
CIGRE UK NGN & Experience So Far
Mark Kent
SP Energy Networks
UK NGN & C1 Technical Secretary
cigre
For power system expertise
cigre
Next Generation
Network

About the

CIGRE UK
Next Generation Network (NGN)

Who are we?

- A professional network for students & young engineers in the power industry
- To engage with CIGRE's activities ("The Gateway to CIGRE")
- To develop knowledge, skills and contacts within the power industry.

How can I get Involved?

- Become a CIGRE UK NGN member (Send an email to
- membership@cigre-ngn-uk.org or follow the instructions at https://cigre.org.uk/ngn/join-ngn/)
  - Free for students & first 3 years for young professionals
- Participate in NGN events (Technical webinars, site visits, educational events)
- Get involved in CIGRE activities (Join international Working Groups, Attend CIGRE conferences)
- Become a CIGRE UK NGN committee member

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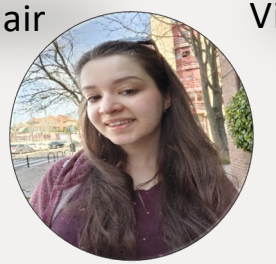
Introduction – The Team

Jiajie Luo
Chair

Nan Chen
Vice-Chair

Wei Gan
Secretary and Treasurer



Maria Oancea
Events Team Lead

Margi Shah
Technical Team Lead

Ali Arjomandi Nezhad
Communication Team Lead

Siva Kaviya
IEC Representative

Yavuz Korman
Membership Team Lead

Jianing Li
Previous Chair & Active Contributor

MANCHESTER 1824
The University of Manchester

PER ARDUA AD ALTA

WÄRTSILÄ

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

ARUP

NESO

wsp

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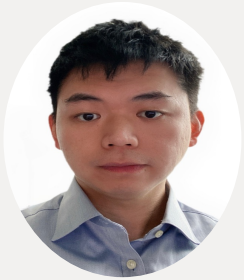
Introduction – The Team

Jingyi Wan

Mark Kent



Kai Lin

Lois Efe

Di Liu

Yixin Li

Liam Fensom

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Wenyan Qian

MANCHESTER 1824
The University of Manchester

Xlinks

ARUP

sse

SP Energy Networks

University of Strathclyde Glasgow

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Benefits of Joining the NGN

- Free
  - For students
  - First 3 years for young professionals
- NGN events
- Get involved in CIGRE activities:
  - Join international Working Groups
  - Support CIGRE-UK Shadow Study Committee Panels
  - Join the NGN Steering Committee
  - Publish Papers in Working Groups and CIGRE conferences
- Personal Development and route to Chartership
- Remember: You don’t need to be an expert to join!

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NGN Events in 2024

1. Successful Events and Workshops
   - 13th November 2024, **CIGRE UK NGN Annual General Meeting**, Birmingham
     - Including keynote speeches and committee elections
   - 25th July 2024, **CIGRE UK NGN and India NGN** collaboration webinar on "**Future of Digital Substations**"
     - Joint webinar to promote the formation of the Indian NGN chapter
   - 19th April 2024, CIGRE UK NGN collaboration webinar with **Ireland NGN, Sweden NGN and IEEE PES WiP** on **"The power and energy systems of the future — sustainable, digitalized and …?"**
     - Co-sponsored by Digital Futures
   - 12th March 2024, **Substation Fundamentals Training and Site Visit** at GE Stafford in collaboration with Study Committee B3
     - Training given by John Finn on two modules about Secondary Systems from the CIGRE Green Book on Substations
   - 24th January 2024, **CIGRE UK NGN Young Members Showcase**, Cardiff University
     - The showcase winners had their travel expenses & fees for the CIGRE Paris Session covered
2. Events for University of Birmingham students organised by the **Birmingham CIGRE UK University Hub** (lectures, seminars, summer school)
3. Looking to create **regional CIGRE UK University Hubs across the country** to promote CIGRE to prospective student members

NGN Experience So Far

- Joined in Q4 2023 supporting Events Team
- NGN Showcase Award
- NGN Mentorship with Adam Middleton
- C1.51 Working Group on Energy Storage
- CIGRE UK Liaison
- Post-Paris Conference
- International NGN (yesterday!)

