nationalgrid

Distribution Network Options Assessment

February 2023

nationalgrid.co.uk

Foreword

With the government's commitment to end the UK's contribution to greenhouse gas emissions by 2050, the role of electricity in helping to facilitate net zero is becoming increasingly important. As our customers shift to electrify their heating and transport needs, our network needs to be smarter and more flexible than ever.

At National Grid Electricity Distribution (NGED) we have a strong track record of delivering best in class service and, as we continue to take a more and more active role in managing the electricity distribution system, we will continue to develop our business and remain at the forefront of Distribution Systems Operations (DSO).

Over the last few years we have opened up a plethora of opportunities for distributed energy resources to help support our network. As we continue to expand these opportunities we will ensure we are able to access the maximum value reinforcement deferral using flexibility is able to provide for our network by utilising ceiling prices for new flexibility contracts.

Developing successful markets also requires confidence in those opportunities continuing in the future and transparency in the process and outcomes of our decision making. This Distribution Network Options Assessment (DNOA) publication outlines our methodology for assessing the use of flexibility to defer conventional reinforcement and how we ensure every investment decision provides optimal value for stakeholders and customers.

As part of our RIIO-ED2 Business Plan we have committed to adopting a 'flexibility first' approach to maximise utilisation of the network. The DNOA process will provide transparency in our approach to meeting this commitment and ensure the optimal investment pathway is taken for all load related expenditure, minimising costs and maximising efficiency.

By providing more information to the growing distribution flexibility market about current and future network requirements across our region, we can help flexibility providers identify relevant opportunities to support the distribution network and bring forward investment in green technologies.

Future developments in the DNOA process are also outlined in this document, including expanding our use of flexibility into the low voltage network. This will increase opportunities for flexibility service providers and further incentivise the uptake of LCTs and other green technologies.

The decisions made within this DNOA will show how we are optimising our investment to deliver secure, sustainable and affordable electricity to meet the evolving needs of the areas we serve.

We welcome any feedback that will help us to push the DNOA even further to drive value and benefit for our customers.

Ben Godfrey
Director of Distribution System Operator

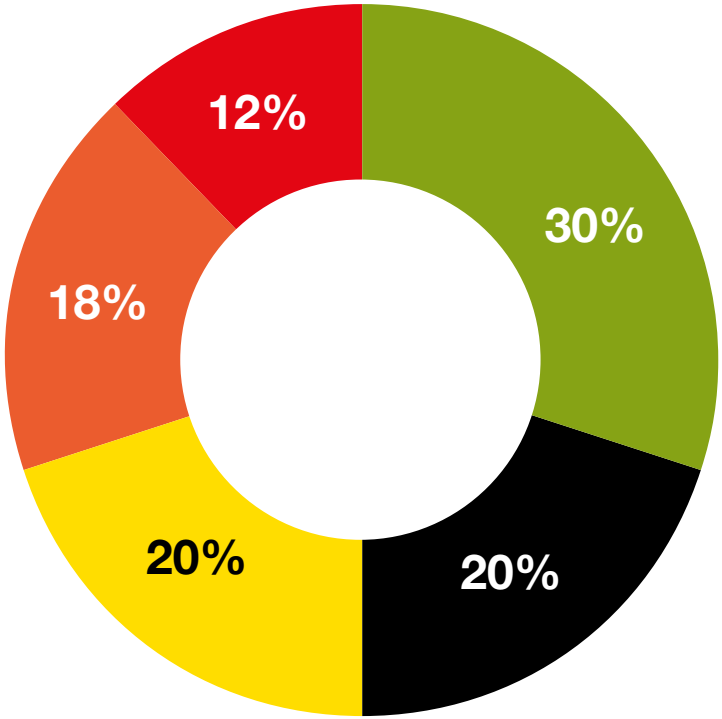
Executive summary

This DNOA report outlines the decisions made using the Common Evaluation Methodology (CEM) Cost Benefit Analysis (CBA) tool on when to defer conventional reinforcement using flexibility services. This analysis was carried out for constraints on the distribution network across NGED's four licence areas to ensure the optimal investment pathway is taken forward based on technical network data, load forecasts and financial inputs.

Below is a summary of the investment decisions reached across the four licence areas. 121 unique schemes were assessed; 42 in the East Midlands, 18 in the West Midlands, 19 in South Wales and 42 in the South West.

This DNOA assesses potential reinforcement schemes with a combined cost of over £398 million.

Total schemes assessed	121
Flexibility	36
Reinforce	24
Reinforce with flexibility	24
Signposting	22
Remove	15



Flexibility indicates a decision to procure flexibility or to maintain the flexibility contracts currently in place to defer reinforcements.

Reinforce indicates a decision to pursue traditional network reinforcement ahead of need without utilising flexibility.

Reinforce with flexibility is when reinforcement is set to begin immediately (or is already underway), but flexibility is required to deal with the constraint in the interim.

Signposting signals a decision to inform potential providers of future flexibility requirements whilst the need requirement is monitored.

Remove signals a decision to remove the scheme from consideration in future DNOAs. All schemes will be re-assessed in future DNOAs until there is no option value left to realise.

Executive summary

This report explains the methodology and data sources for the investment decisions on our network, including how the DNOA fits into the wider load related expenditure planning process. A summary of the investment decisions made is also provided below, with more in-depth information for individual schemes available on NGED's website and on the Connected Data Portal.

Reinforcement and flexibility both have important parts to play in the efficient and economic development of the distribution system. This DNOA has both forwards and backwards looking elements when considering flexibility. The flexibility start years are based on the first year of network requirements under each of the DFES scenarios.

Table 1 Summary of investment decisions for NGED-wide schemes

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Asset replacement	Various condition based issues on NGED assets across all four licence areas.	-	-	-	Reinforce
Fault level	Various fault level constraints on substations across NGED's four licence areas.	-	-	-	Reinforce
Physical restriction	Various physical restriction and switchgear extension reinforcement projects required.	-	-	-	Reinforce
Generation	Various generation driven constraints across NGED's four licence areas.	-	-	-	Reinforce
Protection	Various protection equipment reinforcement projects required.	-	-	-	Reinforce
Green recovery	Various reinforcement projects funded as part of the Green Recovery initiative.	-	-	-	Reinforce

