- These rural networks were characterised by long, branching feeders.
- They all left larger suburban areas and went through some small villages and fed farms.
- Two were situated very close to Areas of Outstanding Natural Beauty.





Impact

While this project came at the issue from a network perspective, the solution can never be delivered solely by networks.

Network challenges

- LV transformer overload.
  - Prevalence of small transformers in rural areas.
  - Previously low load customers.
- Some rural networks are very long.
  - Voltage issues are a challenge now, what about in the future?
- Connection requests.
  - Landowners have lots of scope to connect across a feeder.
- Winter/Summer load demand.
  - Inter-seasonal storage is key.

Changing farm energy needs

- Networks don't know about farm energy needs.
  - Crop farms have very low electrical loads and sit on weaker parts of the network.
  - Farms with higher electrical loads often have far larger heating loads, fulfilled by gas or oil.
- Farmers are keen on self-generation and self-sufficiency.
  - Solar/storage will be most common.
  - Farmers are financially motivated.
  - New technologies aren't mature enough to drive major network investment decisions

Uncertain future

- Farms don't know if they'll go hydrogen or electrical yet.
  - Will biofuels become prevalent?
  - Local circular fuel economies become more likely.
- Electrification is only likely for smaller vehicles.
  - Will we see more robotics and smaller harvesting vehicles?
  - How will different farms approach the problem?
- Is hydrogen as a generated and stored fuel on a farm even viable?
  - How would someone prove it?

Future

Opportunities to capitalise on the questions raised by this project

Develop further rural monitoring projects

Cross sector collaboration

Technology trials

MultiResilience

Building network resilience for at risk locations

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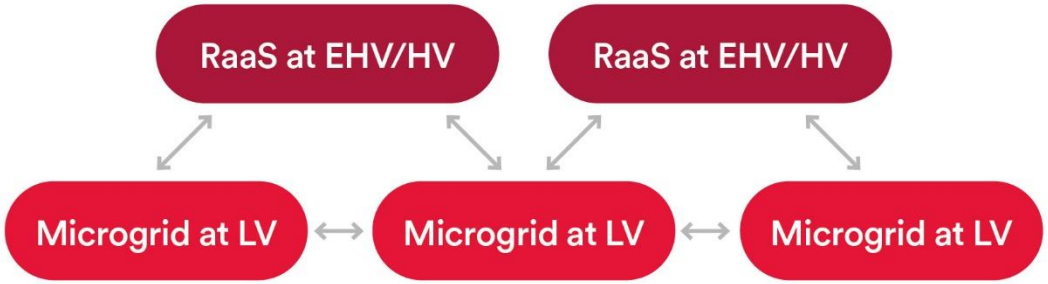
The Challenge

- The need to reduce the impact of outages in vulnerable areas (i.e. rural networks) and minimise the impact to customers in an increasingly electrically-dominated energy system.
- Demonstrate the deployment and coordination of multiple MicroResilience solutions (LV) and RaaS solutions (EHV/HV), combining the benefits and enhancing value of these solutions.
- Compare and contrast technologies and optimise hybrid application of the two approaches, to deliver cost-effective resilience for customers.
- Establish the standard designs, technology interfaces, operational control principles and commercial arrangements that facilitate coordinated resilience from DER assets on the network.
- Demonstrate the inclusion of distributed, smaller-scale, third-party owned energy resources alongside HV resilience solutions.



