Network DC

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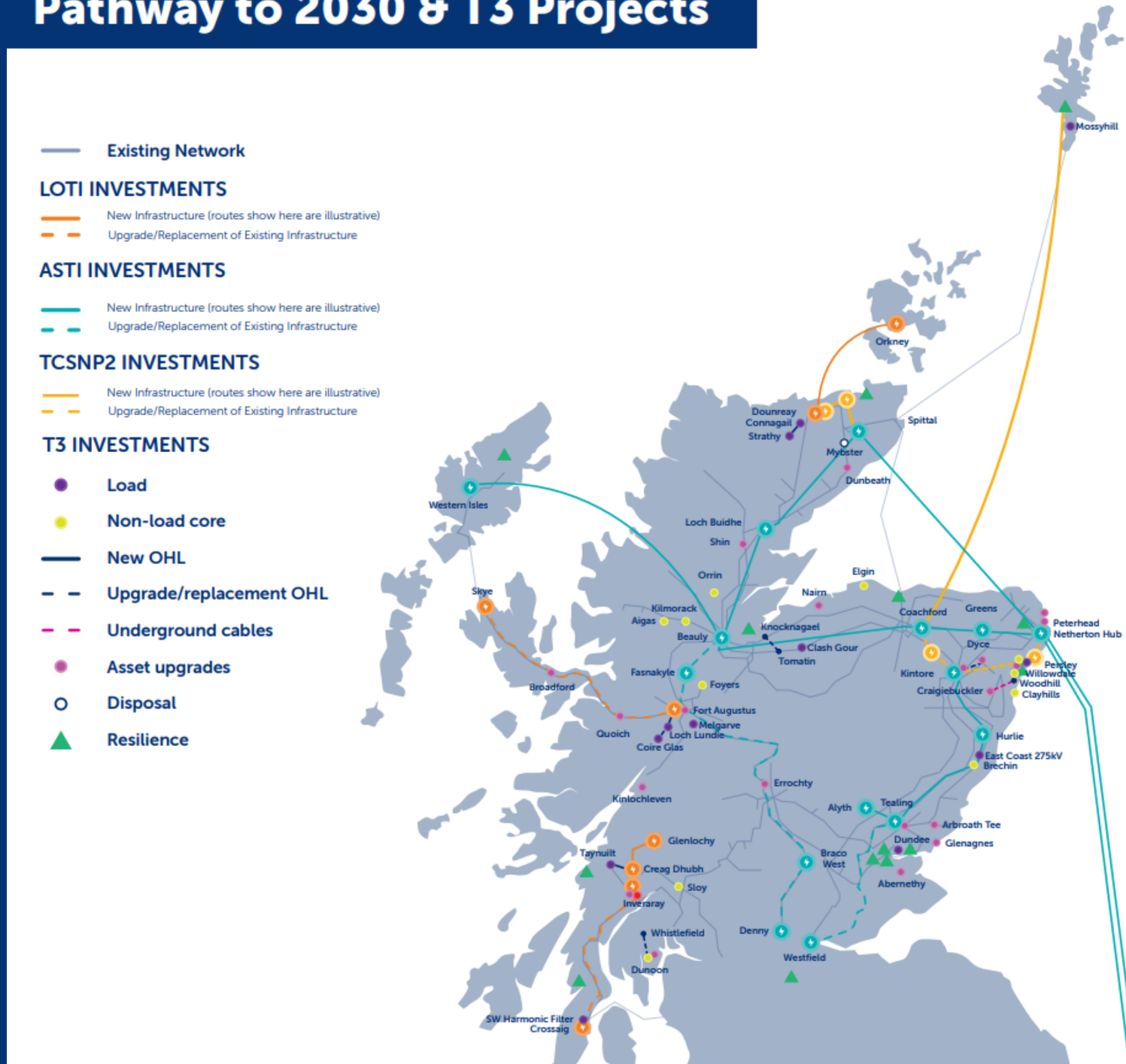
Innovation Delivery Project Manager

NESO National Energy System Operator · CARBON TRUST · THE UNIVERSITY of EDINBURGH · SuperGrid Institute Shaping power transmission · MOTT MACDONALD · The National HVDC Centre · Scottish & Southern Electricity Networks TRANSMISSION

About SSEN Transmission

- Our responsibilities include maintenance and investment in the high voltage 132-400kV AC electricity transmission network along with High Voltage Direct Current (HVDC) cables, overhead lines (OHLs) and convertor stations.
- Our operational area extends over a quarter of the UK's landmass, navigating some of the most challenging terrain and powering our communities by providing a safe and reliable supply of electricity.
- We currently have over 9GW of renewable generation connected to the network, however, by 2050, the network is expected to need upwards of 40GW of low-carbon energy capacity to support net zero delivery.
- As part of the network's ambitious £22bn RIIO-T3 plan, the construction of additional infrastructure consisting of new overhead lines, substations, convertor stations, and subsea links will be vital to unlocking Scotland's potential to be a clean energy powerhouse.
- Innovation will play a critical role in supporting the energy transition, continuing to make our network safe, secure and resilient for future generations.

Pathway to 2030 & T3 Projects



Innovation Strategy & Action Plan

In March 2024, we launched our new SSEN Transmission Innovation Strategy which sets out our strategic innovation purpose, vision and focus areas, and has clear alignment with the ENA's Innovation Strategy and our RIIO-T3 Business Plan.

Our strategy acts as a guide to how we develop and implement the right innovations to help enable SSEN Transmission to support the UK's ambition to transition to a low-carbon economy. Our four focus areas – safer, smarter, greener, and faster - serve as the foundation of our Innovation Strategy and were identified through horizon scanning and stakeholder engagement, pinpointing opportunities where innovation can have the greatest impact.