Involvement in CIGRE UK NGN has been invaluable for my development and opportunities

SP Energy Networks

Distribution Network Planning to Facilitate Decarbonisation Growth

Mark Kent

Agenda

- The 2050 challenge
- Planning our distribution networks for Net Zero
- Enabling distributed generation growth

We are SP Energy Networks

We own and operate the electricity distribution network in Central and Southern Scotland (our SP Distribution network), and in North and Mid-Wales, Merseyside, Cheshire, and North Shropshire (our SP Manweb network). It is through these two networks of underground cables, overhead lines, and substations that we provide our 3.5 million customers with a safe, reliable, and efficient supply of electricity

Decarbonisation challenge by 2050

Double
peak
demand

Four times
distributed
generation

Double
industrial
demand

+55% freight
transport

Up to 8m
electric vehicles
and heat pumps

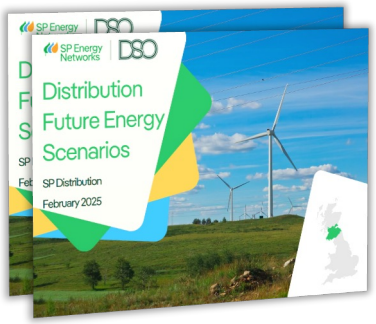
Our plans will play a key role in supporting our customer decarbonisation and growth requirements

Network Planning & Forecasting

SP Energy Networks

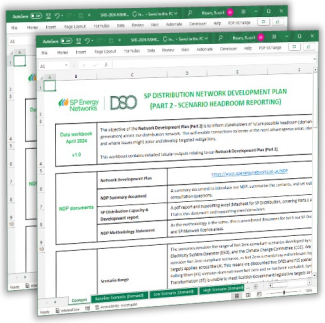
Forecasting

[Distribution Future Energy Scenarios (DFES)]



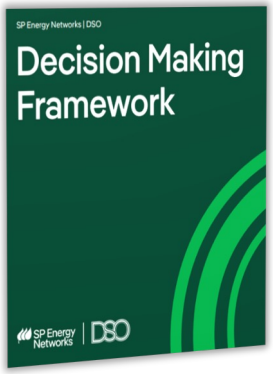
Network Assessment

[Network Scenario Headroom Report (NSHR)]



Options Assessment

[Decision Making Framework (DMF)]



Flexibility Tendering

[Piclo Flexibility Tendering Platform]

Intervention Decision

[Network Development Plan (NDP)]

Network Planning activity shared on our [Open Data Portal]

Forecasting Customer Needs

Forecasting | Network Assessment | Options Assessment | Flexibility Tendering | Intervention Decision

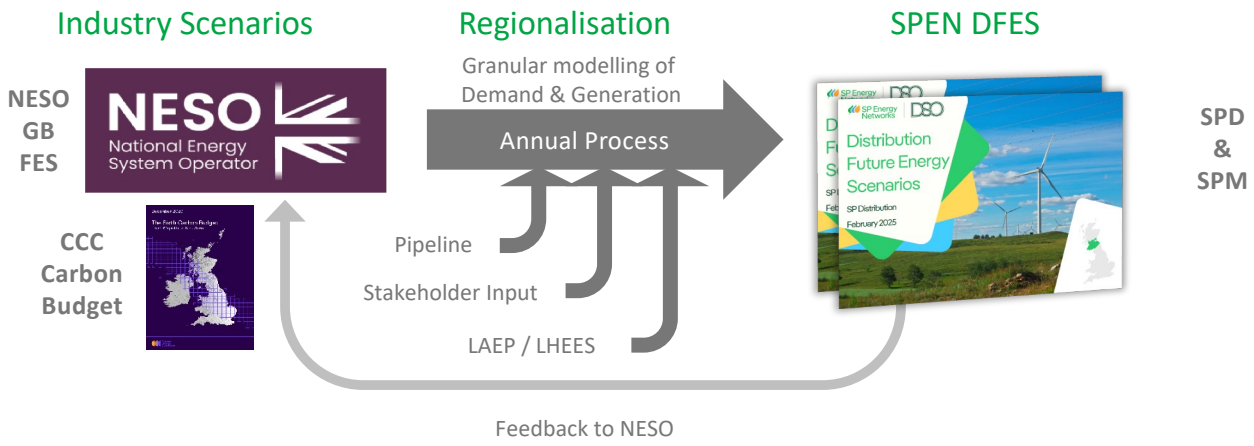
SP Energy Networks

Forecasting our customers' needs to efficiently plan and operate our network

Distribution Future Energy Scenarios

Our DFES scenarios are **developed with stakeholder input** to **assess the range of Net Zero pathways**.

