

Electricity
Transmission

Innovating for a net zero future in electricity transmission

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NGET

nationalgrid



Electricity Transmission

nationalgrid

21,000 pylons
across England and Wales carrying high voltage power lines.

Over 300 substations
converting electricity into different voltages.

7,000 km of overhead power line
(enough to stretch from London to Miami).

2,700 colleagues
working all year round to build and maintain our network.

Reliability and cost

Over £1.3 billion invested annually to adapt and develop our network.	99.99% reliability rate of our network.	3% of the average annual household electricity bill is made up of costs relating to the transmission network.
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Transmission towers (pylons)

400 kV and 275 kV The voltage of electricity carried on most of our overhead lines.	30 tonnes The average weight of each steel pylon on our network.	623 ft The height of the two tallest pylons in the UK (taller than the BT Tower in London).
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Major projects

116 T-pylons The first new pylon design in the UK for nearly 100 years, as part of the Hinkley Connection project.	5 VIP projects Visual Impact Provision projects reducing the impact of existing transmission lines in National Landscapes and National Parks.	65 km of new tunnels constructed in London as part of our £multi-billion London Power Tunnels projects.
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Innovation and net zero

17 major projects being developed as part of Ofgem's Accelerated Strategic Transmission Investment programme.	1 innovation hub Deeside Centre for Innovation, the first high voltage testing and innovation centre of its kind in Europe.	0 emissions from our own operations and carbon neutral construction by 2050.
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Connections

5 countries linked to our transmission network via six interconnectors.	9GW of flexible interconnector capacity connected to our transmission network.	6 distribution networks Lower voltage distribution networks connected to our high voltage grid.
1 subsea link High voltage direct current subsea link between Scotland and England, the Western Link.	Over 90 power sources connected to the transmission network in England and Wales.	Over 66GW of total generation capacity connected to the grid, including 22GW of zero carbon power.

The map is indicative only and the figures are correct as of December 2023.

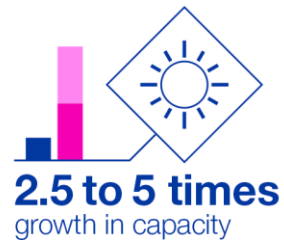
National Context

We must systematically upgrade the transmission network to provide a sustainable 'platform' to service future electricity needs

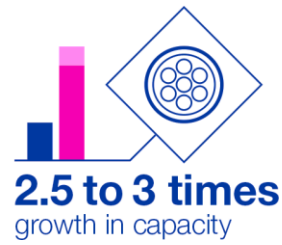
Offshore wind



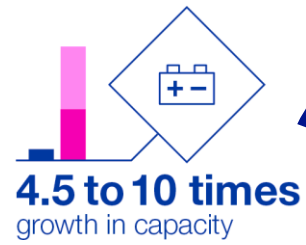
Solar



Interconnectors



Battery storage



At the same time cross sector electrification is expected to increase total electricity demand by around 50%.⁵

Building over **5 times more**



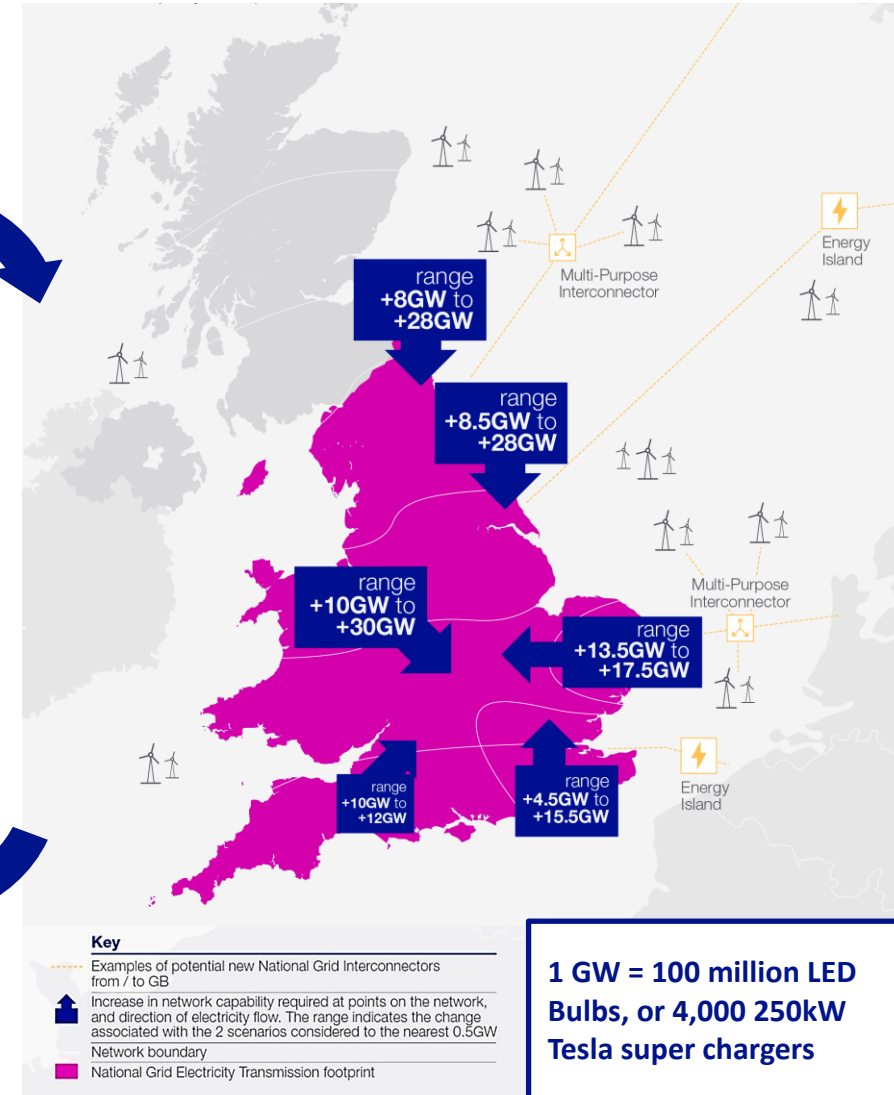
transmission overhead or underground lines than we have built in the last 30 years.