Safer

Using innovation to push to be safer than we are today. We will focus on the security of the network, reducing physical hazards, promoting safe behaviours, and do so by designing out risk and designing in safety from the start.

Smarter

Becoming future ready by learning and adapting to maximise our assets. We will apply logic, data, and the right skills and experience to increase functionality and actively seek new ways of working and collaboration to improve efficiency.

Greener

Applying the test of sustainability to everything we do. We will use innovation to quantify and communicate our contribution to net zero, reducing environmental harm throughout the lifecycle of our assets.

Faster

Keeping pace, increasing productivity, and minimising delays through flexibility, agility, and empowerment. We will apply new tools and assets, focus on the output to remove barriers and champion efficient ways of working.

13
new projects

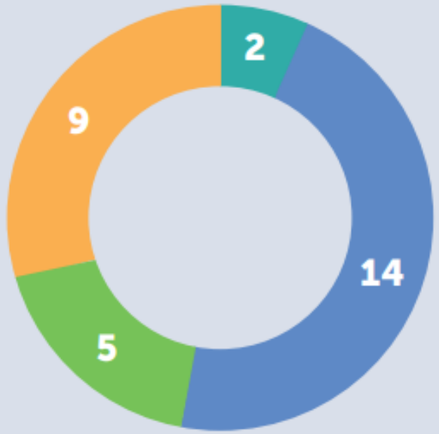
30
live projects

12
projects completed

£14.1m
allocated to innovation portfolio

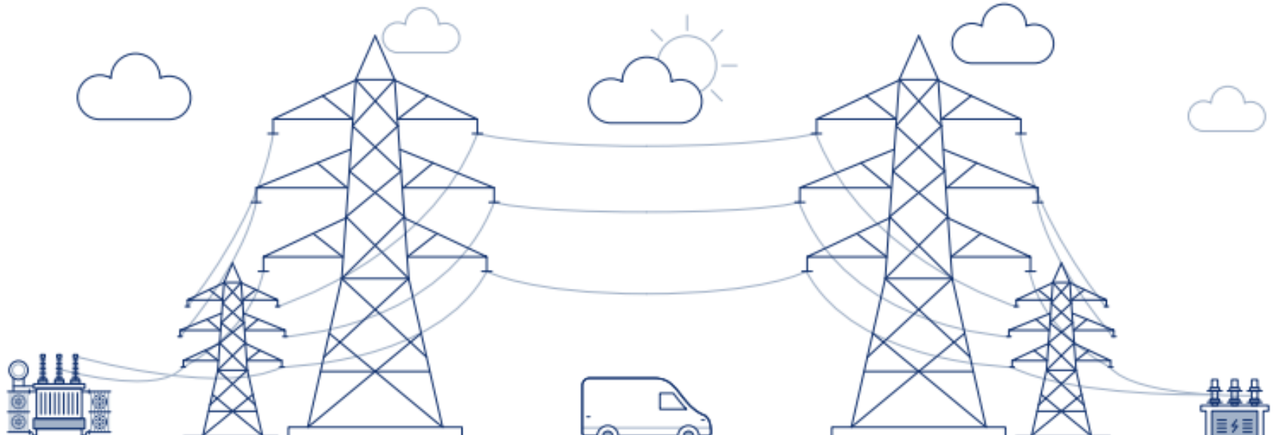
£190m
in benefits by the end of RIIO-T3

Projects allocated to focus areas



SSEN-T Innovation

Network Innovation Allowance (NIA) and Strategic Innovation Fund (SIF) FY24/25



Highlights – a Year in Innovation

Haggis the Robot – a minor celebrity!

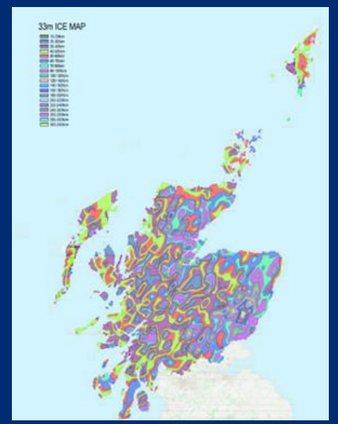
Our Autonomous inspection robot – which aims to provide continuous monitoring of HVDC valve halls – has gone on the road, being demonstrated at Westminster and energy events across the country.

Dynamic Line Rating (DLR) sensors

We have been at the forefront of DLR sensor development, including conducting the largest trial of the technology anywhere in the UK. The DLR sensor has also been demonstrated at energy events.

Other highlights

- **Low Profile steel poles –** investigating new Overhead Line design to allow faster connection of assets while avoiding the need for large lattice towers.
- **REACT** –development of a new visualisation planning tool, providing a comprehensive data-based modelling solution for connecting new, complex assets to the grid.
- **REVISE** – aims to replace the current guidance for applying static line ratings, detailed in TGN26, with an updated methodology, leading to an enhanced grid.
- **Ice Mapping** – we helped deliver a new modelling tool which helps better understand ice accretion to aid overhead line design.