Executive summary

Table 2 Summary of investment decisions in the East Midlands

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Ashby	The Gresley - Moira 33 kV circuits are close to their firm capacity.	2027+	2027	2025 - 2027+	Signposting
Hawton BSP	Hawton BSP is close to its firm capacity for an N-1 outage on one of its GTs.	2027+	2027+	2026 - 2027+	Signposting
Northampton East BSP	Northampton East BSP is close to its firm capacity for an N-1 outage on one of its GTs.	2027+	2027	2026 - 2027+	Signposting
Northampton West BSP	Northampton West BSP is close to its firm capacity for an N-1 outage on one of its GTs.	2027+	2027	2027+	Signposting
Moira	Moira 33/11 kV primary is close to its firm capacity for an N-1 outage on one of its transformers.	2027+	2027	2026 - 2027+	Signposting
Apollo - Tamworth	Apollo 33/11 kV primary has limited capacity for an N-1 fault outage.	2025	2023	2023	Flexibility
Chesterfield Main	The Chesterfield - Grassmoor 33 kV circuits have limited capacity for an N-1 circuit outage.	2026	2023	2023	Flexibility
Grassmoor	Grassmoor 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	-	2023	2023	Flexibility
Hinckley	Hinckley 132/11 kV primary is out of N-1 firm capacity due to a new connection.	2025	2023	2023	Flexibility
Union Street - Rugby	The 33/11 kV transformers at Union Street primary are close to their firm capacities for an N-1 fault.	2027+	2023	2023	Flexibility
Woodbeck	Capacity at Woodbeck primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Chesterfield GSP	N-2 SGT capacity at Chesterfield GSP.	2026	2023	2023	Flexibility
Loughborough	Constraint on the circuits from Ratcliffe GSP to the Loughborough tee during the transfer of Coalville and Hinckley 11 kV into Ratcliffe.	-	2023	2023	Flexibility

Executive summary

Table 2 Summary of investment decisions in the East Midlands

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Ilkeston	Ilkeston 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	-	2023	2023	Flexibility
Grendon - Corby 132 kV	132 kV circuits from Grendon to Corby constrained under N-2 conditions for both demand and generation.	2026	2023	2023	Flexibility
Toton	N-1 condition for the loss of a transformer at Toton primary.	-	2023	2023	Flexibility
Tuxford	N-1 condition for the loss of the transformer at Tuxford primary.	-	2023	2023	Flexibility
Staythorpe GSP	For an N-1 condition for the loss of an SGT the other SGT carries the full group demand.	-	2023	2023	Flexibility
Atherstone	N-1 condition for the loss of the transformer at Atherstone primary.	-	2023	2023	Flexibility
Sharnbrook	Capacity at Sharnbrook primary is limited by the 11 kV backfeeds.	2025	2023	2023	Reinforce with Flexibility
Clowne	Capacity at Clowne primary is limited by the 11 kV backfeeds.	2023	2023	2023	Reinforce with Flexibility
Coalville	FCO condition for a fault on one of the GTs at Coalville BSP could overload the remaining transformer.	2023	2023	2023	Reinforce with Flexibility
Lincoln - Anderson Lane	Demand on the Lincoln - Anderson Lane T1 circuit under FCO is over the rating of the circuit.	2023	2023	2023	Reinforce with Flexibility
Berkswell SGT	N-2 SGT capacity at Berkswell GSP.	2024	2023	2023	Reinforce with Flexibility
Mackworth	Voltage limiting firm capacity of Mackworth primary due to lack of automatic on-load tap changers.	2023	2023	2023	Reinforce with Flexibility

Executive summary

Table 2 Summary of investment decisions in the East Midlands

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Manton	Manton 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	2023	2023	2023	Reinforce with Flexibility
New Dove Valley	Additional load cannot be accommodated at Hatton primary.	2025	2023	2023	Reinforce with Flexibility
Winster	Winster BSP is close to its firm capacity, and the GTs are also in poor condition.	2024	-	-	Reinforce
South Holland - Long Sutton - Holbeach	Low voltage constraint on the 33 kV network around Holbeach and Long Sutton primaries.	2025	-	-	Reinforce
Willington - Derby South - Spondon	For various outage conditions the 132 kV circuits from Derby South BSP to Spondon BSP are constrained.	2026	-	-	Reinforce
Northampton group	The Northampton group (Northampton, Northampton East and Northampton West BSPs) is approaching class of supply E at which point more onerous N-2 restoration requirements under P2/7 will apply.	2028	-	-	Reinforce
Clipstone BSP	Complexity of 33 kV circuits fed from Clipstone BSP.	2025	-	-	Reinforce
Hockley Farm Road	Short section of 33 kV cable feeding Hockley Farm Road primary is constrained for an N-1 conditon.	2024	-	-	Reinforce
Staythorpe C	Two spans of 132 kV overhead line between Staythorpe C and tower AD1C are constrained.	2024	-	-	Reinforce
Wigston	Wigston BSP group demand is close to requiring N-2 restoration under P2/7.	-	-	-	Remove
Bradwell Abbey - Newport	Loss of the BA - NP/Hanslope Park circuit results in the Newport Pagnell demand and half the Fox Milne demand being supplied by the other 33 kV circuit.	-	-	-	Remove

Executive summary

Table 2 Summary of investment decisions in the East Midlands

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Milton Keynes East	Stony Stratford, Bletchley and Bradwell Abbey BSPs are near their firm capacities.	-	-	-	Remove
Alfreton	Meadow Lane 33/11 kV primary is limited by N-1 firm capacity.	-	-	-	Remove
Nailstone	The 33/11 kV transformers at Nailstone primary are close to their firm capacities for an N-1 fault.	-	-	-	Remove
Tamworth Main	The 33/11 kV transformers at Tamworth primary are close to their firm capacities for an N-1 fault.	-	-	-	Remove
Weedon	Capacity at Weedon primary is limited by the 11 kV backfeeds.	-	-	-	Remove
Hawton	Generation related constraint on the Hawton tee – Hawton 132 kV circuits.	-	-	-	Remove

Executive summary

Table 3 Summary of investment decisions in the West Midlands

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Eccleshall	Capacity at Eccleshall primary is limited by the 11 kV backfeeds.	2027+	2027+	2027+	Signposting
Forsbrook - Simplex	Outage on the higher rated of the two incoming circuits to Simplex primary.	2027+	2026	2024 - 2027	Signposting
Stockton	Capacity at Stockton primary is limited by the 11 kV backfeeds.	2027+	2027+	2027+	Signposting
Hill Chorlton	Capacity at Hill Chorlton primary is limited by the 11 kV backfeeds.	2027+	2026	2024 - 2026	Signposting
Cowhorn	Low voltage constraint at Cowhorn primary for an outage on one of the incoming 33 kV circuits.	2027+	2027	2024 - 2027+	Signposting
Knighton	Capacity at Knighton primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Shrewsbury GSP	Arranged outage of Shrewsbury SGT followed by a fault outage on a 132 kV circuit between Ironbridge and Ketley.	-	2023	2023	Flexibility
Hereford - Ledbury Ring	Voltage issue for an outage on one of the infeeds to the Hereford 66 kV ring.	2024	2023	2023	Reinforce with Flexibility
Brimscombe	Voltage issues for an outage on one of the Ryeford circuits and Dudbridge primary is also reaching its firm capacity.	2023	2023	2023	Reinforce with Flexibility
Feckenham South	Voltage issue for an outage on one of the circuits in the Feckenham South 66 kV network.	2023	2023	2023	Reinforce with Flexibility
Hereford BSP	Hereford BSP has limited capacity for an N-1 outage on one of its 132/66 kV transformers.	2023	2023	2023	Reinforce with Flexibility