National Grid

Building around **4 times more**



transmission marine cables than our current offshore network.



Our Innovation Strategy

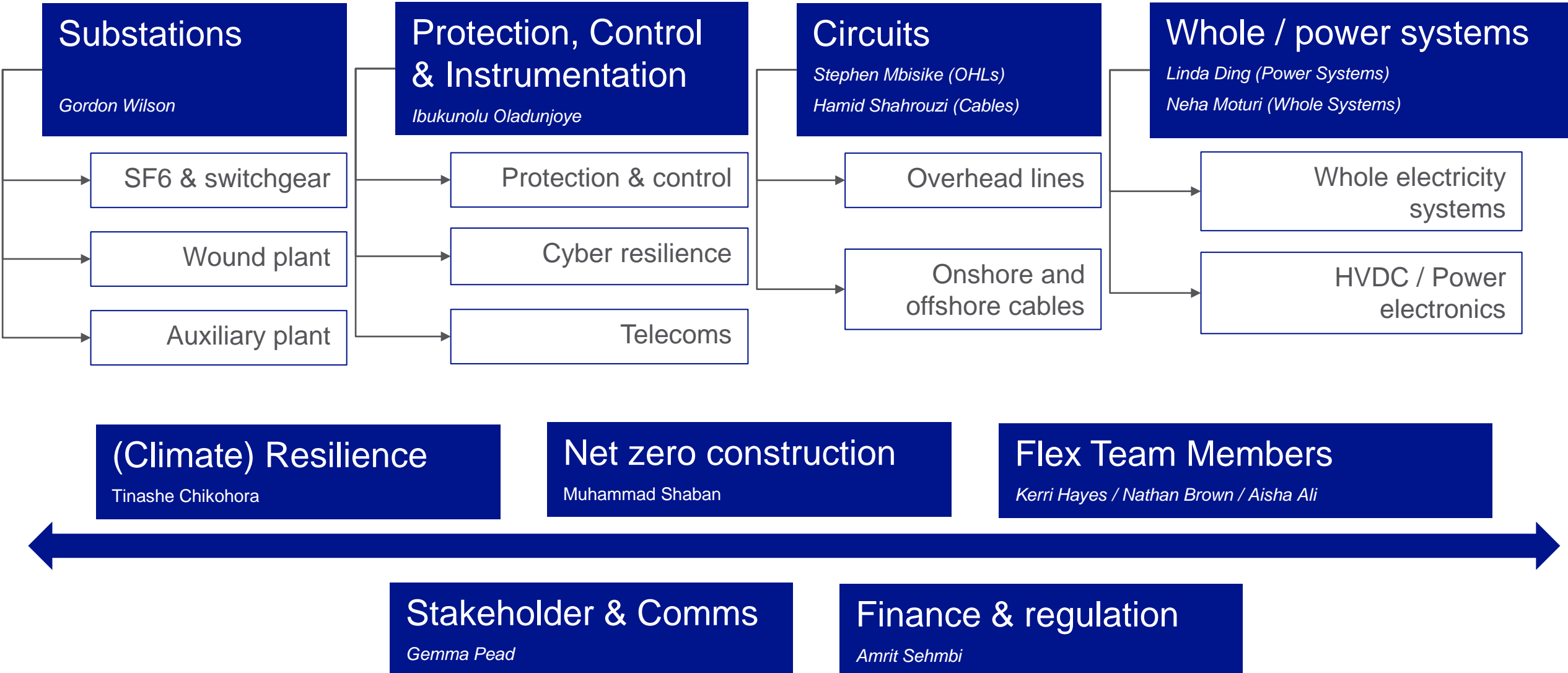
Enabling us to facilitate net zero for GB