DFES is an annual process to forecast LCTs, electricity demand and distributed generation out to 2050.



Enhanced Forecasting

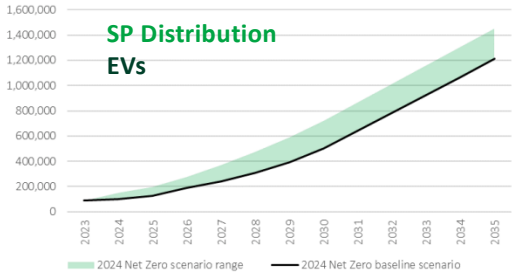
Granular forecasts: EV-Up & Heat-Up identify where and when our customers are likely to adopt LCTs.

Distribution Future Energy Scenarios (DFES)

1.18m - 1.34m
new **EVs** by 2030

0.39m – 0.54m
new **heat pumps** by 2030

+9.5GW – +12.2GW
new **DG** by 2030



DFES **Baseline View** underpins our strategic network investment plan to prepare the network for Net Zero. It forms part of a suite of publications that provide data and information to support our stakeholders in their planning and decision making processes.

Information on future network

Information on existing network

Embedded Capacity Register	Distributed Generation Heatmaps	Long Term Development Statement	Flexibility Tenders	Network Development Plan	Distribution Future Energy Scenarios
Details connected and contracted generation and storage	Interactive geographic snapshot of generation capacity headroom	Detailed network information and overview of developments for 5 years	Details on location, magnitude and timing of flexibility requirements.	Network developments for 10 years, and network capacity headroom	LCT, demand, and generation forecasts to 2050 across a range of future pathways.

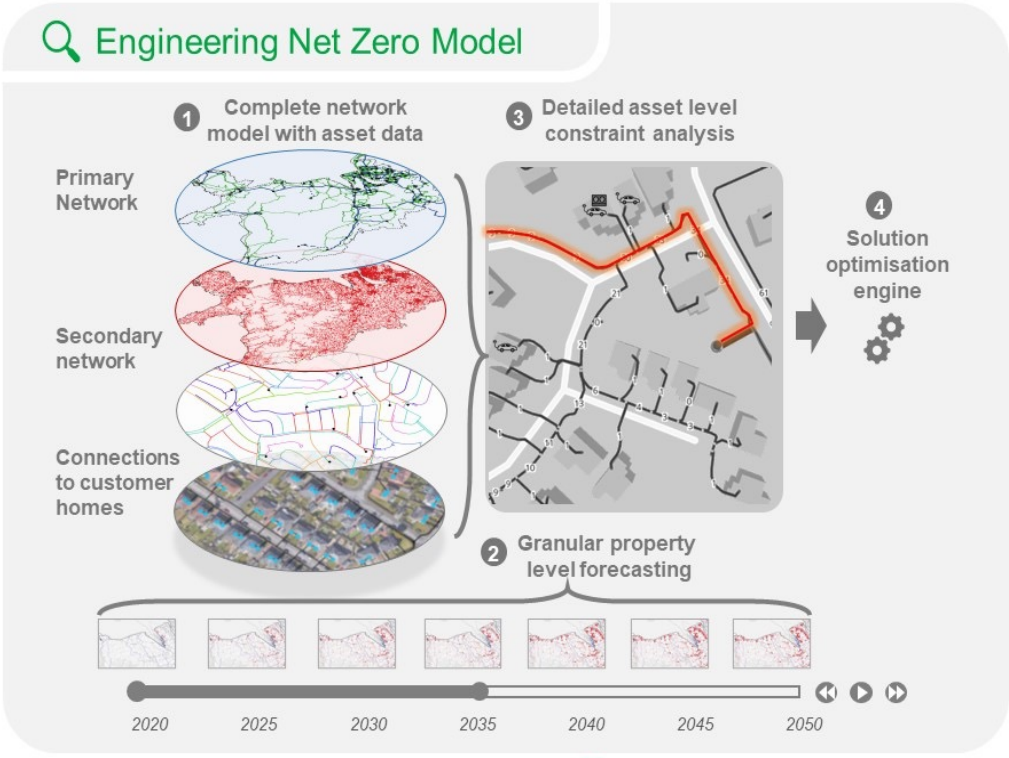
Working with the wider industry on the LTDS and Heatmap reform

Network Assessment

SP Energy Networks

Engineering Net Zero (ENZ)

- Uses micro-level forecasts, asset data, and modelling to **identify timing, magnitude, and location of constraints**.
- For each constraint, uses **linear optimisation** to find the **most economical combination**, sequence, and timing.
- Being **developed** into a **near-real time** platform to support DSO network planning and real-time operations.