Executive summary

Table 3 Summary of investment decisions in the West Midlands

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Barlaston/Meaford BSP	Both N-1 and N-2 constraints at Meaford BSP.	2025	-	-	Reinforce
Chipping Sodbury	Both N-1 and N-2 constraints at Chipping Sodbury BSP.	2027	-	-	Reinforce
Ironbridge - Star Aluminium	Voltage constraint seen for an outage on the direct Ironbridge – Star Aluminium 33 kV circuit.	2027	-	-	Reinforce
Shelton	Limited capacity on the Shrewsbury 33 kV meshed network.	2026	-	-	Reinforce
Bushbury	Forecast constraint at Bushbury 132/11 kV for the loss of one of the three transformers.	-	-	-	Remove
Madeley	Madeley 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	-	-	-	Remove
Smethwick	Forecast constraint at Smethwick 132/11 kV for the loss of one of the three transformers.	-	-	-	Remove

Executive summary

Table 4 Summary of investment decisions in South Wales

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Abergavenny - Crickhowell	Either of the 66 kV circuits from Abergavenny is close to becoming overloaded following an N-1 circuit outage.	2027+	2027	2027+	Signposting
Newport West	An N-1 condition for the loss of one of the GTs at Newport West BSP heavily loads the remaining GT.	2027+	2027+	2026 - 2027+	Signposting
Haverfordwest - Brawdy	An N-1 condition for an outage on the Haverfordwest to Fishguard 33 kV circuit heavily loads the Haverfordwest to Brawdy 33 kV circuit.	2027+	2027	2026 - 2027+	Signposting
Ashgrove	An N-1 condition for an outage on T1 at Ashgrove primary heavily loads T2 (which is lower rated).	2027+	2026	2025 - 2027+	Signposting
Cardiff North	An N-2 condition resulting in both GTs at Cardiff East BSP being out of service leaves the entire BSP's load supplied via the interconnecting 33 kV circuits to Cardiff North BSP.	2027+	2026	2025 - 2027+	Signposting
Llandrindod - Rhayader	Voltage issue for a fault on the 66 kV circuits from Builth Wells.	-	2023	2023	Flexibility
Aberaeron	Capacity at Aberaeron primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Ravenhill	An N-1 condition for an outage on T1 at Ravenhill primary heavily loads T2 (which is lower rated).	-	2023	2023	Flexibility
Milford Haven BSP	An N-2 condition on the Pembroke-Waterston-Milford Haven and the Pembroke-Golden Gill-Milford Haven 132 kV circuits heavily loads the remaining Pembroke-Golden Hill-Milford Haven circuit.	-	2023	2023	Flexibility
Llanfyrnach	Capacity at Llanfyrnach primary is limited by the 11 kV backfeeds.	2026	2023	2023	Reinforce with Flexibility
Trevaughan	Additional load cannot be accommodated at Trevaughan primary.	2023	2023	2023	Reinforce with Flexibility

Executive summary

Table 4 Summary of investment decisions in South Wales

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
East Aberthaw	Limited N-2 restoration capacity for the loss of both GTs at Brynhill BSP.	2023	2023	2023	Reinforce with Flexibility
Mountain Ash	Mountain Ash GT2 projected to become overloaded for a split which is carried out for an outage on an SGT at Upper Boat GSP.	2023	2023	2023	Reinforce with Flexibility
Pembroke	Pembroke South - Broadfield 33 kV circuit and connected primary substation drop below the statutory voltage limit for the N-1 of the Golden Hill - St Florence 33 kV circuit.	2024	-	-	Reinforce
Abergavenny BSP	Abergavenny and Panteg BSPs are run in parallel feeding a 66 kV section of network. The loss of the higher rated GT at Abergavenny leaves the demand on the two remaining GTs. The condition of Abergavenny GT1 is also poor.	2025	-	-	Reinforce
Rhos BSP	An N-2 condition losing both GTs at Carmarthen BSP overloads the GT at Rhos BSP.	2024	-	-	Reinforce
Sully Tee	N-1 constraint on the section of 132 kV circuit from Aberthaw GSP to the tee to Sully BSP.	2024	-	-	Reinforce
Pantyffynnon	An N-1 condition for the loss of one of the 33 kV circuits to Pantyffynnon primary heavily loads the remaining circuit.	2024	-	-	Reinforce
Rhos - Newcastle Emlyn	An N-1 condition for the loss of one of the 33 kV circuits to Newcastle Emlyn primary heavily loads the remaining circuit.	2024	-	-	Reinforce

Executive summary

Table 5 Summary of investment decisions in the South West

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Yeovil - Coker Tee	An N-1 outage on the 33 kV circuit from Yeovil BSP to Montacute primary leaves Coker, East Chinnock, Martock T1 and Montacute primaries fed via a single 33 kV circuit.	2027+	2027+	2027+	Signposting
Barnstaple - South Molton	An N-1 outage on one of the 33 kV circuits feeding Heddon Cross, Aaronsons and South Molton primaries leaves the full demand on the remaining circuit.	2027+	2027+	2026 - 2027+	Signposting
Bridgwater - Bath Road	An N-1 outage on one of the 33 kV circuits from Bridgwater BSP to Bath Road primary leaves the full demand on the remaining circuit.	2027+	2027+	2025 - 2027+	Signposting
Honiton Heathfield and Offwell Ring	An N-1 condition for the loss of one of the 33/11 kV circuits towards Offwell and Honiton primaries.	2027+	2027+	2027+	Signposting
Blagdon	Under intact running the peak load at Blagdon primary is near to the rating of its transformer.	2027+	2027+	2027+	Signposting
Hayle BSP	Hayle BSP is close to its firm capacity for an N-1 outage on one of its GTs.	2027+	2027	2027+	Signposting
St Mawgan	Capacity at St Mawgan primary is limited by the 11 kV backfeeds.	2027+	2027	2027+	Signposting
Plymouth/South Hams	Multiple complex 132 kV network constraints.	2027+	2023	2023	Flexibility
Weston Super Mare	Weston BSP has limited capacity for an N-1 outage on one of its 132/33 kV transformers.	-	2023	2023	Flexibility
Witheridge	Capacity at Witheridge primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
East Yelland	East Yelland BSP has limited capacity for an N-1 outage on one of its 132/33 kV transformers.	-	2023	2023	Flexibility