1. Maximise the use of our current network capacity
2. Accelerating connections for our customers
3. Effectively interface and integrate new transmission and customer equipment across the network
4. Maintain the health of an ageing asset base efficiently and economically
5. Facilitate system access for all work as demand grows
6. Understand the role of whole energy system solutions and their impact on the transmission system
7. Deliver significant new onshore and offshore network capacity while minimizing impact on communities and the environment

Enabling us to decarbonize our own operations

8. Reduce the emissions associated with our SF6 inventory to achieve net zero by 2050, as well as interim reduction targets
9. Reduce the emissions of construction activity, moving to net zero by 2026
10. Ensuring we can maintain resilience against a more challenging external threat landscape, both from natural climate events and cyber events

Net Zero Innovation Team Portfolios



Deeside Centre for Innovation



19 acres, including a substation and overhead line test areas, workshops, storage space and offices. Each of the test areas can operate independently or can be combined with other areas to suit any testing requirements:

- **Overhead lines**
- **Civil infrastructure**
- **Protection and control**
- **Switchgear**
- **Transformers**
- **Gas insulated switchgear & lines**
- **Offices and workshops**

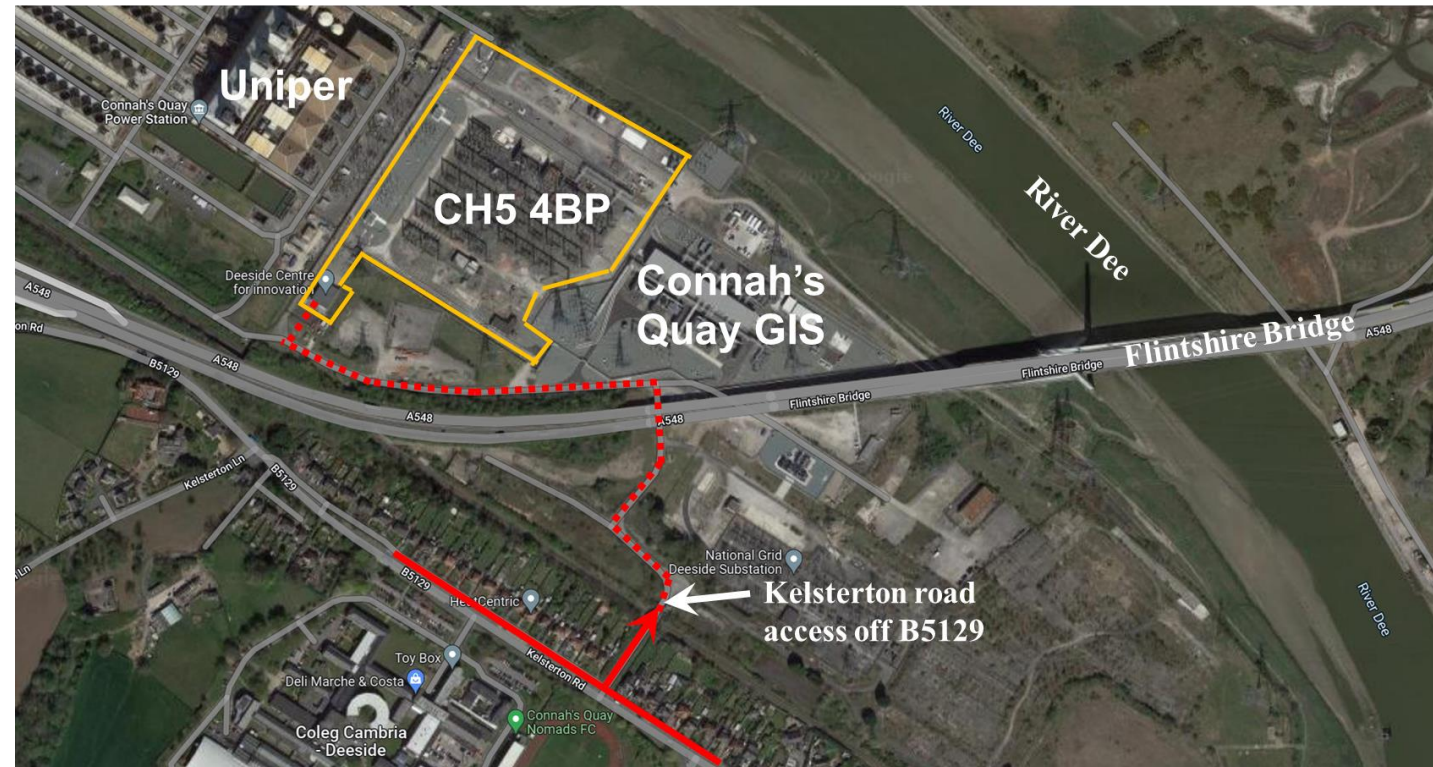
Deeside Centre for Innovation

The site is:

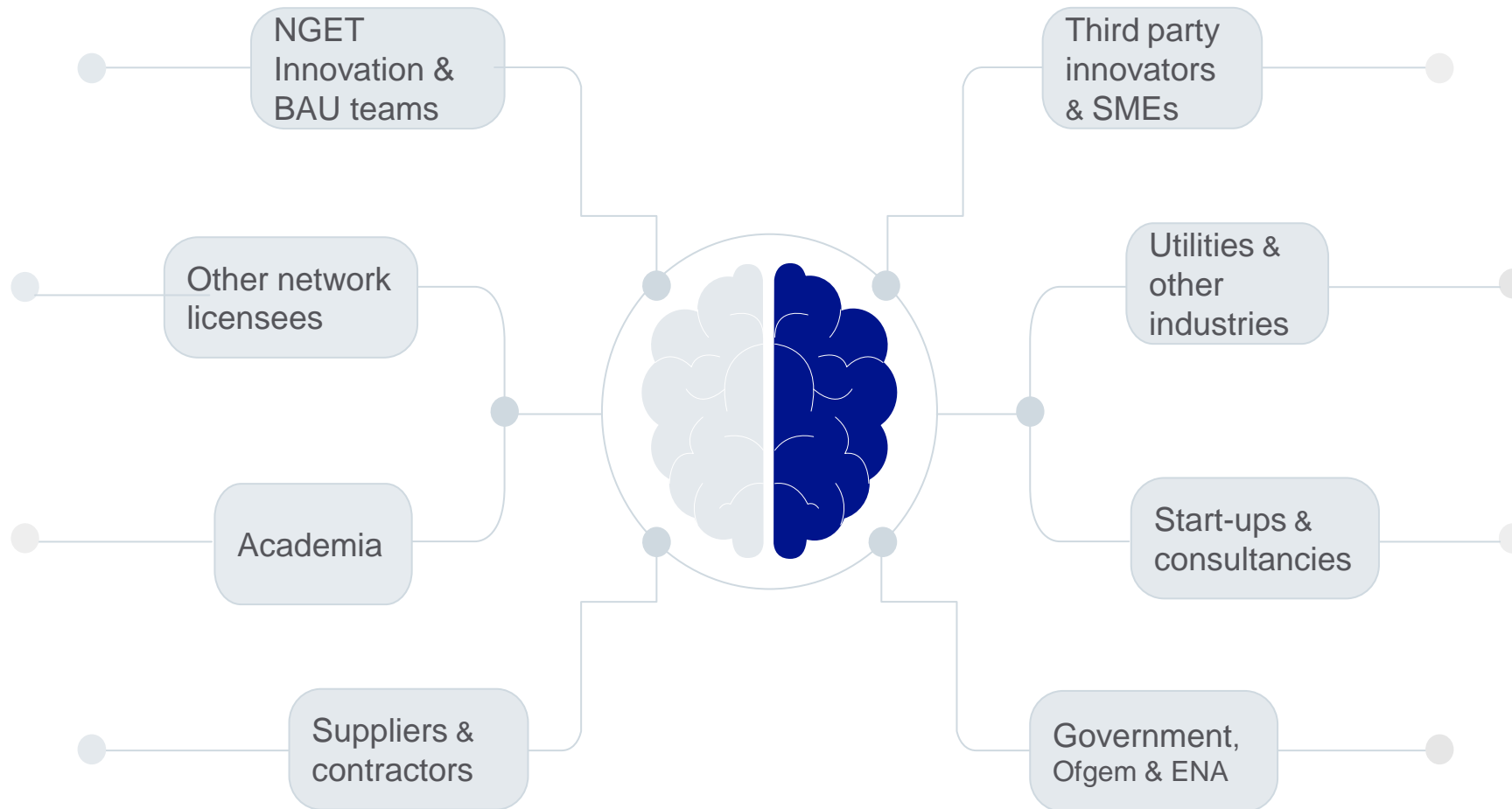
- Sandwiched between Uniper power station & Connah's Quay GIS
- OSEAIT: Off-grid Substation Environment for the Acceleration of Innovative Technology
- A 15.5-acre off-grid test site and comprised of
 - Our offices
 - Substation HV area and
 - The OHL test area

Deeside Centre for Innovation (DCI), Kelsterton Road, Connah's Quay, **CH5 4BP**, UK

→ Visitors access from Kelsterton road off B5129 Access road — DCI boundary



Innovation ideation and collaboration map



+ many more

Types of Innovation Funding

Network Innovation Allowance (NIA)

Ofgem's NIA provides an allowance to network licensees to fund research, development and demonstration trials that must meet six specific eligibility requirements.

1. Facilitate energy system transition and/or benefit consumers in vulnerable situations
2. Have the potential to deliver a net benefit to consumers
3. Involve research, development or demonstration
4. Develop new learning
5. Be innovative
6. Not lead to unnecessary duplication.