Revolutionising our network modelling capability and optimising investment decisions

Options Assessment

SP Energy Networks

Technical

Customer needs
Can it provide the required capacity

Technical requirements
Technically feasible and doesn't introduce other issues

Cost

Whole life cost
Cost benefit considering Capex and Opex

Environmental impact
Losses, noise, visual impact, and carbon impact

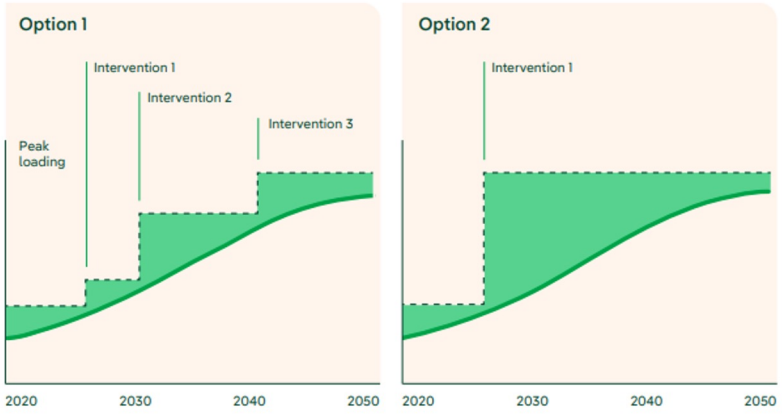
Other

Timing/delivery
Can the solution be delivered in time

Whole system
Transmission/distribution and cross vector interactions

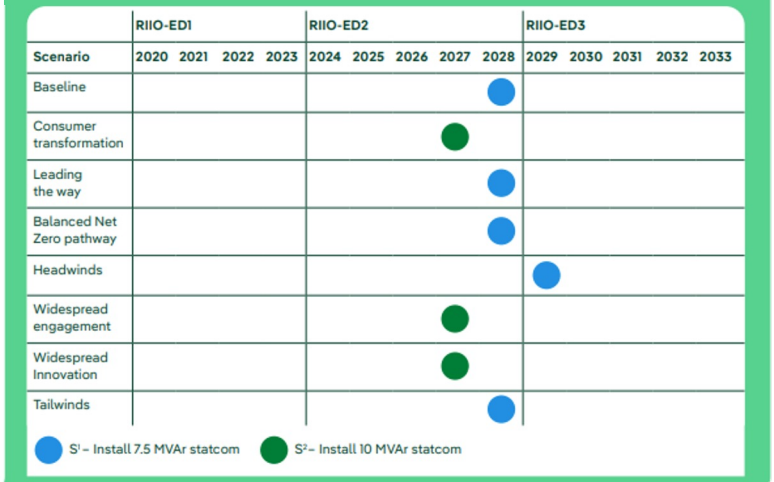
Our linear optimiser for HV and LV assessments

For every LV and HV constraint, we use the ENZ Model/Platform to determine the **most economical combination, sequence and timing of solutions** to meet the required network capacity.



Assessment at EHV and above

As there are fewer constraints and fewer credible solutions, we do more **in-depth design studies** to support cost benefit and technical analysis on a smaller number of credible solutions **across different decarbonisation pathways**.