The Solution

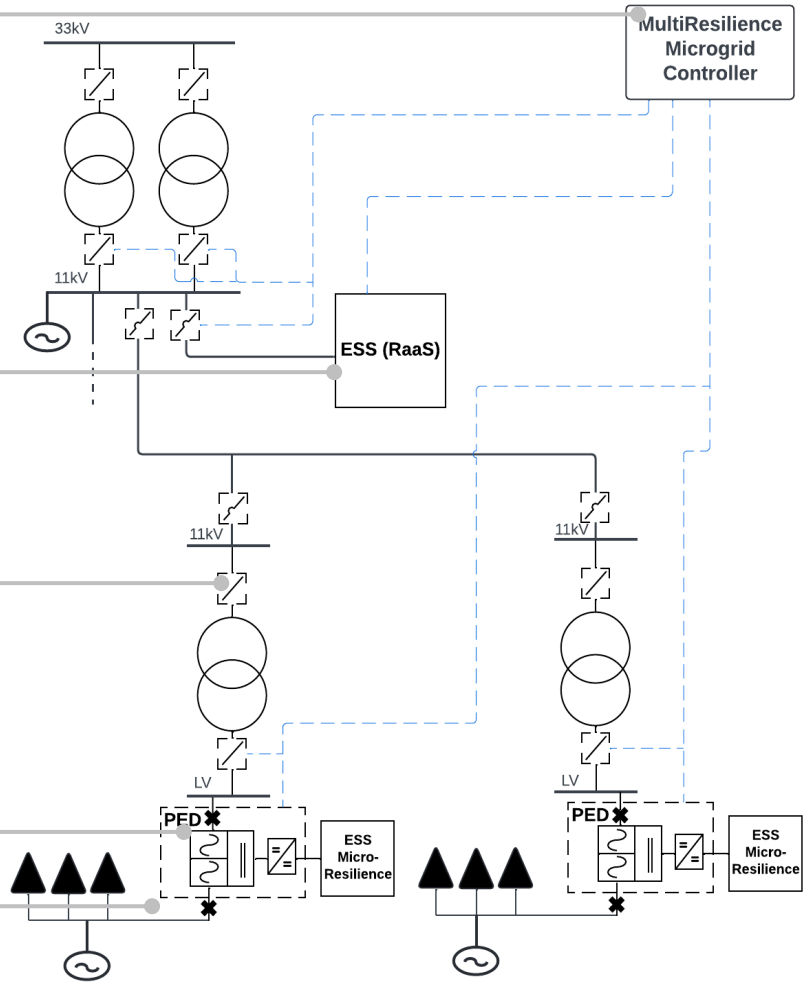
MultiResilience Microgrid Controller
Co-ordinating energy sources and islanded/resynch actions.

Network Switches/Breakers
Isolation of network areas following fault/outage and re-energisation once moved to grid connected mode.

Power Electronics Devices (PED)
Grid-forming microgrid functions: black start, islanded operation, re-synch to grid.

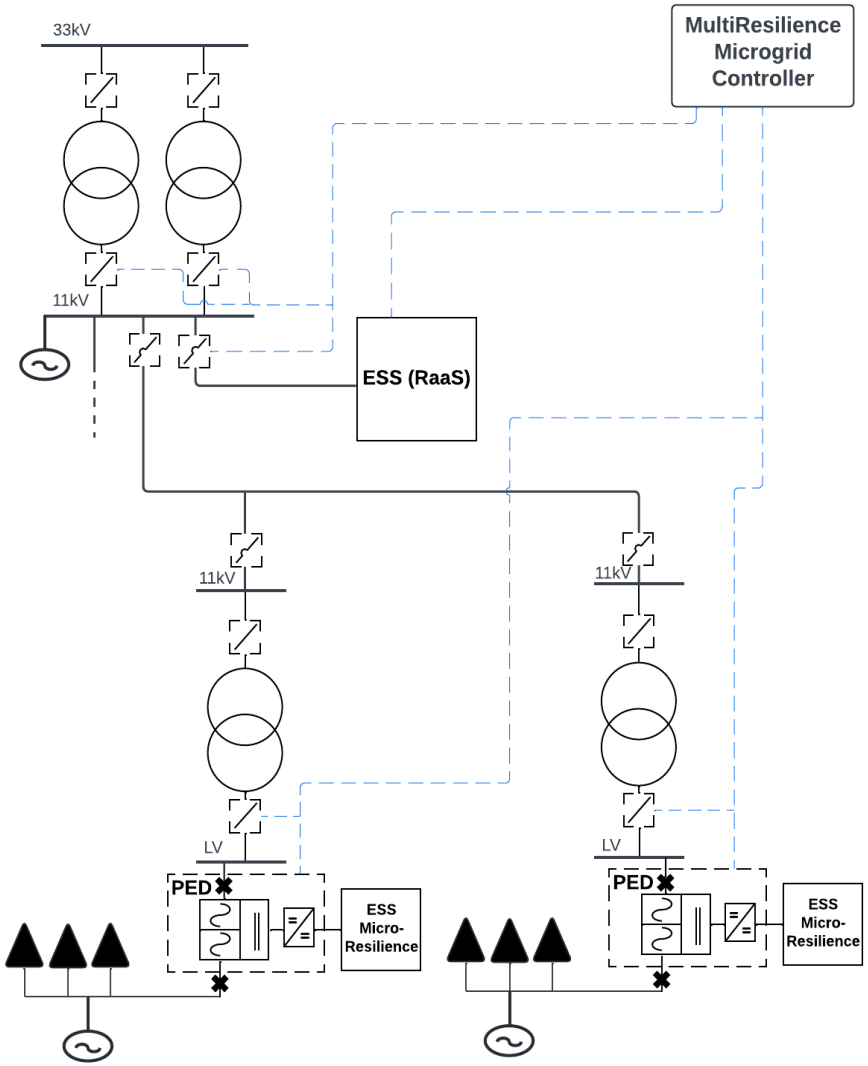
RaaS Battery ESS (>1MVA)
EHV/HV grid-forming energy source