Strategic Innovation Fund (SIF)

Ofgem's SIF is designed to drive the innovation needed to transform gas and electricity networks for a low-carbon future with £450m available for GB networks over the five-year regulatory period.

Ofgem set the focus areas / challenges for SIF. SIF is a competitive innovation fund that requires bidding for funding. It is split across 3 stages:

- Discovery (feasibility)
- Alpha (proof of concept)
- Beta (large scale demonstrators)

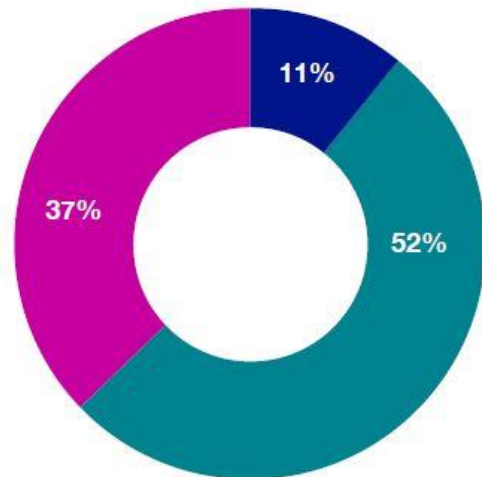
Self Funded Innovation

Innovation is self-funded through various projects; most recent examples are:

- London Power Tunnels concrete pour
- New Plug and Switch System (PASS) bay at Willesden Substation
- Shunt Reactor Bay at Stalybridge Substation
- Bengeworth Road SF6-free substation

NGET Net Zero:

Our innovation in numbers



Distribution of Technology Readiness Level (TRL) by volume of NIA projects in RIIO-T2

- Research (TRL 2-3)
- Development (TRL 4-6)
- Demonstration (TRL 7-8)

NIC Projects

2 ongoing NIC projects

SIF Projects

2 SIF-led alpha projects registered 2023/24

1 SIF-led discovery projects worked on

SF6 leak sealing & alternatives

- An SF6 leak sealing solution has been implemented into BAU for smallbore pipework. This mold leak sealing solution provides >95% leak reduction.
- We'll continue to build on existing work that has proved the SF6 alternative C4F7N can be retrofilled into existing assets and disproved the viability of other alternative gases.



Harnessing the power of drones and AI

OHLs

- The VICAP project has proven and tested that we can automate the capture and processing of corrosion related condition assessment data for the steelwork on our lattice pylons.



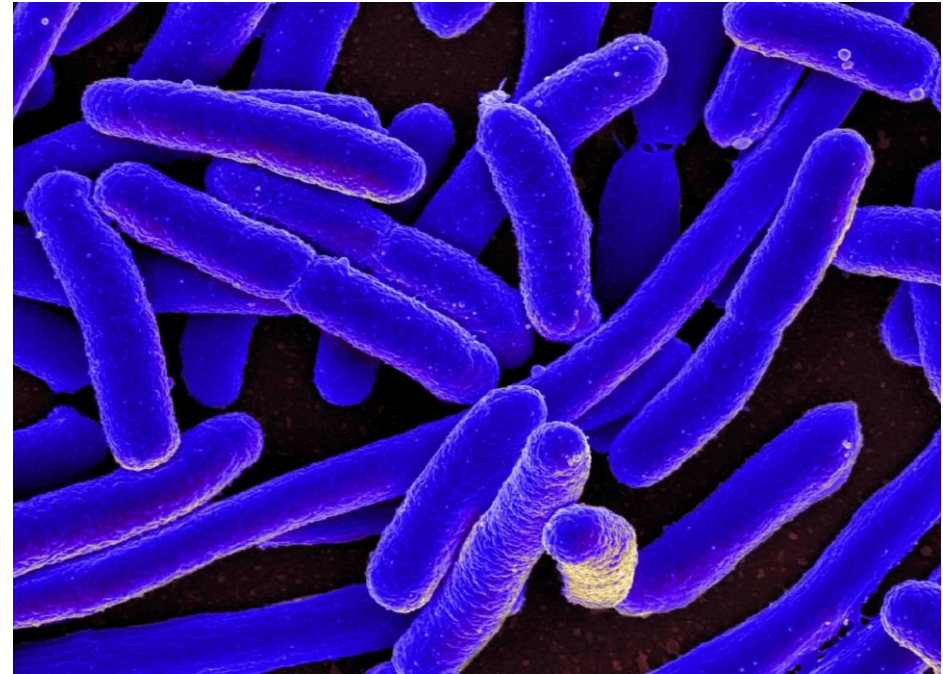
Substations

- The AATIS project is investigating how we can use drones and Artificial Intelligence (AI) to automatically monitor the thermal condition of our substation assets.



Bacteria to decommission oil filled cables

- A new method to decommission fluid-filled cables via bioremediation is being trialled at London Power Tunnels. This solution can remove more than 95% of the cable oil. Cables can be safely left in-situ with no risk to the surrounding environment.
- Reduces the need for excavation and thus disruption to local communities as it does not require monitoring pits, nor does it require any subsequent purging. Reduced excavation is also a safety benefit.