Executive summary

Table 5 Summary of investment decisions in the South West

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Hemyock	Capacity at Hemyock primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Mullion	Capacity at Mullion primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Stokenham	Capacity at Stokenham primary is limited by the 11 kV backfeeds.	2027+	2023	2023	Flexibility
Laneast	Capacity at Laneast primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Countess Wear	Capacity at Countess Wear primary is limited by the 11 kV backfeeds.	2027+	2023	2023	Flexibility
Probus	Capacity at Probus primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Morwenstow	Capacity at Morwenstow primary is limited by the 11 kV backfeeds.	-	2023	2023	Flexibility
Chewton Mendip	Capacity at Chewton Mendip primary is limited by the 11 kV backfeeds and the transformer rating.	2027+	2023	2023	Flexibility
Filton Airport and Cribbs Causeway Ring	An N-1 condition for the loss of one of the 33/11 kV circuits towards Cribbs Causeway primary and Filton Airport (a future primary).	-	2023	2023	Flexibility
Newton Abbot - Newton Abbot Main	An N-1 condition for the loss of one of the 33/11 kV transformers/circuits at Newton Abbot Main primary would overload the remaining transformers/circuits at peak loading.	-	2023	2023	Flexibility
Camborne Treswithian	Under intact running the peak load at Camborne Treswithian primary is near to the rating of its transformer.	-	2023	2023	Flexibility

Executive summary

Table 5 Summary of investment decisions in the South West

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Feeder Road BSP	Feeder Road BSP has limited capacity for an N-2 outage on two of its four GTs.	-	2023	2023	Flexibility
Plympton BSP	Plympton BSP has limited capacity for an N-1 outage on one of its GTs.	2024	2023	2023	Reinforce with Flexibility
Tiverton	Tiverton BSP has limited capacity for an N-1 outage on one of its 132/33 kV transformers.	2024	2023	2023	Reinforce with Flexibility
Hayle - Camborne	The outage of the Rame-Hayle 132 kV circuit overloads the 132 kV circuit between Indian Queens-Fraddon-Camborne.	2026	2023	2023	Reinforce with Flexibility
Exeter City	Exeter City BSP has limited capacity for an N-1 outage on one of its 132/33 kV transformers.	2024	2023	2023	Reinforce with Flexibility
Isles of Scilly	For an outage on the 33 kV submarine cable to the Isles of Scilly the demand is met by the back-up power station.	2025	2023	2023	Reinforce with Flexibility
Moretonhampstead	Capacity at Moretonhampstead primary is limited by the 11 kV backfeeds.	2023	2023	2023	Reinforce with Flexibility
Truro - Truro Treyew	Truro-Truro Treyew Road 4L5 33 kV circuit becomes overloaded for the loss of the Truro 1L5 and 3L5 circuits.	2023	2023	2023	Reinforce with Flexibility
Gunnislake	Gunnislake 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	2024	2023	2023	Reinforce with Flexibility
Portishead BSP	Issues with parallel operation of Sandford and Seabank.	2024	-	-	Reinforce
Woodcote - Chard	An N-1 condition for the loss of one of the 33 kV circuits to Chard primary heavily loads the remaining circuit.	2025	-	-	Reinforce

Executive summary

Table 5 Summary of investment decisions in the South West

Scheme	Constraint	Proposed scheme closure	Best View Flexibility Start Year	DFES Scenarios Flexibility Start Year	DNOA Decision
Lapford and Tinkers Cross	Low volts at Lapford and Tinkers Cross primaries for an N-1 condition.	2025	-	-	Reinforce
Fraddon - Newquay Trevamper	An N-1 condition for the loss of one of the 33 kV circuits to Newquay Trevamper primary heavily loads the remaining circuit. There is also a voltage constraint seen.	2024	-	-	Reinforce
Tiverton - Dunkeswell	An N-1 condition for the loss of one of the 33 kV circuits to Dunkeswell primary heavily loads the remaining circuit.	2025	-	-	Reinforce
Newton Abbot - Chudleigh	For an outage on the circuit to Chudleigh Knighton primary T2 the circuit to T1 overloads.	2024	-	-	Reinforce
Bristol Airport	Busbar faults at Churchill BSP can lead to either overloads or leaving Bristol Airport at single circuit risk.	2024	-	-	Reinforce
Western Approach	Western Approach 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	-	-	-	Remove
Bridgwater/Street	N-2 requirement for the Bridgwater/Street group.	-	-	-	Remove
Taunton GSP	Constraint was for N-2 restoration for the loss of any of the SGTs at Taunton GSP or Bridgwater GSP.	-	-	-	Remove
Roundswell	Roundswell 33/11 kV primary has limited capacity for an N-1 outage on one of the transformers.	-	-	-	Remove

Document overview

The strategic network planning process

NGED produces a number of publications on the future of electricity across the Midlands, South West and South Wales. The Distribution Future Energy Scenarios (DFES) provides data on the predicted growth in demand and generation across the four licence areas on an annual basis.

Forecasting

The Distribution Future Energy Scenarios (DFES) identify how customers will use out network in future.

Network Impact Assessment

The Network Development Plan (NDP) uses forecasts to analyse and identify future network constraints.

Optioneering

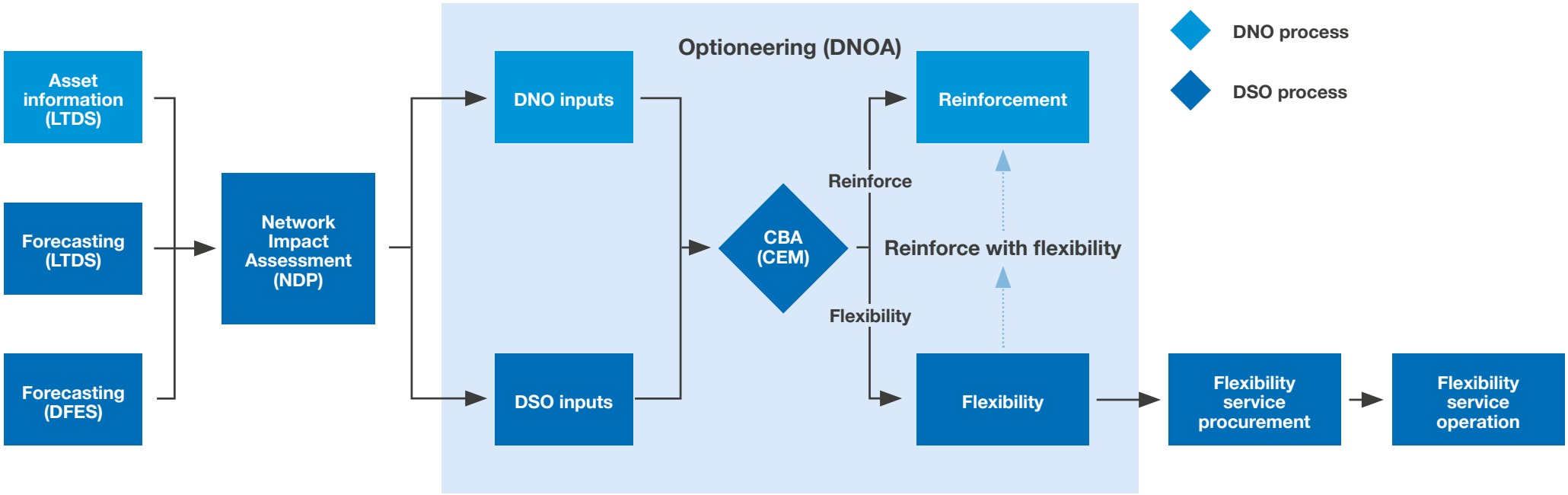
The Distribution Network Options Assessment (DNOA) outlines how we plan to invest in our network to solve constraints.