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Network DC

Strategic Innovation Fund – Beta Round 1

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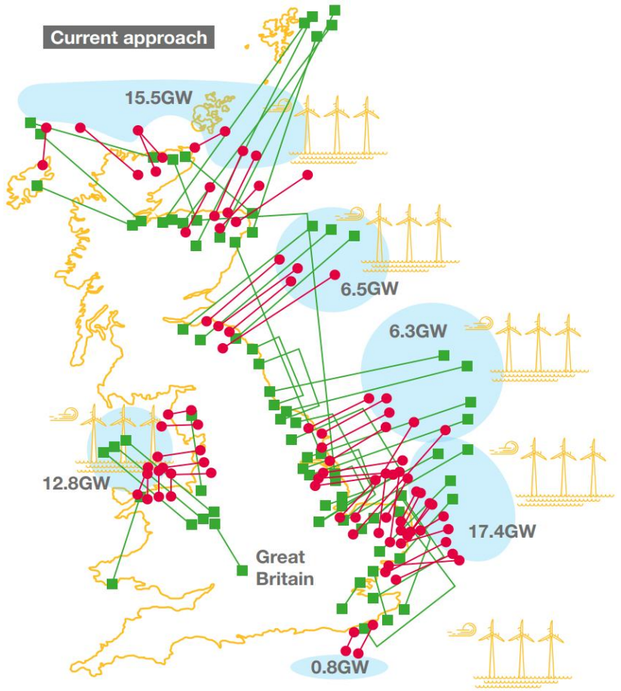
Status Quo

- 50 GW+ of offshore wind by 2030 Net Zero target
- Under current planning and design approaches that will result in many point to point links.
- Huge amounts of very visible infrastructure up and down the coast line.
- Current approach necessary to limit the amount of power loss that can be accommodated by the network should a fault occur.



Source: NESO, Offshore Coordination Phase 1

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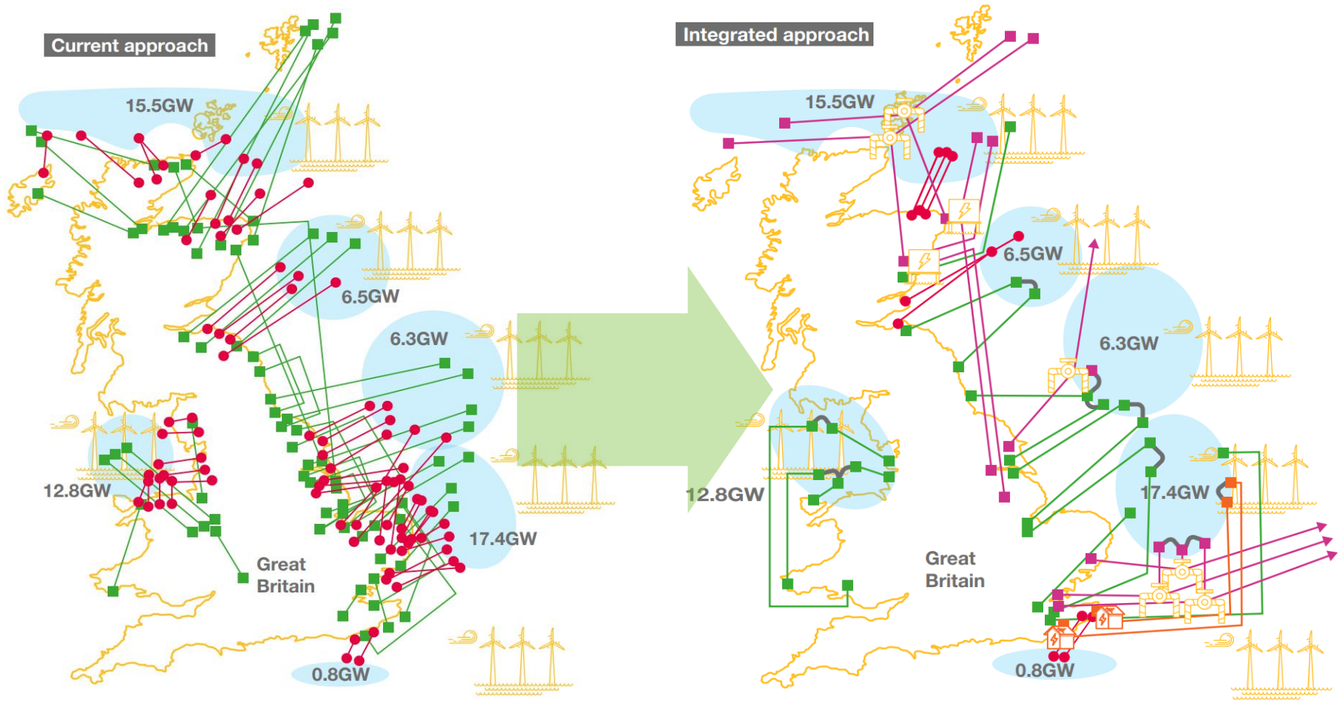
How can DCCBs help?

- Massive opportunity and challenge of offshore wind
- Reduce the number of transmission assets required.
- Reduce impact on coastal communities.
- Reduce cost by avoiding the need for additional infrastructure.
- Increases the DC networks flexibility.
- Uncertainty of implementing DCCBs in GB