Automated Weather Alerts Tool – NGET Asset Resilience

A platform for more efficiently monitoring and predicting risks to National Grid assets caused by severe weather events, flooding and erosion. An automated approach will improve the speed and accuracy of decision making. Additionally, the sensor picks up temperature, lightning, ice, snow, wind.

Flood Forecasting

PREVISICO

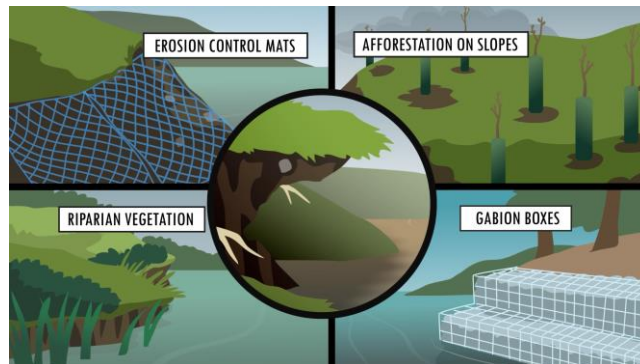
- Unique flood nowcasting and forecasting for NGET asset locations including fluvial and surface water flooding
- Bespoke Sensor installations in strategic locations and real-time data



Long Term Erosion

UNIVERSITY OF
LIVERPOOL

- Long Term hazards posed to NGET asset locations by river and slope erosion
- Consideration of effects caused by climate change by a novel forecasting method



Open Source Data

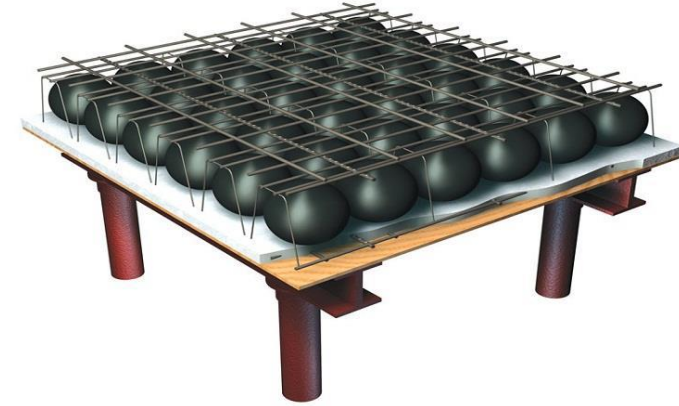
FRAZER-NASH
CONSULTANCY
— A KBR COMPANY —

- Open source data-sets for informing other types of hazards, potentially including:
 - Lightning
 - River Levels
 - Severe Wind
 - Temperature fluctuation
 - Snow & Ice



Net zero construction

- Use of innovative materials and techniques for construction is exploring the viability of: weathering steel, polymer materials, bubble and waffle slabs, ashcrete, graphene enhanced concrete and 3D printing.
- We're conducting feasibility and testing of products and assessing: strength, weight, carbon footprint, ease of construction i.e. reduced earthing, asset management and decommissioning.



T1 & T2 Innovation Rollout Examples

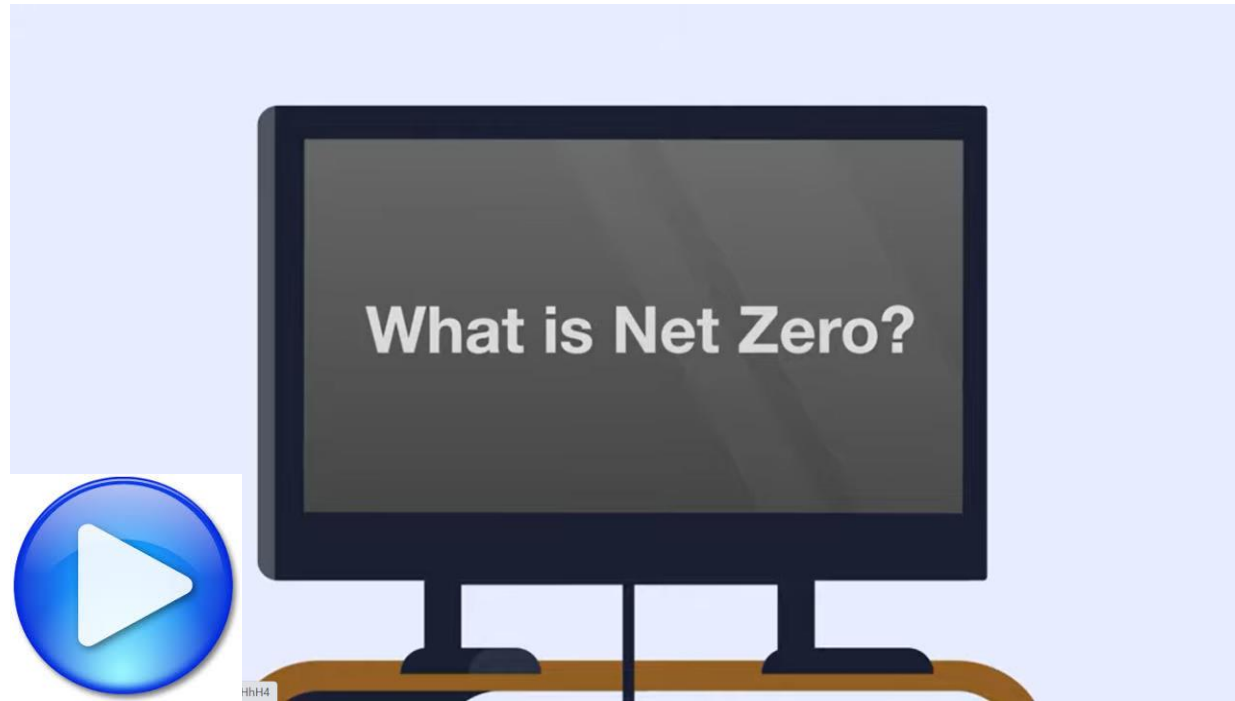
A subset of projects we have implemented as BAU are shown below, offering a range of benefits including safety, risk-reduction, extracting more capacity from the network and emissions reductions aligned with our responsible business charter.