This scenario growth data facilitates the identification of areas on the network where constraints are expected through network impact assessment. This is carried out as part of NGED's Network Development Plan (NDP) published every two years, and as part of routine studies of the distribution network conducted by engineers.

Conventional reinforcement solutions are then developed, taking into consideration NGED's network asset data and the load forecasts from the DFES process to ensure the solution is enduring, efficient and strategic. These conventional reinforcement solutions are then assessed against the use of flexibility as part of the DNOA process.

The strategic network planning process

NGED's overall DNOA process from forecasting through to procurement is shown in the figure below. This process is carried out every six months to look forward and identify which constraints should have services procured to help mitigate them, as well as looking backwards to ensure they continue to provide value.

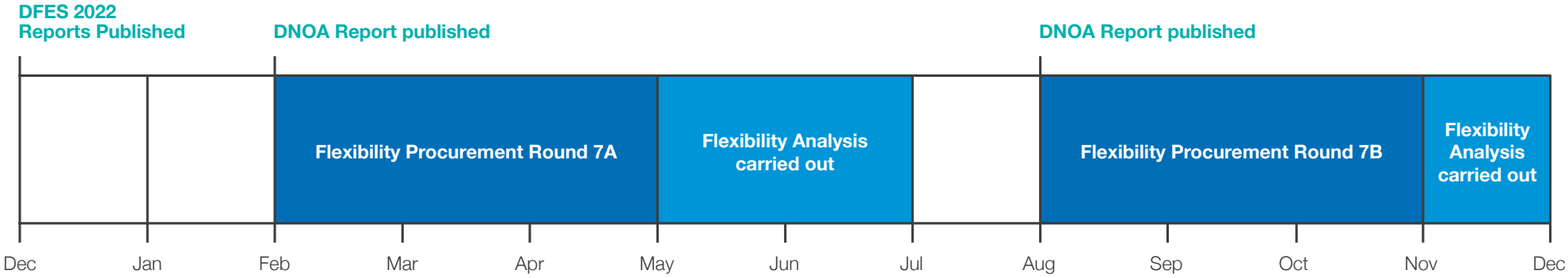


DNOA process timeline

The DNOA outcomes are published twice a year in February and August. This is based on the latest DFES data published each year, with existing schemes being reassessed periodically to ensure the investment pathway remains optimal. Any new constraints identified on the network are also assessed in the DNOA process.

After each procurement cycle NGED checks that sufficient flexibility is available to manage each constraint. This will determine whether procurement will be needed in the next cycle (or if reinforcement should be triggered due to insufficient flexibility availability).

The DNOA process repeats every six months. The processes and reports carried out as part of the strategic network planning process are shown in the timeline below, from forecasting through to the publication of DNOA reports.



DFES overview

Using local planning data, demand pipeline data and local engagement, a range of credible future scenarios are created that predict growth across NGED's four licence areas up to 2050, down to the Electricity Supply Area (ESA) level.

For this DNOA the data used has been taken from the DFES for all four licence areas. The four base DFES scenarios are Consumer Transformation, Leading the Way, Steady Progression and System Transformation.

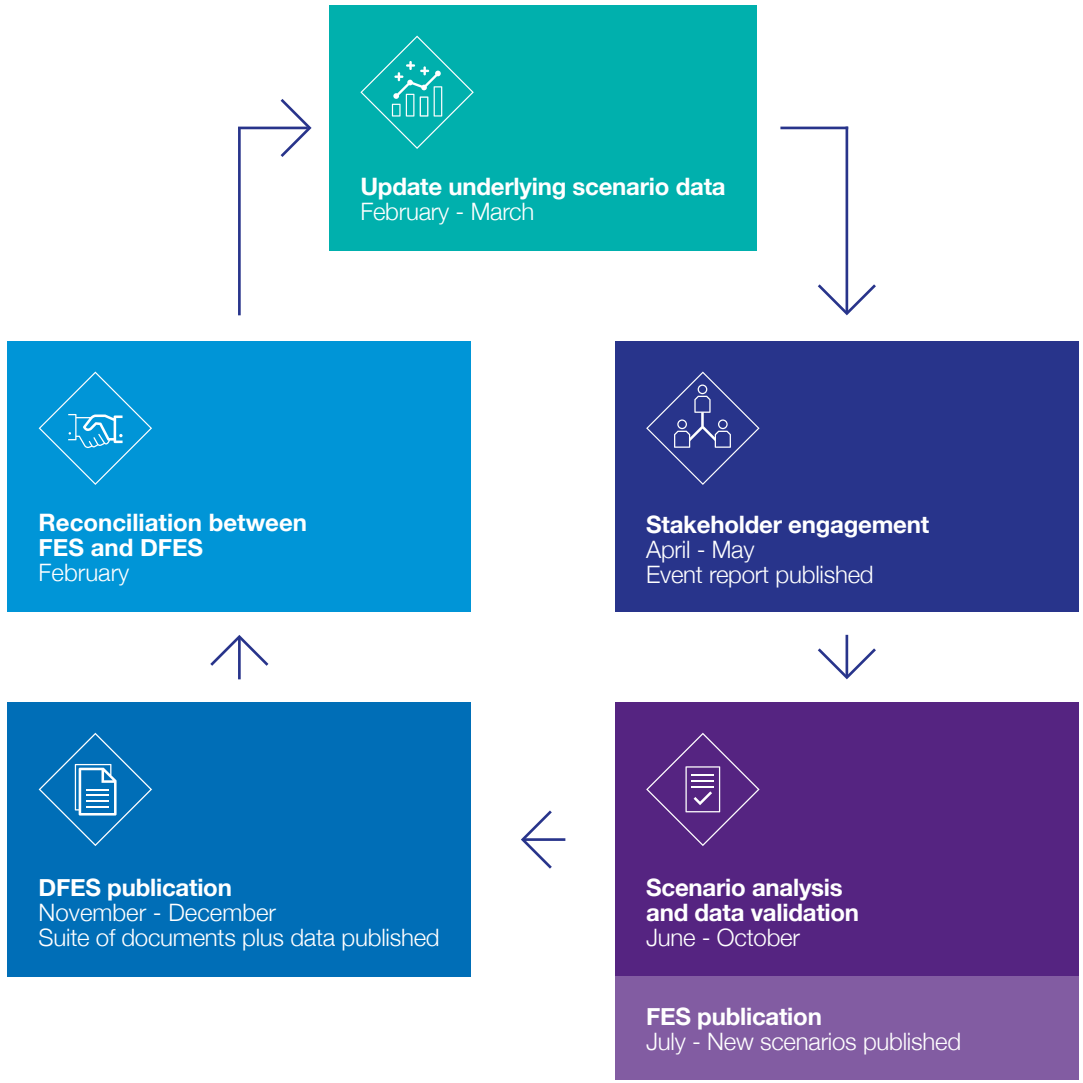
These four base scenarios encompass divergent levels of societal change and speeds of decarbonisation. The forecasting methodology used here is aligned with National Grid ESO's Future Energy Scenarios (FES) and the projections made by other Distribution Network Operators (DNOs).