MicroResilience Battery ESS (<0.5MVA)
LV grid-forming energy source



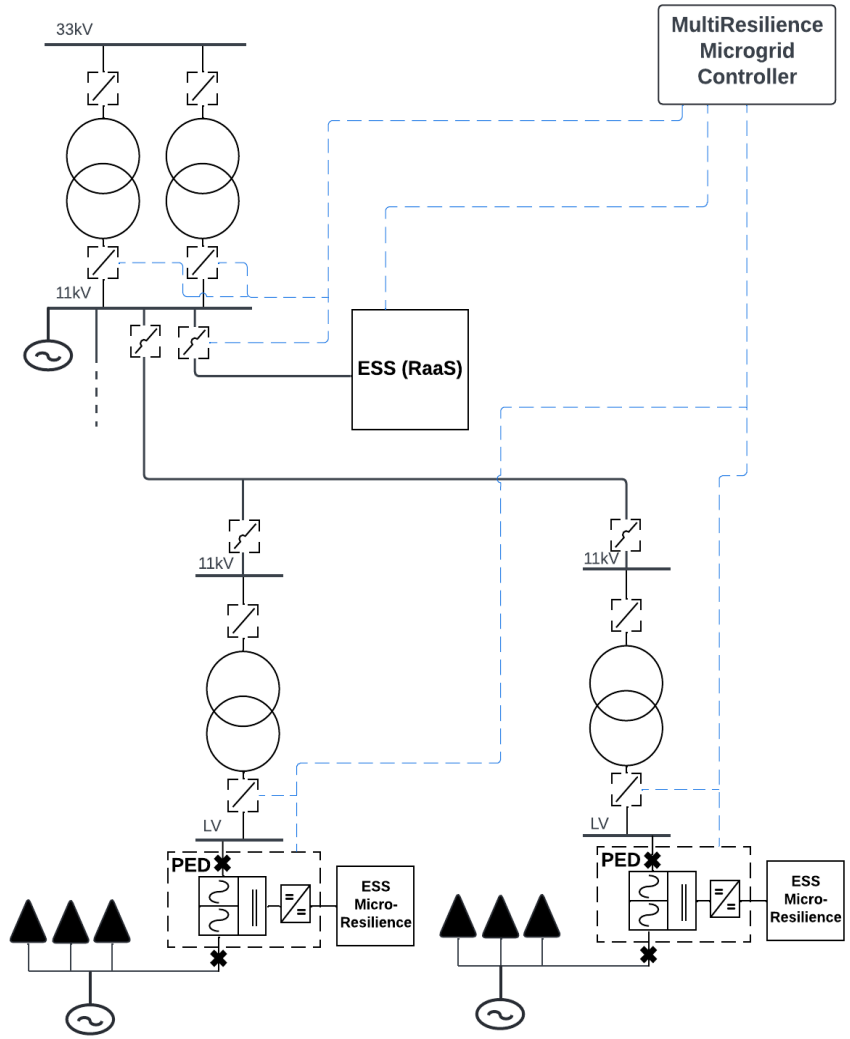
The Solution

- Resilience is delivered via:
  - MicroResilience LV-ESS and PED in cases of localised outage affecting a distinct LV network.
  - RaaS EHV/HV ESS under HV or EHV outages affecting a wider network area.
  - Co-ordinated groups of LV-ESS and EHV-HV ESS to extend reach and expand the duration of the microgrid operation, avoiding conflict between systems and enhancing the value case for solution deployment.