<i>Innovation Project</i>	<i>Partner</i>	<i>Outputs and BAU Implementation Approach</i>
Smart Wires Power Flow Control Deployment	Smart Wires	<i>Extracts more capability from the existing network. World-first design, deployed at 5 sites with other deployments planned. Reduces constraints and unlocked 2GW north-south power flow capacity.</i>
Synthetic Ester Filled Transformer Pilot Project	GE	<i>NGET have 22 synthetic ester transformers either built or in active construction (9 deployed, 13 under construction) which equates to a £5.17m cost reduction and therefore consumer benefit. .</i>
UKs first SF6 Free Substation	Linxon, Hitachi & more	<i>The UK's first SF6 free substation using an alternative gas is delivered at Bengeworth Road in London.</i>
Novel methods for sealing SF6 leaks	Rawwater	<i>Rawwater's leak sealing technique is now BAU. Across all BAU deployments to date, this technique has currently saved 167kg of SF6 leaking into the atmosphere (equivalent to 1000 cars off the road).</i>
Visual Inspection & Condition Assessment of OHL Towers (VICAP)	Keen.ai & Sees.ai	<i>NGET has created an automated end-to-end process for condition assessment of overhead line steel lattice towers using AI. This is now rolled out as BAU with our condition monitoring team.</i>
Environmental Risk & Assurance (ERA)	Frazer Nash	<i>The ERA project is developing software that will be used by control centre staff to better plan for and mitigate the risks of severe weather events on transmission assets. Planned for rollout summer 24.</i>

What is Net Zero?

Net zero refers to the balance between the amount of greenhouse gas produced and the amount removed from the atmosphere.

We reach net zero when the amount we add is no more than the amount taken away.



Graduate programmes placements

18 month programme

All depts apart from Finance and ET
- Substation Engineer

0-6 months Placement 1:
Ownership

6-12 months
Placement 2: Broadening

12-18 months
Placement 3:
Collaboration

24 month programme

ET -Substation Engineer

0-6 months Placement 1:
Project Lead

6-12 months
Placement 2: Senior
authorised person

12-18 months
Placement 3:
Commissioning Engineer

18-24 months Placement
4: Senior Authorised
Person

36 month programme

Finance only

0-12 months Placement 1:
Finance

12-24 months
Placement 2: Finance

24-36 months
Placement 3:
Finance

Top 7 reasons to choose an Apprenticeship

1. You join the Net Zero Energy Workforce

The UK is on a journey to cut carbon emissions and reach [net zero](#) by 2050. You can learn the vital skills required to fill some of the roles that will help us build a greener, cleaner energy system.

2. Skip those student loans - there are no fees to pay for now or further down the line.

3. Earn from day one

As an apprentice, you'll receive a salary throughout your apprenticeship. On top of this, as a National Grid apprentice you'll get free, full board accommodation when attending our academy and we'll cover travel costs associated with your training.

4. Kickstart a career

With an apprenticeship, you're acquiring the skills that employers really want and have a clear career path.

5. Get qualifications and experience

Training on the job and at dedicated training facility you will also gain qualifications whilst on scheme. Those on Higher Apprenticeship (after A levels) going to Aston University, Birmingham gaining a foundation degree or Level 4 diploma. Those on the Advanced apprenticeship scheme going post GCSE's being awarded a Level 3 Qualification

6. Get social

Our apprentices have plenty of opportunities to get together either on the job or at our National Training Centre in Eakring, Nottinghamshire where the training starts, to get to know other apprentices.