The DFES report is published once a year, with the scenarios changing to reflect the direction the energy landscape has taken, any legislative changes that have been revealed and expected customer behaviour driving increased growth rates.

Stakeholder engagement is held to get input on the approach and scenarios considered. Finally, the FES and DFES are reconciled to ensure a consistent picture. These steps form a feedback loop that acts as an annual process to continually improve upon the DFES as shown on the right.

A more comprehensive description of the DFES process can be found on the DFES page on the NGED website:

nationalgrid.co.uk/distribution-future-energy-scenarios-regional-information



Defining a Best View

By amalgamating the four base scenarios, a fifth scenario is created which represents NGED's expectation of the most likely future growth, called Best View, which is used to inform investment decisions.

To derive the Best View, NGED uses an iterative process. DFES data and previous Best View data is used to support stakeholder and Local Area engagement, which then allows the quality of Local Area Energy Plans to be assessed using criteria derived from Ofgem guidance to gauge their ambition, engagement and deliverability.

The assessment is carried out by NGED's senior regional managers, scoring against the criteria matrix and a Local Area specific DFES scenario is selected.

The DFES scenario is chosen by closely comparing the ambition of the planned volumes across all technology types within the area, and then further ranked on how close this ambition is likely to be to the needs of stakeholders (engagement completed), how accurate the modelling is and the capability of the area to deliver.

A single DFES scenario is currently chosen to approximately represent all technologies, but there is scope in the future for differentiation between expected uptakes of technologies to also be simultaneously assessed. This process enables the scenario volumes to be summated up to a licence area level, checked against NGED strategic views of development and a new Best View can then be delivered.

Before the Best View is finalised, the licence area totals are checked against national ambition to ensure NGED targets are aligned to deliver government policy. Scenario boundaries across the rankings may be moved to more closely align, assuming incentives and policy is directed at achieving national net zero ambitions. Each primary substation also receives a disaggregation of this "Best View" which is used to inform the growth rates required for planning investment across the network.

Constraint identification

The load forecasts created as part of the DFES process are used to carry out network studies in order to identify any current or future constraints on the distribution network across NGED's four licence areas.

Comprehensive electrical analysis is carried out using load flow studies for each possible outage combination. This analysis is carried out for each of the five DFES scenarios for half-hours of peak loading across a number of seasons for both the existing and future network.

This process identifies where intervention is required to maintain compliance with NGED's obligations and keep the network safely operating within its technical limits.

The primary activity for the network impact assessment is the Network Development Plan (NDP), part of Electricity Distribution Licence SLC 25B. This outlines where DNOs expect to develop networks in a 0-10 year window.

More information on NGED's constraint identification process and the custom developed analysis tools used can be found in the latest NDP which can be accessed from the link below:

nationalgrid.co.uk/network-strategy/network-development-plan

Whilst the Network Development Plan process identifies the constraints that may occur, additional constraints can also be identified as a result of large new connection applications, which may not be captured in the current DFES projections.

These are also assessed periodically as part of the DNOA process.

Flexibility analysis

Once a constraint has been identified (either through the NDP process or during a routine study of an area of the distribution network carried out by one of NGED's engineers) options for managing the constraint are then assessed.

Various traditional reinforcement options are evaluated to find the most cost effective solution. This may not be the cheapest option, as the solution will need to be enduring and strategic (often multiple constraints can be alleviated using a single intervention). The cost for the optimal reinforcement scheme is then taken forward to the CBA.

In accordance with NGED's 'flexibility first' commitment in the RIIO-ED2 Business Plan all load related expenditure is assessed against flexibility. The first step in this process involves identifying constraints which are unsuitable for mitigation using flexibility (such as fault-level constraints). All load related constraints where deferral of expenditure using flexibility is deemed possible are then taken forward to the next stage of flexibility analysis.

In order to carry out a CBA on the use of flexibility against conventional reinforcement, the volume of flexibility required to manage the constraint each year needs to be calculated. This is done using NGED's custom built Flexibility Analysis Tool.

This tool takes a load profile recorded from the network over multiple years and plots it against the network capacity for each season. The network capacity is usually the thermal ratings for each season of the limiting asset under the most onerous outage condition, but for more complex constraints load flow analysis is required to understand how load may be split between multiple assets/sites.

The tool takes load growth coefficients from the DFES process to assess when and by how much the loading on the network is expected to exceed the capability of the assets over the next five years for each scenario.

This is then used by the tool to calculate the volumes of flexibility required to manage the constraint each year and scenario (including any over-procurement deemed necessary to mitigate the risk of the network's needs not being met).

These volumes for each flexibility scheme are then taken forward into the CBA.

Common Evaluation Methodology

To improve transparency in how DNOs reach decisions regarding flexibility procurement and the potential to delay conventional reinforcement, a Common Evaluation Methodology (CEM) CBA tool was created by Baringa Partners. This tool is used to assess the net benefit of flexibility against a baseline of conventional reinforcement for each of the four base scenarios plus Best View over a number of years.

The economic analysis is based on the Time Value of Money whereby delaying reinforcement costs creates a significant economic benefit. For existing flexibility zones, if this benefit is greater than the cost of flexibility required during the deferral period, then flexibility procurement is deemed the optimal solution and could create savings that can be passed on to customers and stakeholders.

The amount of flexibility availability and utilisation projected to be required to manage a given constraint is taken from NGED's Flexibility Analysis Tool and input into the CEM CBA tool.

The cost of flexibility availability and utilisation is then used to calculate the total cost of the flexibility required each year and scenario. The costs associated with the optimal reinforcement solution identified by NGED are fed into the CEM CBA tool to provide a baseline against which flexibility is assessed.

The CEM CBA tool is then used to calculate the ceiling price for flexibility (i.e. the break-even point at which the cost of flexibility is equal to the economic benefit of deferring reinforcement) for each year and DFES scenario.

These ceiling prices are then used to inform the MWh prices for areas where we are procuring additional flexibility. The ratio between the availability and utilisation costs per MWh is set to ensure it remains consistent for each product, without affecting the overall value of flexibility calculated by the CEM CBA tool.

Additional functionality within the tool also allows for consideration of losses and other carbon and societal impacts. This functionality will be utilised further in future DNOA tranches. By cultivating greater transparency in the decision making process and providing robust justifications for the investments made on the network, customers can be assured that their money is being utilised effectively.

Current and future ceiling prices published in the DNOA will help flexibility service providers understand the opportunities available in each area, and inform their investment in flexibility accordingly. This will help encourage a more competitive market for flexibility to develop, resulting in further savings for customers.