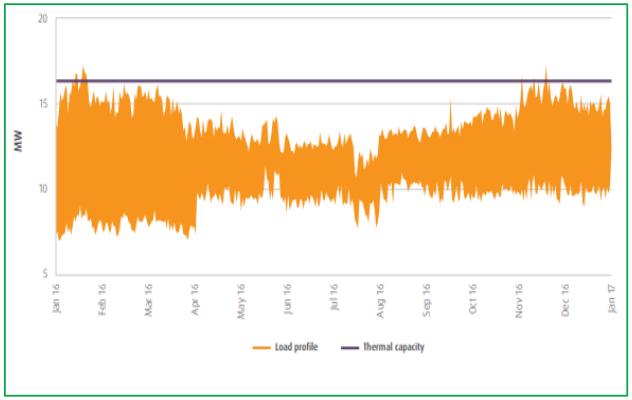


Use of Flexibility

Forecasting | Network Assessment | Options Assessment | Flexibility Tendering | Intervention Decision

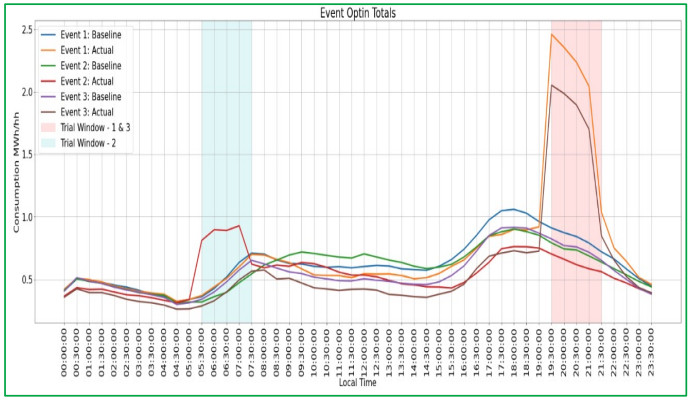
SP Energy Networks

Flexibility helps manage network constraints



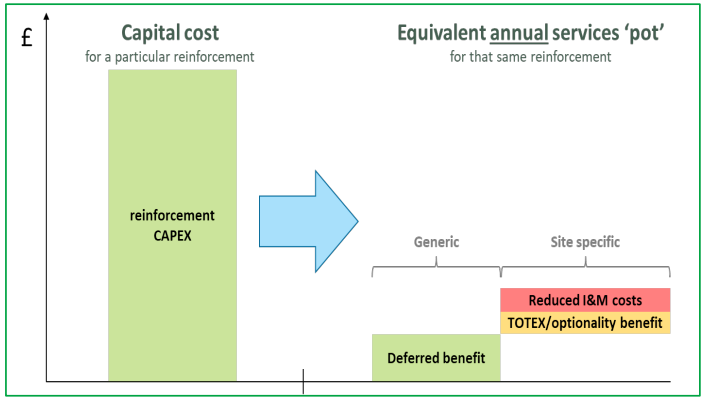
Constraints occur on **daily** or **seasonal** peaks; managing constraints can **defer** the need for **reinforcement**.

Flexibility needs consumers to do things differently



Flexibility providers and their customers have **proven** that flexibility **works** and can **respond** to network needs.

Flexibility is a way of optimising costs



Cost effectiveness is **tested**, ensuring **lowest lifecycle cost** and contracts are placed via a **transparent** tender process.

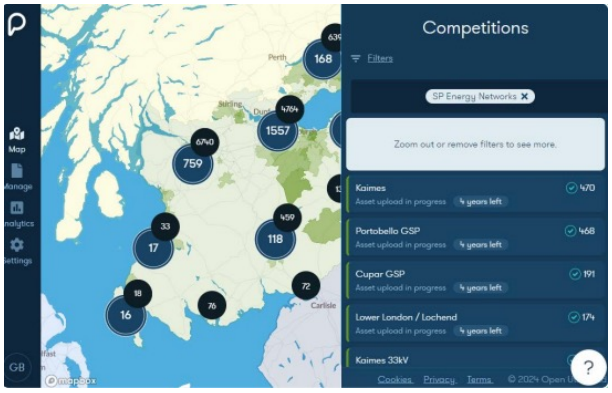
Flexibility Tendering

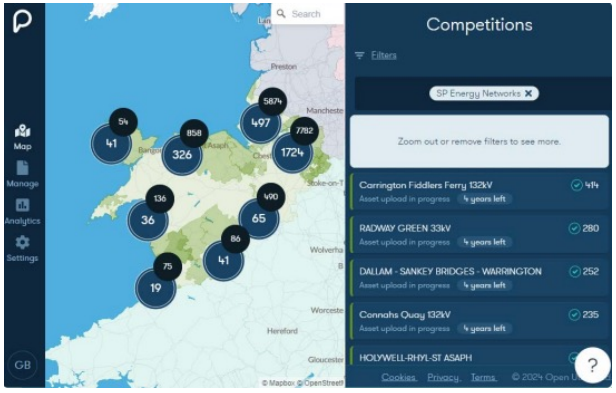
- Customers that agree to actively change their demand/generation in return for payment are called as **Flexibility Service Providers (FSPs)**.

