Electricity Transmission

Innovation Stakeholder Event

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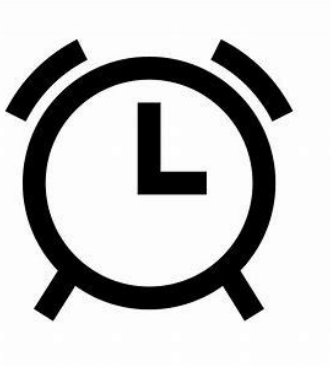
Before we start…



The webinar should last 90 minutes, made up of 50 minutes presentation followed by 20 minutes breakout and 15 mins Q&A

Please ensure you are on mute

We will be using Teams for polling throughout the presentation. Please also use the ‘Chat’ for any questions and we will answer during the Q&A at the end.

Agenda

10:00 – 10:05	**Welcome**	**Gary Stockdale**
10:05 – 10:30	**Our Innovation Strategy for RIIO-ET3**	**Simon Orr**
10:30 – 10:40	**Deeside Centre for Innovation**	**Sean Coleman**
10:40 – 10:50	**Our RIIO-ET3 Innovation Business Plan**	**Gary Stockdale**
10:50 – 11:10	**Breakouts**	**All**
11:10 – 11:30	**Q&A and Close**	**Gary Stockdale**

3 desired outcomes from today's webinar

1. For you to understand our proposed innovation strategy for RIIO-ET3 and how this will shape our business plan

2. To gather your feedback on our proposed RIIO-ET3 innovation strategy and business plan

3. For us to understand how we can adapt our innovation strategy and business plan considering your feedback

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Innovation Strategy for RIIO-ET3

Simon Orr, Head of Strategy and Innovation

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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.

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).

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.

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.