More information regarding the CEM CBA tool can be found on the Energy Networks Association's website:

energynetworks.org/industry-hub/resource-library/

Reinforcement options

Reinforcement schemes aimed to alleviate constraints on the network can involve replacing a number of different assets, or installing new assets. Most conventional reinforcement will involve some combination of the four options below.

Build new circuits

Upgrade existing circuits

Build a new substation

Upgrade existing substation

Circuit installations and upgrades can involve replacing or installing overhead line conductors and/or underground cables for 11 kV, 33 kV, 66 kV or 132 kV circuits.

Substations considered for reinforcement include primary substations, Bulk Supply Points (BSP) and Grid Supply Points (GSP).

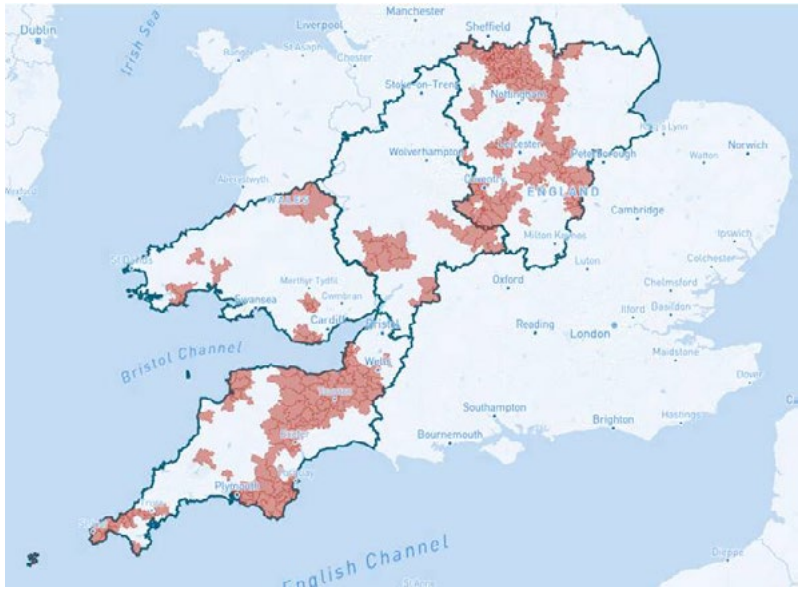
Other options for managing constraints include System Voltage Optimisation (SVO), STATCOMs for reactive power management and other innovative solutions.

In areas where multiple complex constraints are affecting a number of customers over a long period of time, Active Network Management (ANM) can also be implemented.

Flexibility services

NGED has always used the flexibility inherent in the distribution network to provide economic and secure supply ahead of undertaking conventional reinforcement. For the past few years this has also included market-provided flexibility.

This flexibility is sought following a six monthly procurement cycle in areas triggering load related reinforcement. These areas are known as Constraint Management Zones (CMZs), the figure below shows these areas as of January 2023. To give providers and operators of flexibility services advanced notification of future needs, signposting information is provided for a five year window for each area on the network with forecasted constraints.



More information on our use of flexibility and any future developments can be found in our Distribution Flexibility Services Procurement Statement:

nationalgrid.co.uk/distribution-flexibility-services-reporting

The three main flexibility products offered to providers are standardised across the industry:

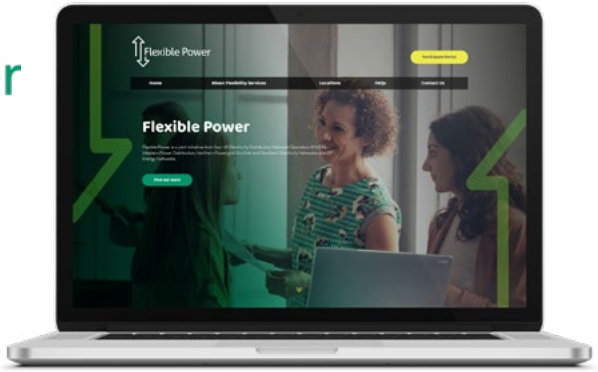
Secure
Used to manage peak demand loading on the network to pre-emptively reduce network loading.

Dynamic
Developed to support the network in the event of specific outage conditions, namely maintenance work.

Restore
Supports power restoration following rare fault conditions.

Flexible Power

The customer-facing brand for flexibility services established by WPD in 2017 is known as Flexible Power. The Flexible Power website allows businesses to confirm their eligibility for flexibility products and to begin the procurement process.



This process involves registering to be added to NGED's dynamic purchasing system, responding to a tender, setting up the API comms link required to receive stop/start signals, using the participant portal to declare asset availability and then receiving payments for utilised availability on a monthly basis.

Find out more at: **flexiblepower.co.uk**

Interpretation of DNOA outcomes

The ceiling prices for each scheme across NGED's four licence areas are given in the scheme pages on the DNOA page on NGED's website, along with information on the proposed reinforcement schemes. These ceiling prices are given for every scenario and every year up to 2027. Other information pertaining to each zone is also given on these scheme pages. This section outlines how this information should be interpreted.

The decision tree to the right demonstrates the different choices our analysis can lead to. Firstly, the schemes that do not require any intervention are removed from future DNOAs (usually because reinforcement works have been completed).