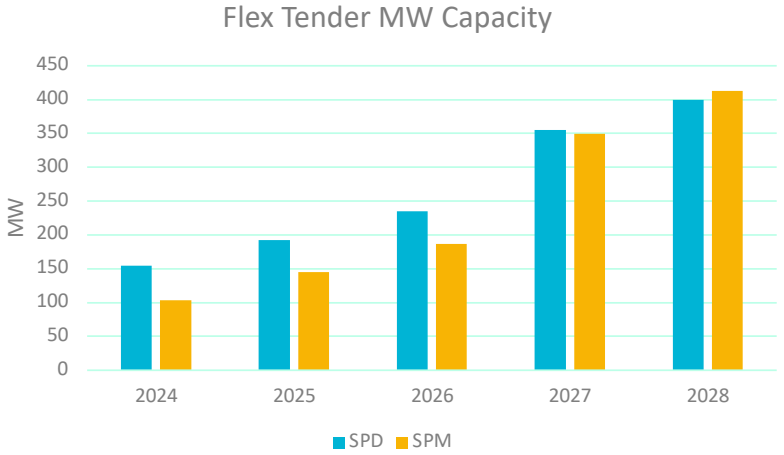
- In an industry first, we have contracted Piclo to develop and implement and end-to-end **flexibility service platform**, called **Piclo Flex**.

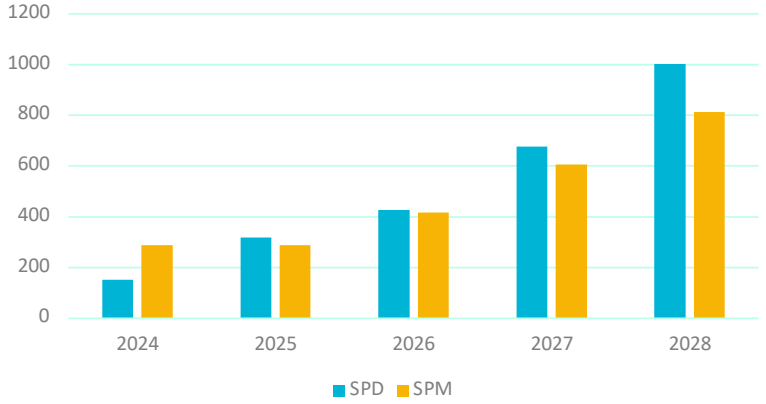
- For each tender, we provide the following info:
  - **Location**
  - **Service Window** (when the flexibility service is required)
  - **Capacity** (the MW/MVAR required)
  - **Technical Parameters** (including voltage, run time and response time)
  - **Ceiling Price** (so participants know potential value of the opportunity)

- Note: **flexible services are different from flexible connections** (customer choosing a non-firm curtailable connection upon asking us for a connection).









Intervention Decision

Forecasting | Network Assessment | Options Assessment | Flexibility Tendering | Intervention Decision

SP Energy Networks

Buy…

- Paying providers to respond
- Potentially lower cost
- Quicker solution
- Annual operating cost providing optionality

OR…

Build…

- Conventional investment
- High capital outlay
- Long lead times
- Recovered over 45yrs through use of system charges

- We review the flexibility service bids to ascertain whether the flexibility solution identified is technically and economically viable. Where this is not the case, we will reject the bids and proceed with the alternative solutions.
- Where the alternative is a long-lead reinforcement solution, we will continue to re-tender for flexibility services before placing build orders to ensure we are still using the most efficient intervention.
- Whichever solution(s) are selected, these are taken forward and assured through our governance process.

Intervention Decision – NDP Publication

Forecasting | Network Assessment | Options Assessment | Flexibility Tendering | **Intervention Decision**

SP Energy Networks

Our NDP provides transparency on network planning information, detailing network developments (up to 10 years) and forecast network constraints and capacity headroom.

- **Summary** - outlining the scale of the decarbonisation challenge and our response.
- **Network Development Report** – details strategic context per license and our intervention plan per GSP.
- **Network Capacity Headroom Report** – forecast demand and generation headroom for each substation out to 2050.