Source: NESO, Offshore Coordination Phase 1

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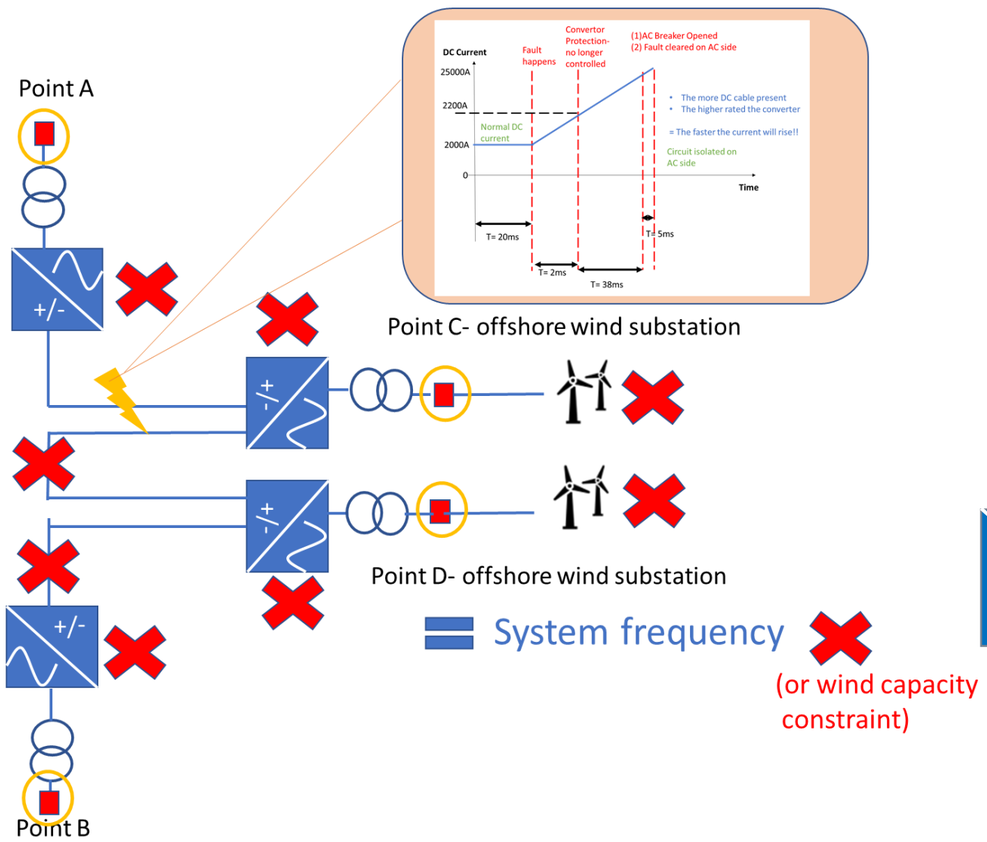
What do DCCBs achieve?

DC Networks ***without*** DCCB



Key

- AC breaker
- Breakers open
- Fails
- Fault event
- HVDC converter station

- No quick way to stop faults in the system
- Entire DC network can shut down during a fault
- Leads to large generation losses and frequency issues on the AC system
- Limits how much offshore wind can be connected
- Bigger networks = faster, more severe faults

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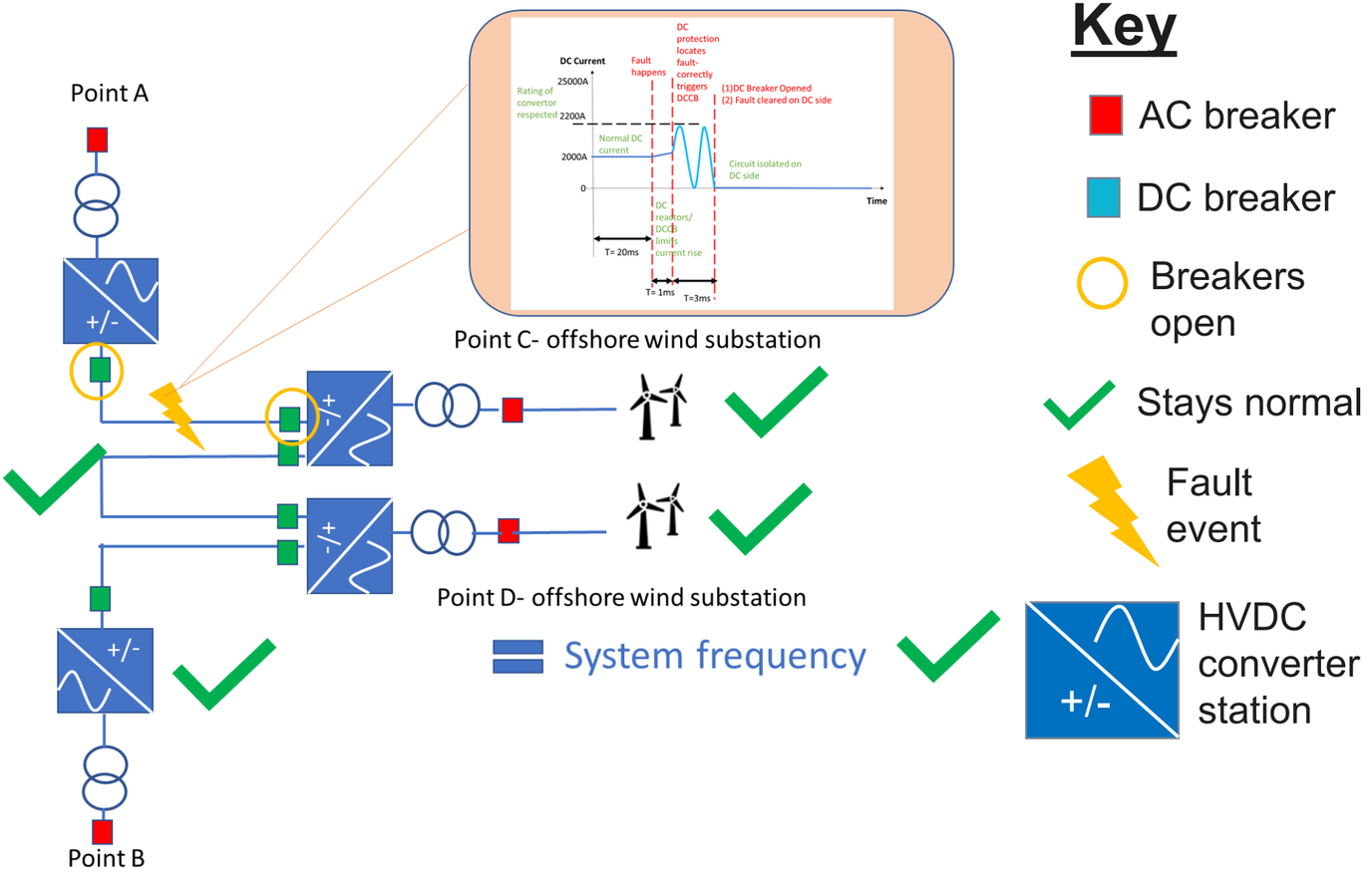
What do DCCBs achieve?