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

4.5 to 6 times
growth in capacity

Solar

2.5 to 5 times
growth in capacity

Interconnectors

2.5 to 3 times
growth in capacity

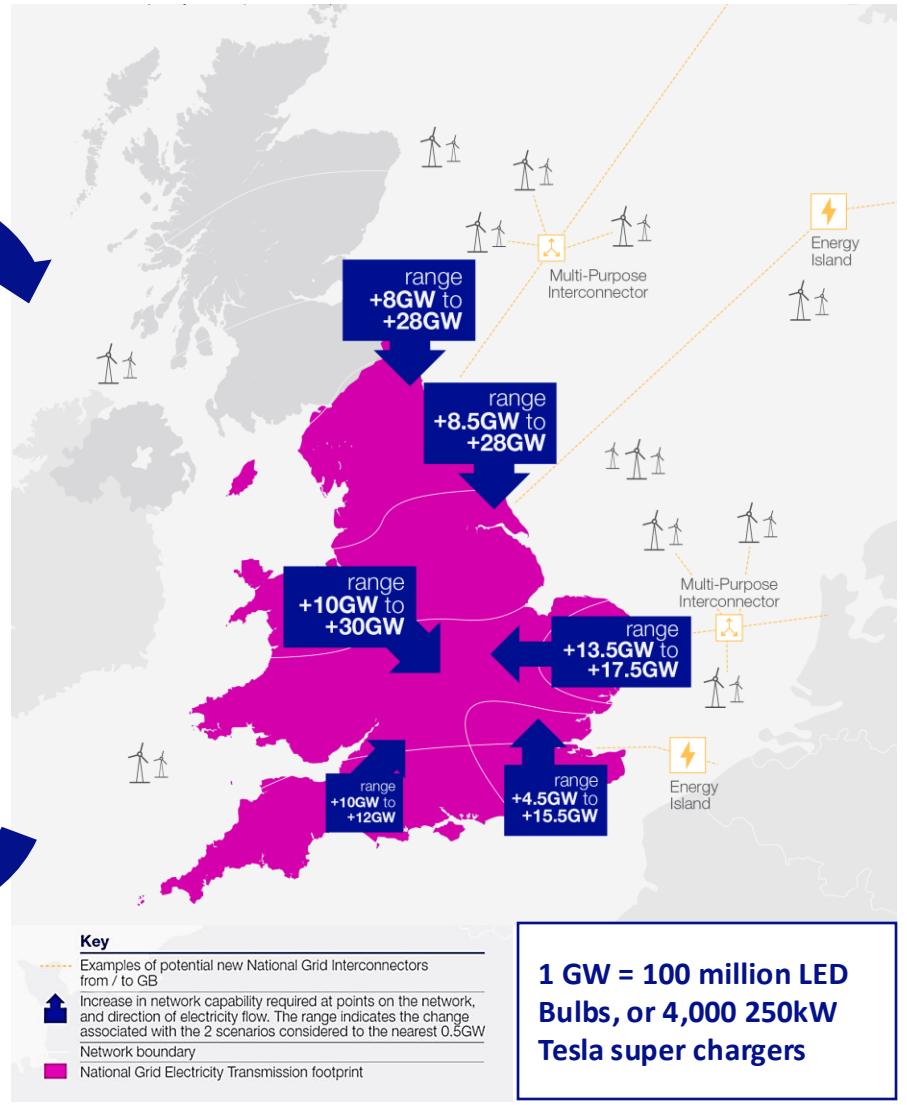
Battery storage

4.5 to 10 times
growth in capacity

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.

Building around
4 times more
transmission marine cables than our current offshore network.



1 GW = 100 million LED Bulbs, or 4,000 250kW Tesla super chargers

T2 Innovation Performance

NIA In Numbers

Projects	Benefits Ratio	Project Partners	Spend to Date	T1 & T2 Projects Rolled Out
54	56:1	50+	£22m	12+

SIF In Numbers

NGET as Project Lead	NGET as Project Partner	Spend to Date	Submission Success Rate
11	7	£2.6m	73%

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.

Innovation Project	*Partner*	*Outputs and BAU Implementation Approach*
Smart Wires Power Flow Control Deployment	**Smart Wires**	*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.*
Synthetic Ester Filled Transformer Pilot Project	**GE**	*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. .*
UKs first SF6 Free Substation	**Linxon, Hitachi & more**	*The UK's first SF6 free substation using an alternative gas is delivered at Bengeworth Road in London.*
Novel methods for sealing SF6 leaks	**Rawwater**	*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).*
Visual Inspection & Condition Assessment of OHL Towers (VICAP)	**Keen.ai & Sees.ai**	*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.*
Environmental Risk & Assurance (ERA)	**Frazer Nash**	*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.*

T2 Stakeholder Collaboration / Partnerships

- It is critical that we **ensure effective stakeholder engagement in innovation, as well as dissemination of project outcomes**. This is vital to ensure we deliver what stakeholders need from us and that we deliver value for consumers.
- We run/attend a **programme of stakeholder engagement events** each year to enable us to do that, both virtually and in person. Examples of recent events include: National Grid Pathway to Net Zero, T3 Network Stakeholder Workshops, ENA Basecamp, Innovation Zero, Utility Week Live etc.
- Our T2 innovation projects span a range of different types of partners, including: **academia, SMEs, large organisations, networks, startups** etc.
- Our **Customer Relationship Management (CRM) system** allows us to systematically manage submission and progress of ideas, ensuring we capture actions taken and always close the loop.
- Stakeholders can also reach out to us using: **our website, LinkedIn page or e-mail our centrally managed .box.**

We have multiple key partnerships that enable us to learn and share best practice from other networks, as well as identify opportunities for collaboration and work with new innovators.