7. Enjoy perks and benefits

A salary is just the start of the perks you enjoy as an apprentice. Our apprentices also get other benefits, including £200 towards driving lessons, a pension scheme, access to leisure facilities and more.

Feeder Programmes to the graduate scheme

<h2>Power Academy Students</h2> <p>IET programme. Opportunity to build early relationships with undergraduates in our desired degree disciplines – pipeline for Graduate Development Programme</p>	<p>8 week summer placements and sponsorship</p>
<h2>Internships</h2> <p>Opportunity to build early relationships with undergraduates in our desired degree disciplines – pipeline for Graduate Development Programme</p>	<p>12 week summer placement during the summer of penultimate year at University</p>
<h2>Industrial Placements</h2> <p>Opportunity to build early relationships with undergraduates in our desired degree disciplines – pipeline for Graduate Development Programme</p>	<p>12 month placement typically in penultimate year of degree</p>

Training



We offer world-class training and development opportunities — including our outstanding residential training centre at Eakring in Nottinghamshire, UK.

Qualifications gained whilst on scheme

Scheme	Field/office based	Qual gained whilst on scheme	Accreditation	Where the qualifications are gained
Advanced Apprentice	Field based	Fully-funded level 3 qualification - subsidiary diploma in Engineering	Eakring training centre	Eakring training centre
Higher Apprentice	Both Field and Office based	Fully-funded foundation degree in Engineering	Aston University	Aston University
Graduate – our Technical	Office based	Technical, role specific	Institution of Mechanical	Eakring training centre

The Application Process



Stage One - Online Application

Complete the online application form

Your application should take around one hour to complete - can save it and return to it later

You will be asked for your personal details, work history etc and also a motivational question e.g. why have you applied for this role.

Stage Two - Digital Interview

The digital interview will consist of a number of short competency-based questions. At this stage we want to find out how you communicate and build relationships; what drives you, and how you tackle challenges. You'll be able to record and complete your interview anytime and anywhere.

Stage Three - Profile Assessments

Complete a profile assessment which consists of a number of short online games that look at different elements of your cognitive, emotional, and social traits. You will receive personalised feedback after completing the games

Stage Four - Assessment Centre

Invite to attend one of our assessment centres, where you'll experience a number of exciting activities along side other applicants.

We will provide more details about the virtual assessment centre closer to the time.

Short-listing at each stage

Application hints and tips

- Apply early – for popular roles we sometime close earlier than advertised
- Give yourself plenty of time to check and submit your application
- Deadlines – ensure you stick to deadlines where possible. We're not always able to extend these
- If you're unsure about any part of the process, just ask – we will provide contact details when you start your application so you're able to contact us throughout the process
- Use the STAR method when answering the questions which should ensure you answer the question fully and show your capabilities
- Consider a space where there are likely to be no distractions and you feel comfortable in.
- Check technology is working prior to interview prior to recording your interview
- Try and complete to the best of your abilities but don't put too much pressure on yourself!

Links for more Information

Apprentice: [Apprentices](#)

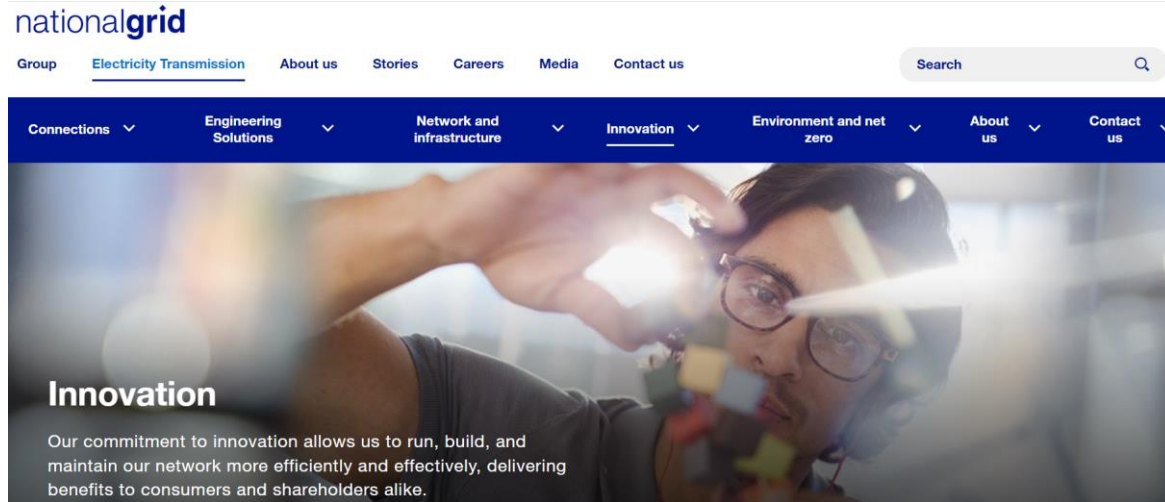
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