DC Networks ***with*** DCCB



Key

- AC breaker
- DC breaker
- Breakers open
- Stays normal
- Fault event
- HVDC converter station

- **Faults can be cleared quickly, like in AC systems**
- **System remains stable and converters keep supporting the grid**
- **No need to limit offshore wind generation**
- **Enables larger HVDC networks offshore**

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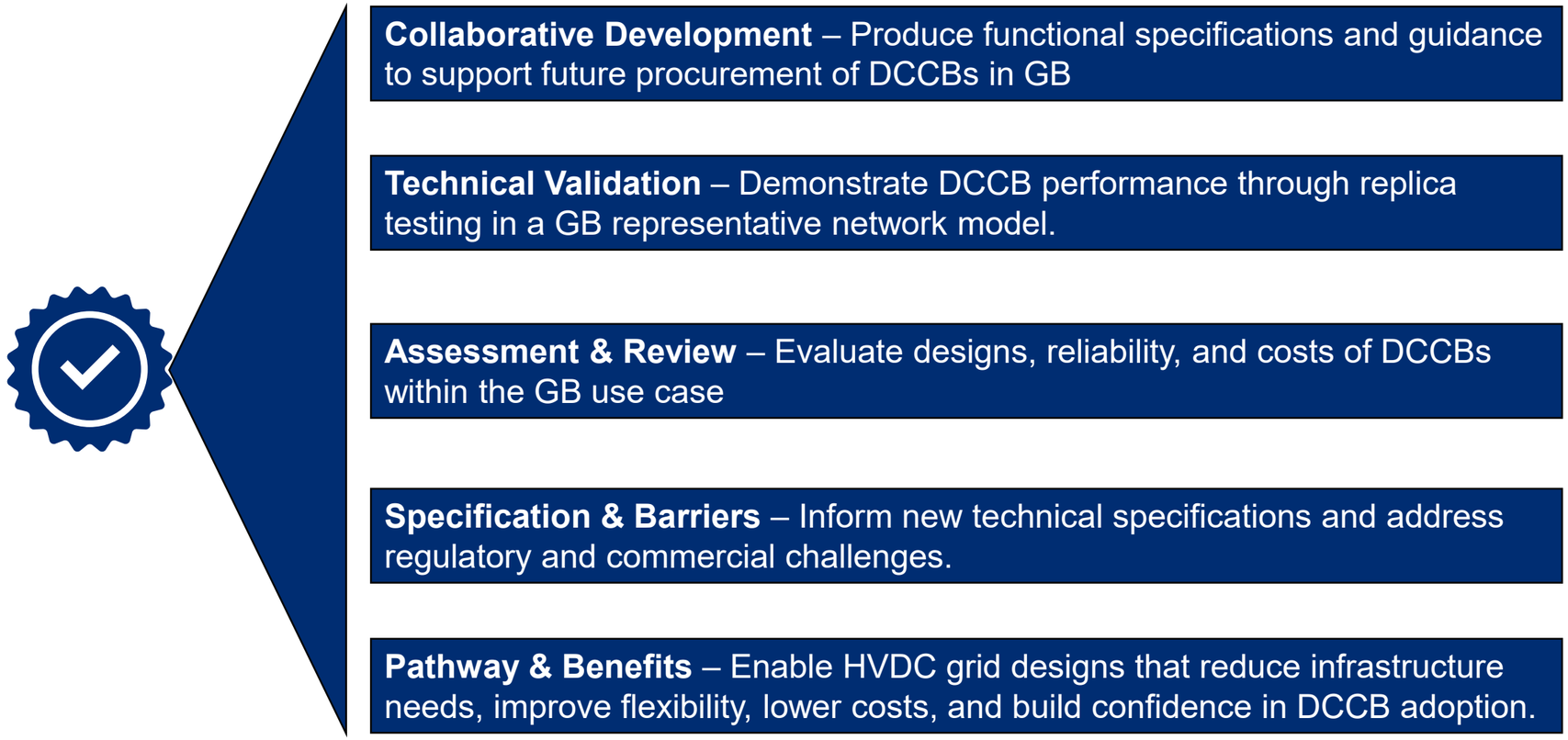
What will Network DC deliver for the industry?