E|C Together we innovate

ena energynetworks association

Academic Framework

LEO® Discover. Connect. Innovate.

i3P

EPRI

cigre

We have refreshed our Innovation Strategy

We've now created 4 key priority areas and updated our engineering outcomes

1 Build the Future Network

- Maximising the capacity of our current infrastructure
- Deliver significant new onshore and offshore network infrastructure
- Ensure the transmission system is optimised as part of the whole energy system
- Enhance the intelligence of our network infrastructure

2 Accelerate Customer Connections

- New ways of connecting the growing number of customers to our network
- Maintaining system operability and stability as the energy system decarbonises
- Facilitate system access as the energy system decarbonises

3 Sustainable Network

- Reduce emissions throughout the lifecycle of our assets
- Reduce the emissions of our construction activity
- Minimise the impact of our infrastructure on communities and the environment

4 Resilient Network

- Maintain the health of an ageing asset base efficiently and economically
- Ensure we can maintain resilience against a changing external threat landscape, including from natural climate events and cyber events

Poll Questions 1

Do you agree with our ‘Build the Future Network’ innovation priority?

Do you agree with our ‘Accelerate Customer Connections’ innovation priority?

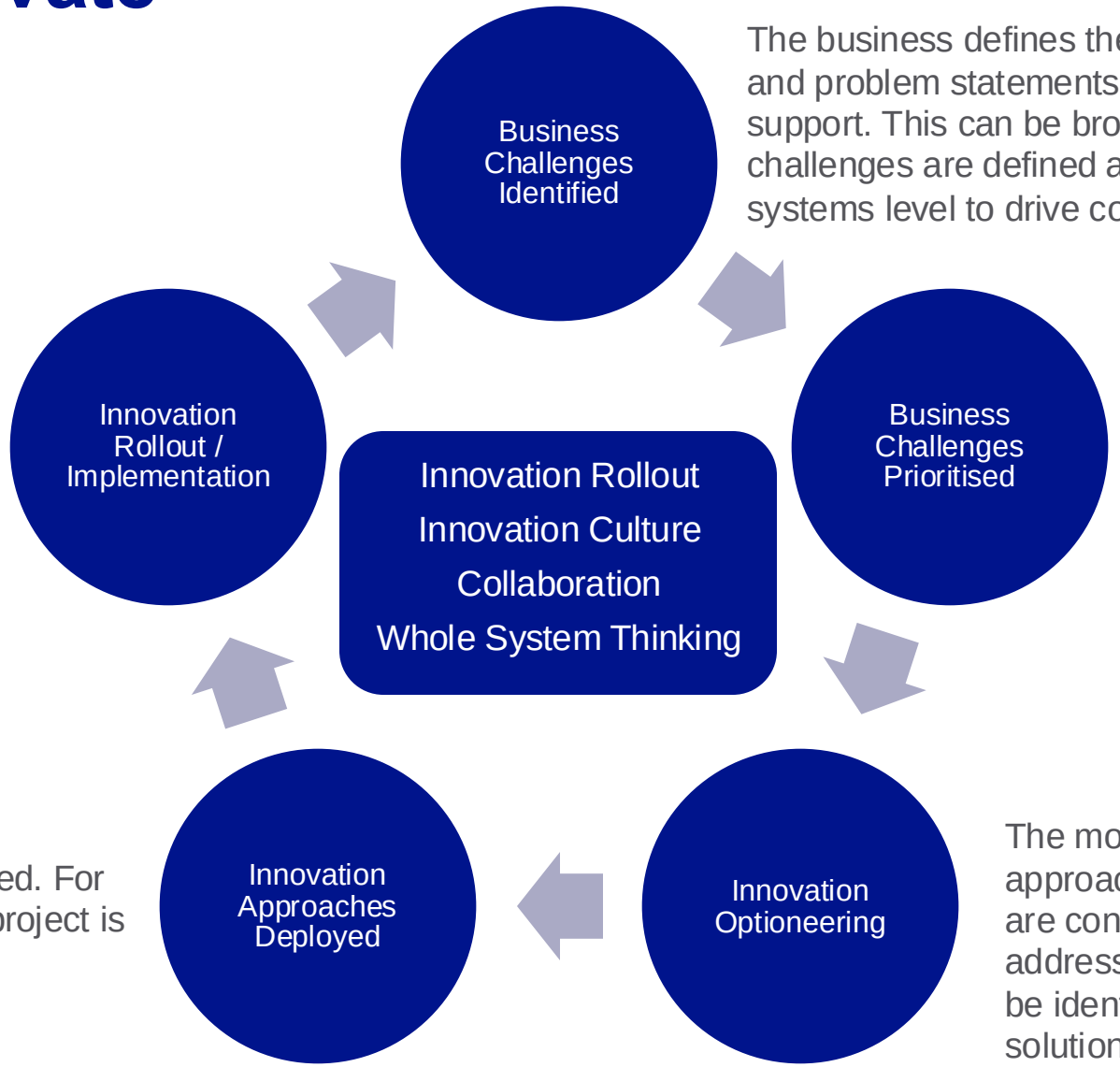
Do you agree with our ‘Sustainable Network’ innovation priority?