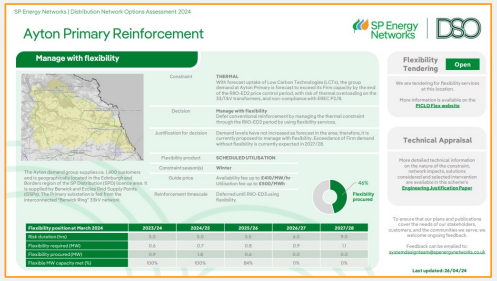
NDP Documents

www.spenergynetworks.co.uk/NDP

- SPEN — NDP Summary Document
- SPD, SPM — Network Development Report
- SPD, SPM — Network Capacity Headroom
- SPEN — Methodology Statement

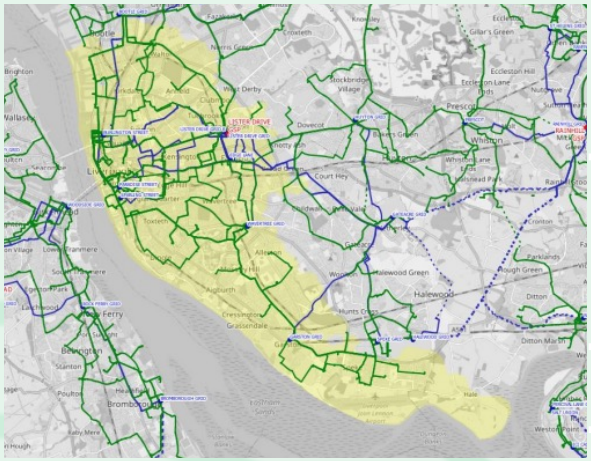
Distribution Network Options Assessment (DNOA)

- **We publish our Decision Making Framework** to provide visibility of our inputs, process, and outputs; This was established for our ED2 plan and tested through our Independent Net Zero Advisory Committee
- Our DNOA signposts our investment plan in longer term and any **flexibility potential for FSPs**



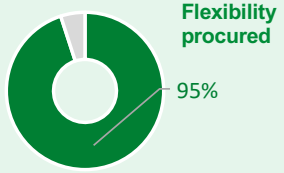
Lister Drive 132kV reinforcement

Manage with flexibility & automation



The Lister Drive 132kV network group provides supplies to ca. 165,000 customers including Liverpool city centre as well as the shipping docks and industries along the Mersey river. The 132kV network group is supplied from National Grid Electricity Transmission at Lister Drive by 4 x 275/132kV 240MVA Super Grid Transformers (SGTs).

Constraint	**THERMAL** Flows on the Lister Drive–Burlington St 132kV circuit within the Lister Drive group are at risk of exceeding equipment summer thermal ratings. This strategic circuit supplies two 33kV groups in the Liverpool City Centre. Furthermore, demand and LCT growth within the group is likely to exceed the firm capacity of the demand group within the RIIO-ED2 period.
Decision	**Manage with flexibility & automation** Install real time thermal monitoring equipment on the 132kV circuit to Burlington Street. Employ Constraint Management Zone (CMZ) based automation scheme to trip the Burlington Street–Bootle circuit and close either line or bus section beaker to supply it from Bootle. Flexibility will be used to reduce dependence on automation scheme, and to manage the utilisation of the whole group throughout the RIIO-ED2 period.
Justification for decision	Deferral of significant, conventional reinforcement works via flexibility and automation presents a better value for money solution.
Flexibility product	**Scheduled Utilisation**
Constraint season(s)	**Year round**
Flexibility guide price	Availability fee up to **£150/MW/hr** Utilisation fee up to **£185/MWh**
Reinforcement timescale	Thermal monitoring: 1-year CMZ automation: 2-years



Flexibility position at March 2024	2023/24	2024/25	2025/26	2026/27	2027/28
Risk duration (hours)	-	344	382.5	1,080	1,265
Peak flexibility required (MW)	-	3.1	5.2	6.1	7.8
Flexibility procured (MW)	-	9.6	12.8	4.93	16.5
Flexible MW capacity met (%)	-	>100%	>100%	81%	>100%

Flexibility Tendering

Open

We are tendering for flexibility services at this location.