Collaborative Development – Produce functional specifications and guidance to support future procurement of DCCBs in GB

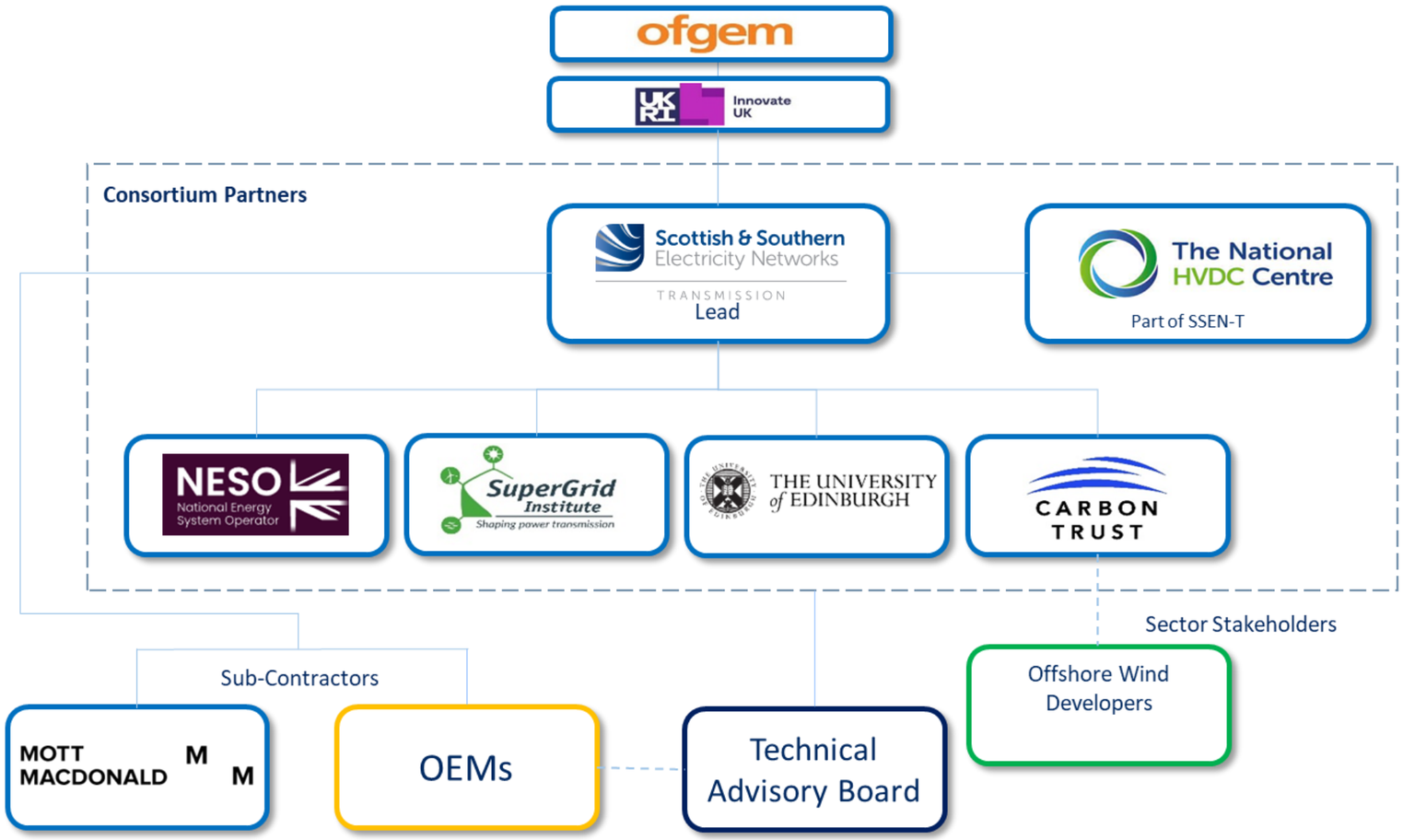
Technical Validation – Demonstrate DCCB performance through replica testing in a GB representative network model.

Assessment & Review – Evaluate designs, reliability, and costs of DCCBs within the GB use case

Specification & Barriers – Inform new technical specifications and address regulatory and commercial challenges.

Pathway & Benefits – Enable HVDC grid designs that reduce infrastructure needs, improve flexibility, lower costs, and build confidence in DCCB adoption.

Project Consortium



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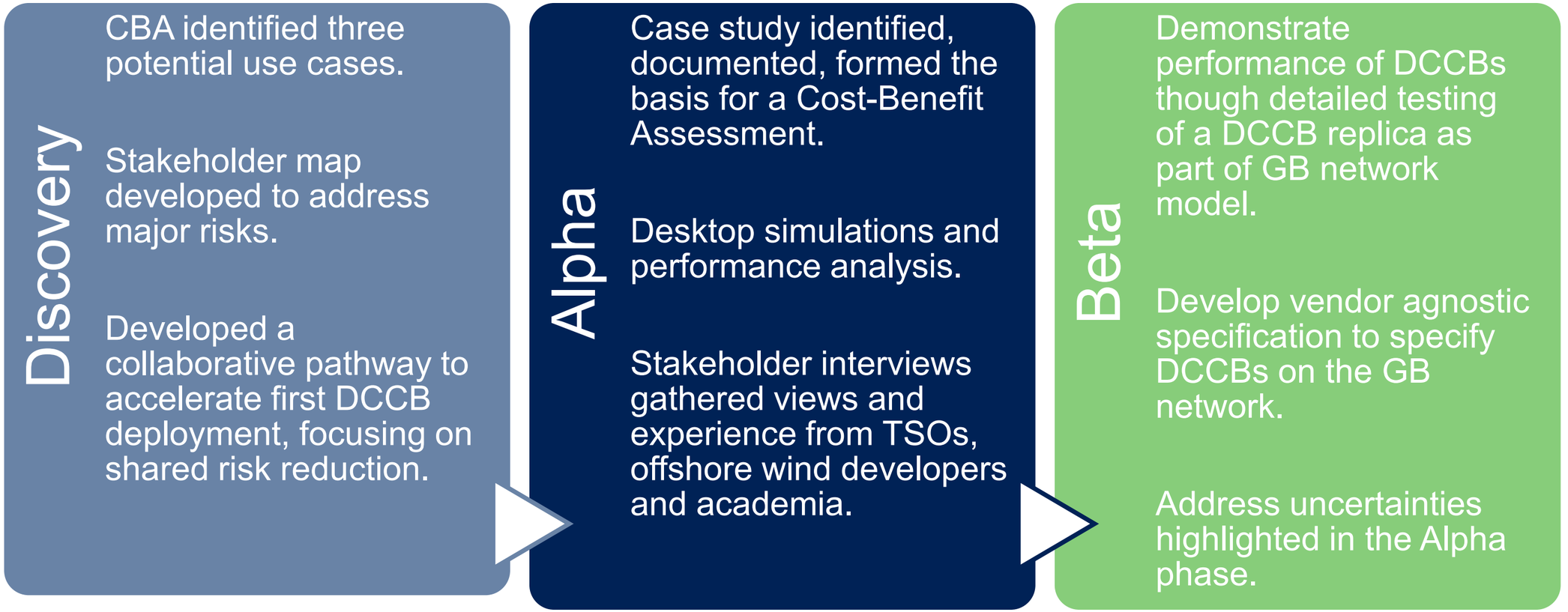
Journey to Beta