Do you agree with our ‘Resilient Network’ innovation priority?

Poll Question 2

Please can you rank our 4 innovation strategy focus areas in order of priority?

How we'll innovate



The business defines their key challenges and problem statements with innovation support. This can be broader where challenges are defined at networks or whole systems level to drive collaboration.

The business prioritises their innovation problem statements to ensure resources are deployed in the right way.

The most appropriate innovation approaches and stakeholders are considered and selected to address the problem. This could be identifying market ready solutions, delivering an innovation project etc.

The chosen innovation approach(es) are deployed. For example, an innovation project is set up and run.

The solution is implemented and/or rolled out into the business. This could be a technology or process rollout, updates to standards and asset management practices, a follow on project etc.

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Deeside Centre for Innovation

Sean Coleman, Innovation Manager

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DCI Test Site

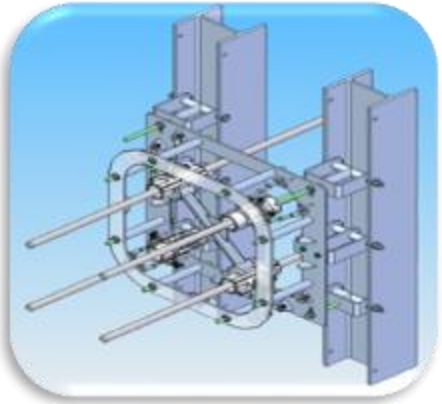
- 400 kV electrical substation
- Site is supplied via 11 kV RMU
- 8 dedicated fenced off test areas
  - 6 substation HV test area
  - 2 OHL test area
- Test areas provide electrical and mechanical testing of HV asset and OHL equipment

OHL Test Area

231kV 1-ph voltage capability

20 and 90 m spans conductor test rigs

500 kN shaker for mechanical testing



6 kA AC/DC converter and conductor clamping

300 kN actuator for conductor tensioning

Deeside Centre for Innovation Projects

Completed

- SF_6 leak sealing trial testing
- Cemfree testing
- Hydrogen powered backup generator

Ongoing

- Monitoring using RF sensors
- Condition monitoring of assets using drones
- Retrofit insulated cross-arms
- Eye in the sky- satellite imaging

Upcoming

- 400 kV composite insulator testing
- Heat recovery project
- Retro-filling SF_6 equipment with environmentally friendlier gas
- Asset cool – OHL conductor coating
- Conductor vibration testing

Deeside and the future of Innovation

- **Deeside Centre for Innovation is central to NGET's innovation strategy**
  - **It is a tool for the whole industry to benefit from**
  - **De-risks innovation**
  - **Allows testing to mature technology in a safe, real-world environment before deployment onto live networks**

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RIIO-ET3 Business Plan

Gary Stockdale, Innovation Manager

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Innovation Rollout of T2 Projects

1 Build the Future Network

- HVDC Lifecycle Analysis – carbon emission tool for HVDC assets
- AssetCool – increased conductor capacity by installing reflective coating with robot
- Optimise Fault Infeed – controlling fault levels to mitigate or defer reinforcements