More information is available on the **PICLO Flex website**

Technical Appraisal

More detailed technical information on the nature of the constraint, network impacts, solutions considered and selected intervention are available in this scheme's **Engineering Justification Paper**

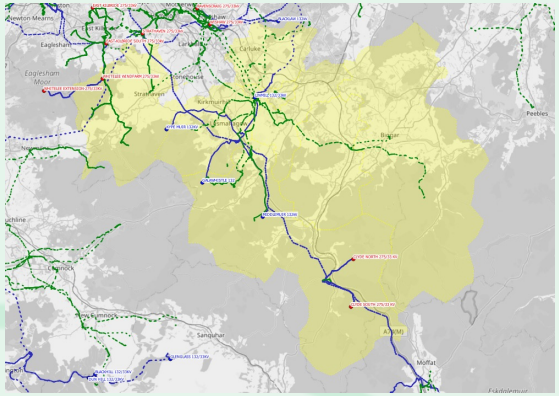
To ensure that our plans and publications cover the needs of our stakeholders, customers, and the communities we serve, we welcome ongoing feedback.

Feedback can be emailed to: systemdesignteam@spenergynetworks.co.uk

Last updated: 26/04/24

New Redshaw GSP

Reinforce without flexibility



The Linnmill demand groups supply ca. 28,000 customers and is geographically located in the Lanarkshire region of SP Distribution (SPD) licence area. The GSP supplies seven 11kV primary substations; Biggar, Braidwood, Corra Linn, Douglas West, Lanark, Lesmahagow and Symington. There is also interconnection with both Wishaw and Newarthill GSP's.

Constraint	**FAULT LEVEL** The peak make fault level at the Linnmill GSP 33kV switchboard exceeds the network design limit and the RMS Break is above 95% of the design limit, which would prevent connection of future Low Carbon Technologies (LCTs), as it would require a prohibitive cost for the fault level mitigation.
Decision	**Reinforce without flexibility** It is proposed to establish a new 132/33kV 90MVA Redshaw GSP which shall connect into a new Redshaw 400/132kV transmission substation. Transfer Lesmahagow and Douglas West feeder circuits, as well all encompassed generation including Andershaw Wind Farm, which will have a dedicated circuit breaker. These proposed transfers will create sufficient fault level headroom at Linnmill GSP.
Justification for decision	Due to the predicted increase in fault levels, operational management is not an enduring solution. Flexibility would not relieve fault level constraints.
Flexibility product	**N/A**
Constraint season(s)	**Year round**
Guide price	Competition closed
Reinforcement timescale	2027/28

Flexibility not required

Flexibility position at March 2024	2023/24	2024/25	2025/26	2026/27	2027/28
Risk duration (hrs)					
Flexibility required (MW)					
Flexibility procured (MW)					
Flexible MW capacity met (%)					

Flexibility Tendering

Closed

We are not currently tendering for flexibility services at this location.

Technical Appraisal

More detailed technical information on the nature of the constraint, network impacts, solutions considered and selected intervention are available in this scheme's **Engineering Justification Paper**

To ensure that our plans and publications cover the needs of our stakeholders, customers, and the communities we serve, we welcome ongoing feedback.

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Last updated: 26/04/24

Enabling renewable generation & demand growth

Renewable Generation

We are accelerating connections subject to network constraints.

We have already connected **6.5GW** of generation (more than our network peak demand!)

We have an 11GW contracted pipeline. We are **accelerating over 4GW** of this **by upto 10 years** using Automated Load Management Schemes (LMS, T/D limits, CMZ, LMZ) at over 150 sites.

Energy Storage

We led industry to standardise electricity storage network access rights.

Successfully implemented new access rights across all DNOs and at the T/D interface. These avoid triggering unnecessary reinforcement or sterilising capacity required for decarbonisation.

This work was independently assessed to deliver up to **£400m in GB benefits** by 2040.
Across GB **>60GW of connections offered**, **>28GW accepted** under new arrangements.

Demand Capacity

Enabling a pipeline of over **1.5GW** of **large demand connections by 2035** including:

- Industrial & Commercial decarbonisation (500MW)
- Datacentres (450MW)
- Hydrogen production, storage & carbon capture (450MW)
- Housing/district heating (150MW)
- EV charging stations (100MW)

Using technical and commercial solutions to enable faster lower cost connections

Conclusions

- Vast growth in distribution network requirements as society decarbonises
- Robust distribution network planning vital to deliver networks fit for Net Zero
- New processes and tools delivering solutions for all customers from LV to 132kV

Q&A