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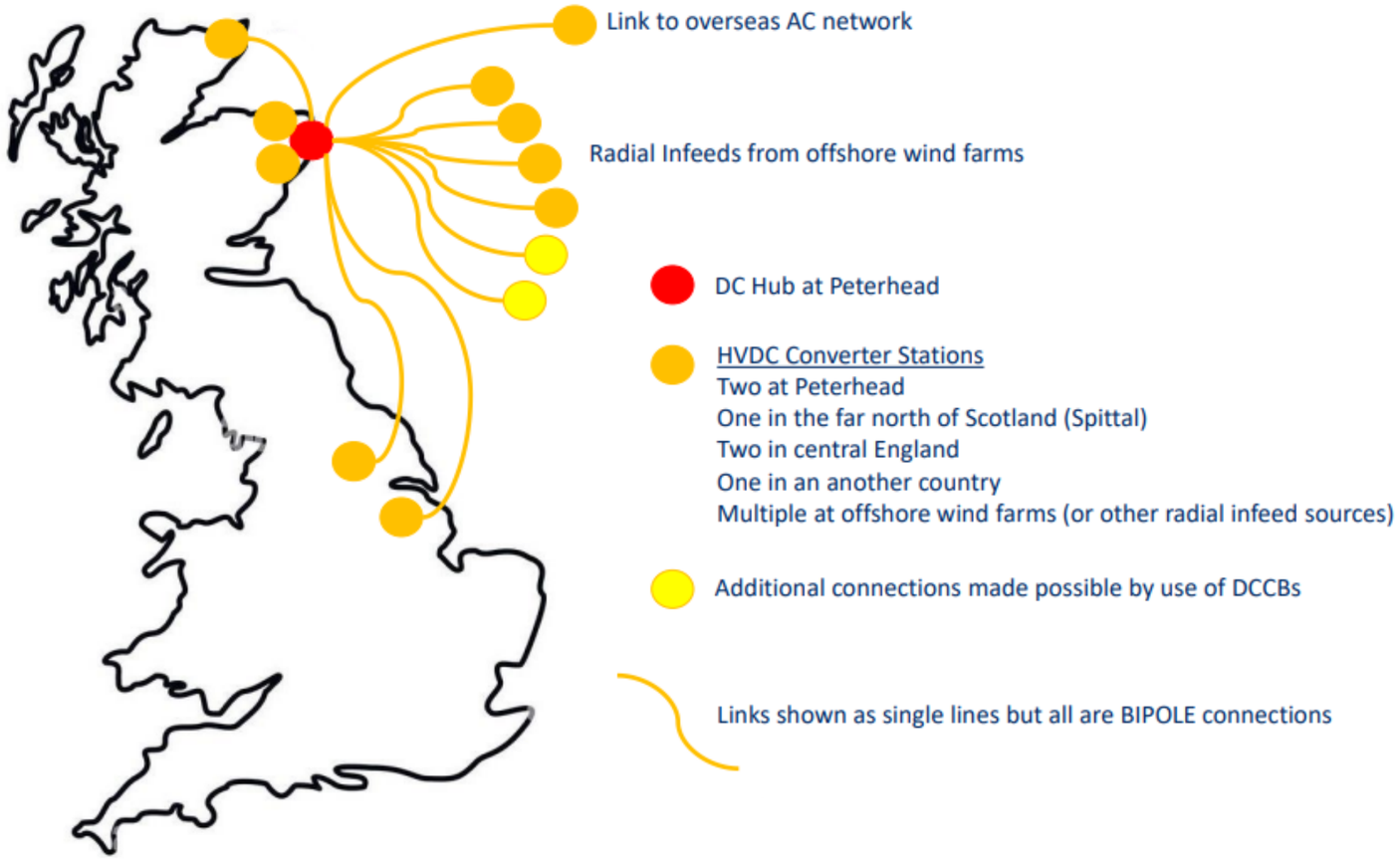
Netherton Switching Station (near Peterhead)

Progression from paper-based review to real-time simulation and testing



DCCB Protection & Control Replicas

Hardware-in-Loop (HiL)

Software-in-Loop (SiL)