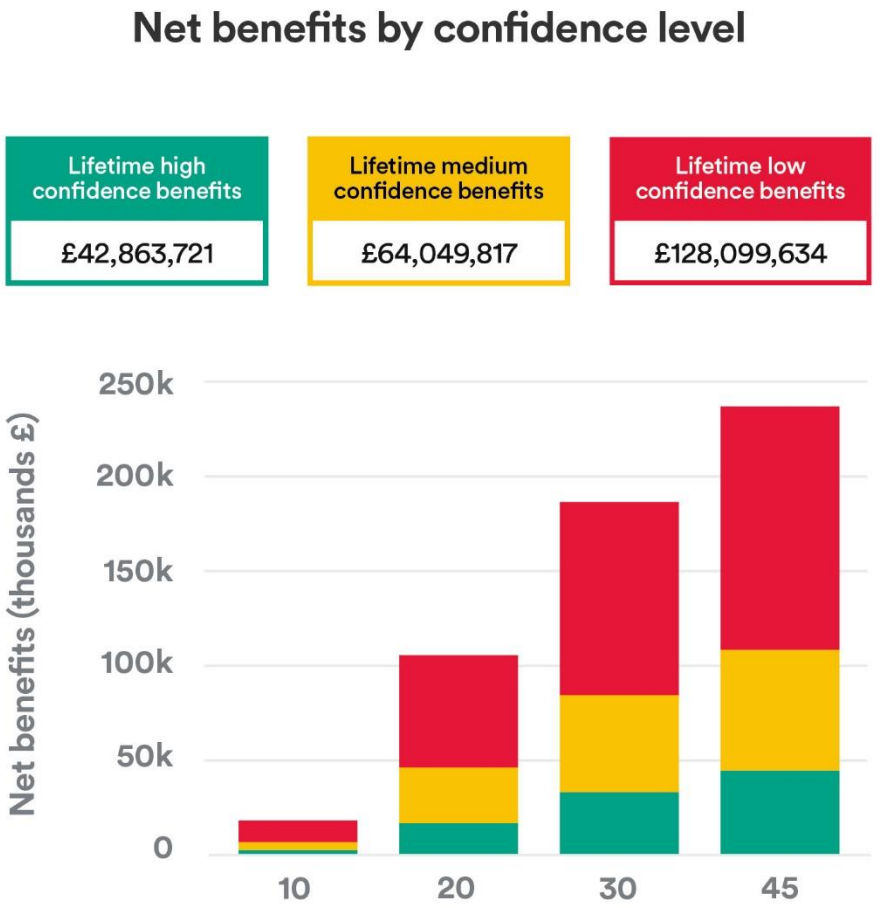
The Solution

- Interaction with existing network assets and systems to ensure safe network operation:
  - SCADA / ADMS - providing control room access for manual interventions and approvals and critical visibility of operation for safety purpose i.e. control-room aware grid energisations and isolations.
  - Switches / Isolators - implementing control-room approves switching as part of a microgrid state transition.
  - Protection / Earthing - enabling/disabling/adapting protection configuration and modes to reflect the operational situation on the network i.e. islanded, grid-connected.
  - Existing network DER - visibility of DER status (and control where appropriate) to ensure stability when co-ordinating microgrid state transitions and extend the operating window.



Impact

- Overall impact - reduces the impact of grid outages in the most vulnerable network areas.
- Assume third-party resilience is needed on 65 of the most rural primaries on Northern Powergrid's network (~10% of the network).
- RaaS-like service, sized to supply 2/3 of peak demand, receiving £10,000 / MW / year.
- MultiResilience allows 20% reduction in the volume of this service, due to LV DERs and ESS.
- £13.9m benefit for Northern Powergrid customers, £27.8m for Northern Powergrid and SSEN customers combined, and £106.9m (central estimate) for all DNOs.



StormTriage™

Improving storm restoration response through enhanced data and informed decision-making.