2 Accelerate Customer Connections

- BLUEFIN – EMF studies for subsea cables to increase consenting speeds
- Wide Area Power Flow Control – managing power flow and oscillations to unlock additional capacity for connections
- Grid Forming Converter Modelling & Stability – modelling for a low inertia decarbonised network

3 Sustainable Network

- Innovative materials – low carbon construction materials and techniques
- SF6 leak repair, SF6 retrofill, SF6 lifecycle analysis
- Warmer hubs – providing safe and warm hubs for vulnerable consumers

4 Resilient Network

- VICAP – AI to automate steel tower condition monitoring
- Environmental Risk & Assurance – tactical network management for climate related weather risks
- WELLNESS – inform network investment decision making
- High Security Protection & Control - lab testing cyber software and setting future standards for cyber

Developing New T3 Projects

Our T3 innovation plan will be built around the 4 focus areas (draft – still to be agreed)

1. Build the Future Network

Focusing on areas such as:

- Upgrade / increase / enhance transmission network power transfer capability and capacity
- System stability in a future low carbon energy network
- Innovations that will mitigate or reduce supply chain constraints
- Optimising transmission as part of whole energy systems
- Enhancing the digital and intelligent capability of assets such as within the substation environment and smart power systems and control
- Example RIIO-ET3 planned projects include: Dynamic System Rating

2. Accelerate Customer Connections

Focusing on areas such as:

- New technologies and methods for physically connecting growing numbers of customers.
- Modelling and facilitating requirements for network upgrades / new network infrastructure based on customer demand. Additionally, facilitating optimal locations for new demand i.e. data centres based on network capacity.
- Managing a transmission system with more renewable energy which causes challenges with inertia, voltage and frequency control etc. For example, real-time network adjustment.

NGET Innovation T3 Plan continued

Our T3 innovation plan will be built around the 4 focus areas (draft – still to be agreed)

3. Sustainable Network

Focusing on areas such as:

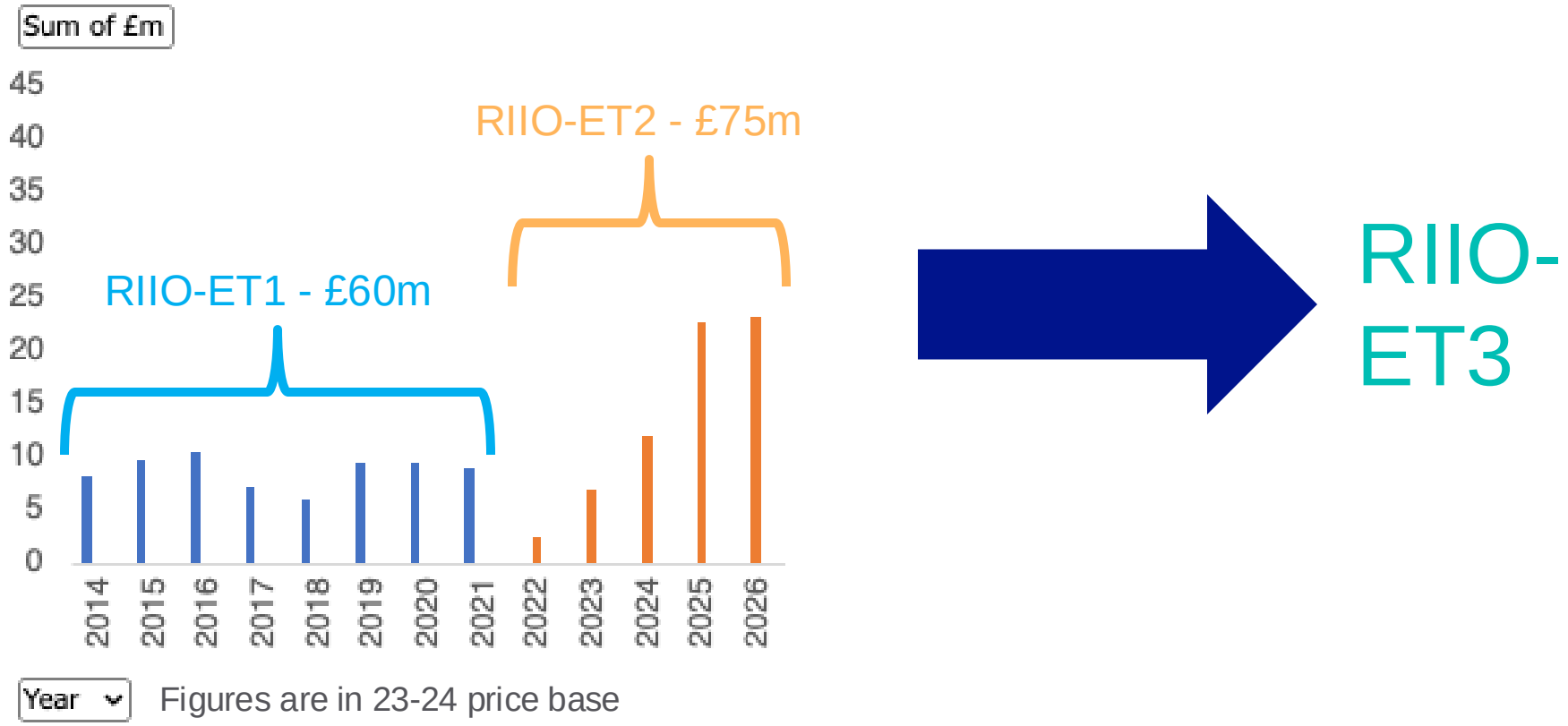
- Net zero construction including new techniques and technologies for construction to support transmission growth
- SF6 leakage reduction including more techniques to detect and seal SF6 leaks
- SF6 retrofill and lifecycle analysis, as we begin to replace SF6 within our assets with alternatives, we need to undertake lifecycle analysis to understand ageing, requirements for condition monitoring, maintenance etc.
- Supporting vulnerable consumers, such as continuing to partner with DNOs to provide expertise and support to vulnerable consumer projects.
- Example RIIO-ET3 planned projects include: Compact Substations, Innovative Materials

4. Resilient Network

Focusing on areas such as:

- Cyber security innovation, particularly as the operational technology on our network becomes more digitalised, the requirement for cyber security becomes more paramount.
- Climate related weather event prediction and management – continued innovation around prediction, modelling, and tactical / strategic asset management based around key climate threats. Ambition to combine into one tool for predicting and managing threats.
- Improved asset management decision making in the face of climate related weather events
- Example RIIO-ET3 planned projects include: High Security Protection and Control, Intercompatible Cable Repair

Flexible Funding (NIA) Innovation Spend



Poll Question 3

Given our forecasted T2 NIA spend of £75m, do you think we should spend:

- **More in RIIO-ET3**
- **Around the same in RIIO-ET3**
- **Less in RIIO-ET3**

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Breakouts

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Break out questions

- **Are we missing any focus areas / themes from our innovation strategy?**
- **Are there any best practices we're missing for the 'how' we'll innovate?**
- **Do you have suggestions for problem statements within our focus areas that we should include in our business plan?**

Breakouts Summary

Are we missing any focus areas / themes from our innovation strategy?

Overall, feedback suggested our strategy is covering the the right focus areas. Feedback for potential additional focus areas included:

- Future workforce
- Supply chain
- Offshore infrastructure
- Society and community innovation ie to smooth the process of building new infrastructure
- Local area energy plans

Are there any best practices we're missing for the 'how' we'll innovate?

- Importance of skills and workforce availability to successfully implement new technologies at scale
- The use of AI and quantum computing for network innovation processes
- More methods for testing new asset innovations
- Look more globally for best practices

Do you have suggestions for problem statements within our focus areas that we should include in our business plan?

- How can we think differently to accelerate the pace for connecting new customers
- How can we accelerate the consenting process for new infrastructure projects

Q&A