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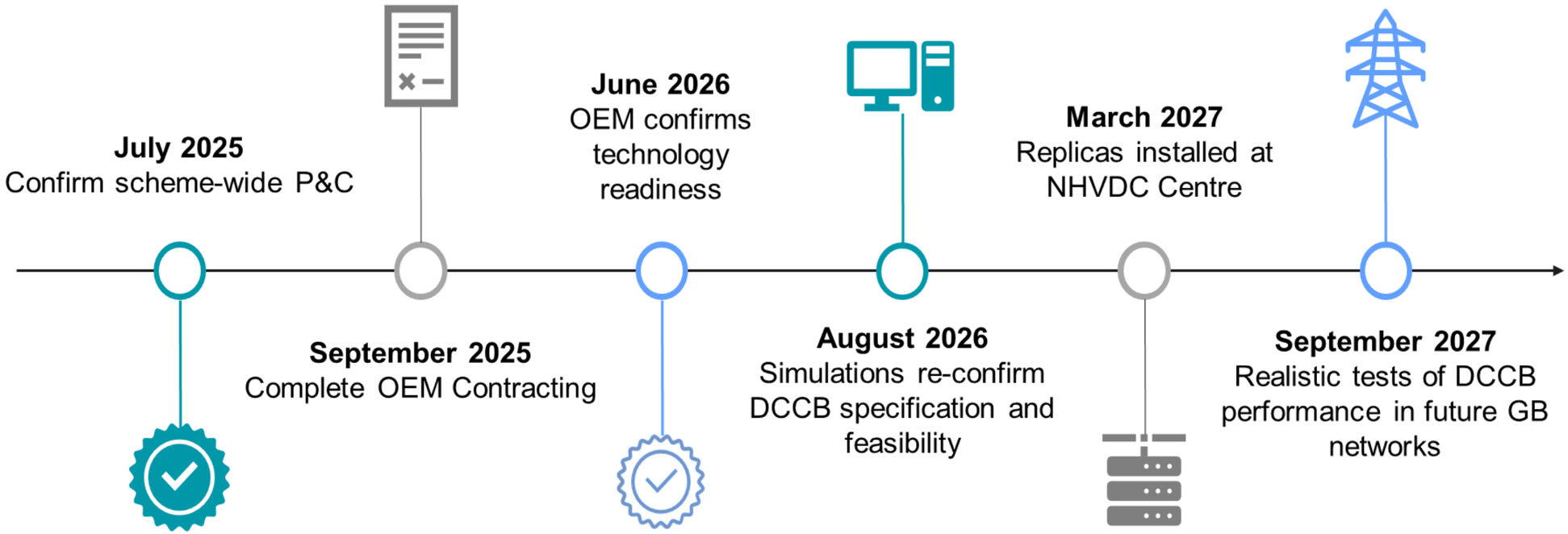
Key Steps



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Beta Phase Progress

Collaboration

- Competitive tender completed, leading vendors shortlisted
- Strong partnerships with UK & European research institutes and universities
- Technical Advisory Board in formation with global experts

Technical

- Feasibility confirmed: DCCBs can manage GB grid fault
- Demonstrated a viable control & protection concept
- Advanced modelling & simulations show DCCBs work within realistic operating conditions
- Reliability modelling underway to assess system performance

Commercial

- Updated cost–benefit analysis confirms strong net value for GB consumers
- Vendor-neutral specification being developed to encourage market participation
- Engagement with OEMs to align technical capability with project needs

Policy and Regulatory Landscape

- Literature review completed. No significant new barriers were identified.
- Stakeholder interviews held with Ofgem, NESO, TenneT, HVDC Centre, vendors and buyers
- Workshop Findings: No regulatory obstacles identified; grid code changes seen as straightforward.
- Key challenges are the need for clear DESNZ/Ofgem signals and stronger communication between vendors, buyers, and regulators

Next Steps

Conclude contracting and onboard OEMs.

Hold first Technical Advisory Board meeting, bringing together experts from the UK, Europe, USA, China, and Japan..

Validating DCCB performance using proprietary OEM models.

Use hardware-in-the-loop simulations to demonstrate operation under realistic network conditions.

Further develop CBA to build confidence in results and continue to monitor policy & regulatory landscape.

Useful Links

SSEN-T Annual Innovation Summary 2024-2025: https://www.ssen-transmission.co.uk/globalassets/documents/innovation-at-work/ssen-transmission-annual-innovation-summary-2024-25-.pdf

SSEN-T Innovation Strategy 2024: https://www.ssen-transmission.co.uk/globalassets/documents/innovation-at-work/SSEN-Transmission-Innovation-Strategy-2024

Beta ENA Portal: https://smarter.energynetworks.org/projects/10067854/

Alpha ENA Portal: https://smarter.energynetworks.org/projects/10036946/

Discovery ENA Portal: https://smarter.energynetworks.org/projects/10020383/

Beta Phase 60 second video: https://www.youtube.com/watch?v=ObDWXznW9fA

Discovery Phase 60 second video: https://www.youtube.com/watch?v=N2NsxAqIa6Y

WEBINAR: Network DC – Innovations in DCCBs and HVDC Grid Technologies (May 2025): WEBINAR: Network DC – Innovations in DCCBs and HVDC Grid Technologies – The National HVDC Centre

WEBINAR: Network DC Project (Oct 2023): WEBINAR: Network DC Project (Oct 2023) – The National HVDC Centre

Get in touch

To find out more about what we are doing in Innovation, our future ambitions, the Network DC project, or to discuss your innovation ideas. Please reach out to us:-

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