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The Challenge

Regularity of Storms

- Increasing frequency of Winter storms.
- Direct impact of the jet stream on the UK.
- ‘Storm Season’ is evolving and expanding.
- Mitigation and resource measures are critical.

Severity of Storms

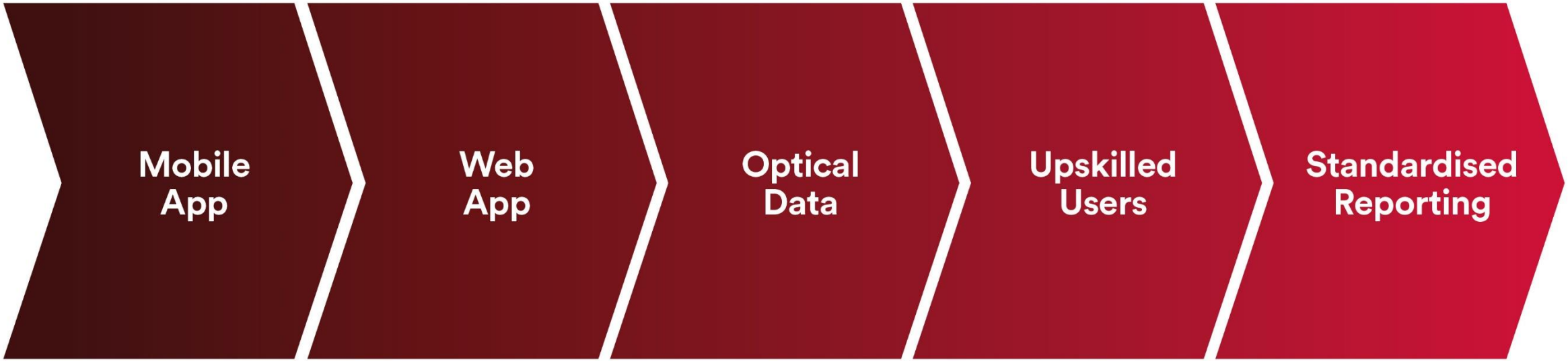
- Disproportionally severe UK storms.
- Increase in Winter wind speeds.
- As climate warms, heavier storms hit.
- Energy release = rapid intensification.

Impact of Storms

- Multi-day storms are becoming common.
- More significant impact and cost.
- Greater impact felt in the North of England.
- Disruption to way of life – plus loss of life.

The Solution

- StormTriage™ combines a range of innovative technologies including ML, AI and XR.
- Delivers a solution designed in collaboration with its intended users, Northern Powergrid front runners and co-ordinators.
- Provides quality optical data and situational awareness benefits during reconnaissance.




STORM TRIAGE™

Impact

Field Test

- 10 Front Runners, one Co-ordinator, one Remote Expert.
- 25 scenes, 567 photos, 20 videos, 22 models, four Remote Expert Calls.
- 100% of participants 'Very Likely' to recommend further development.

Traction

- Northern Powergrid appetite for BAU adoption and rollout.
- Positive feature recommendations.
- DNO and non-utility interest in project.

Post-adoption

- "Potential game-changer"
- EEC2 – 5-day, >85mph, 70k customers – 10% GSOP = £49k saving
- EEC3 – 10-day, >70mph, >75% ice, >20cm snow, 300k customers – 10% GSOP = £1.6m saving.

Future

NORTHERN POWERGRID

StormTriage™ Release Candidate

Deployable BAU Tool Stable, Robust, Reliable, Scalable.

Expansion of User Base

StormTriage™ in the hands of third parties.

Expansion of Applications

Tech stack repurposed for asset management BAU use cases.

STORM TRIAGE™

NORTHERN POWERGRID

Experience StormTriage™ in VR and AR

We're on Stand M6.

Network View

- Next steps
  - Further engagement and dissemination of the project learning.
  - Exploring opportunities to work more closely with agricultural and farming communities.
  - Field testing StormTriage™ during the 2024-25 Storm Season.
  - Progression of MultiResilience project, made possible following a recent £8m SIF award.
  - Focus on future innovation projects: Come and talk to us on Stand M6.

NORTHERN POWERGRID

Come and talk to us!

We're on Stand M6.