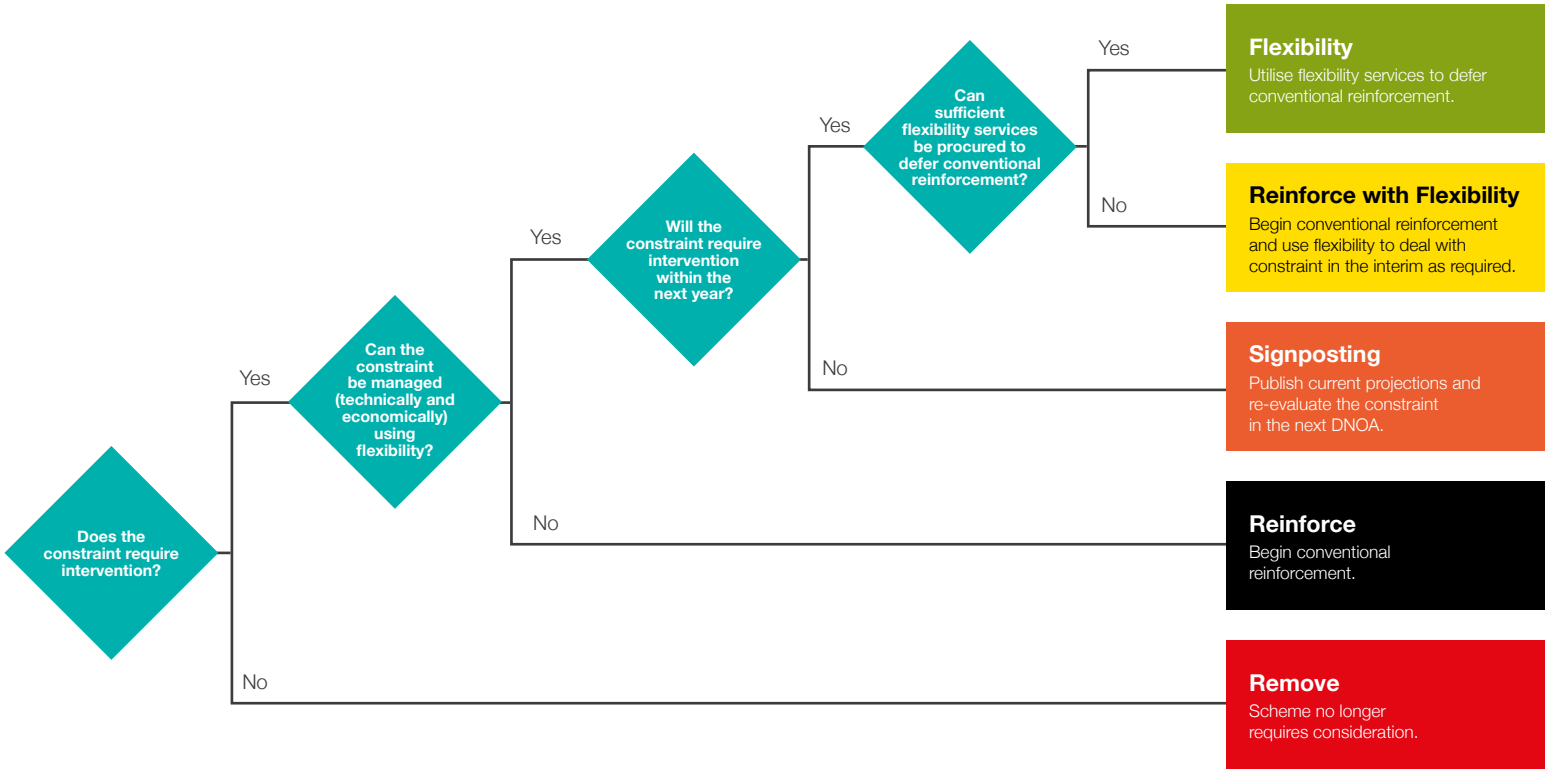
Among the schemes which do require intervention, if the constraint cannot be managed using flexibility then reinforcement is pursued.

If the constraint can be managed using flexibility but no intervention is required within the next year signposting is published.

The schemes which require flexibility services within the next year undergo CBA in order to calculate the ceiling prices for availability and utilisation of flexibility.

If sufficient flexibility cannot be procured to defer conventional reinforcement, reinforcement works will begin in order to be completed before the network need arises.

Flexibility may be used in the interim as required to manage the constraint and provide additional network security before the reinforcement is completed.



Interpretation of DNOA outcomes

Scheme description

For each scheme presented in this DNOA the description will outline the constraint on the network that is being addressed, along with an overview of the proposed or ongoing reinforcement works to deal with said constraint.

For reinforcement schemes that are currently underway, the expected completion data will be given.

For reinforcement works that have not begun yet, the time it would take to complete said works is given in the EPRC.

EPRC: Earliest Possible Reinforcement Completion

This date shows when conventional reinforcement could be completed by if it were to begin immediately. For projects that have already begun, the expected end date is given. There may be some instances where the EPRC can change due to equipment lead times and consenting timescales. As a result, some mobilisation design work may need to be undertaken prior to the scheme being triggered for reinforcement.

If reinforce or reinforce with flexibility are chosen, this will reflect when the reinforcement will be completed in reality. If flexibility or signposting are chosen this date will not reflect the actual reinforcement completion timeline, as deferral will be taking place.

Scenario Key:

BV: Best View

CT: Consumer Transformation

LTW: Leading the Way

ST: System Transformation

SP: Steady Progression

Ceiling price

For each scenario the ceiling prices for flexibility are given. The ceiling price per MWh will usually drop year-on-year as the benefit of deferral remains constant but the volumes of flexibility required increases. Reinforcement will be deferred until sufficient flexibility is no longer available to manage the constraint.

Estimated flex utilisation required per year table

The estimated flex utilisation required per year for every scenario is given for each scheme in MWh.

This should give an idea of the expected annual flexibility energy requirements across the optimal flexibility duration for each scenario. For more detailed data on this, a link to the Flexible Power website page for each scheme is provided.

Constraint management timeline

The constraint management timeline shows what decision has been made for each scheme in each procurement cycle from when the scheme was created up to the upcoming procurement cycle.

Justification for decision

For each scheme the reasoning behind the DNOA decision is explained. For schemes where flexibility is an option the decision to defer will be driven by sufficient flexibility being procured to manage the constraint.

For reinforce schemes, the reason why flexibility is not viable will be given. Likewise, for remove schemes, the reason why the constraint no longer needs intervention will be provided (e.g. reinforcement works have been completed).

Other information

Also provided is the season (or seasons) the constraint being addressed is expected to arise (and therefore the season in which flexibility services are required) and the flexibility product expected to be utilised (secure or dynamic).

For signposting schemes the flexibility product may change closer to procurement to ensure the network's requirements are met. Alongside the secure and dynamic products, the restore product will also be used.

Future developments

Secondary flexibility

At present NGED only utilises flexibility procurement to manage constraints on the primary and sub-transmission networks with our existing products. Moving into the RIIO-ED2 price control period and beyond we also plan to deploy significant flexibility on the secondary network.

These low voltage flexibility schemes will be utilised to defer conventional reinforcement on the secondary network, including upgrading and installing pole mounted and ground mounted distribution transformers.

Our approach to determining the ceiling prices for secondary flexibility zones will (similarly to existing products used on higher voltage networks) be based on the volumes of flexibility required to manage the constraint and the unit costs associated with the optimal conventional reinforcement solution.

By expanding our opportunities for engaging in flexibility markets to the secondary network the number of customers able to participate and benefit will rise significantly. This will help further incentivise the uptake of LCTs and other green technologies as we push towards net zero.

Ceiling prices

Moving forward into future iterations of the DNOA we will continue to refine our approach to calculating and using ceiling prices. This will include periodically reassessing the minimum and maximum ceiling prices used, in order to meet the needs of the evolving flexibility markets. We will also work alongside other DNOs as part of the ENA's WS1A group to develop the CEM CBA tool to ensure its functionality regarding the calculation of ceiling prices is fit for purpose.

Expanding opportunities

To ensure the maximum value possible is achieved for the network from flexibility markets, we will work to improve our internal processes for calculating flexibility requirements.

This will allow us to use flexibility to manage more complex constraints, including voltage issues and generation driven constraints. This will further expand opportunities for a range of potential flexibility service providers.

Stakeholder engagement

We want to hear your views on the DNOA process and our report format as feedback from stakeholders will be valuable in shaping future publications.

In order to do this we aim to collect feedback after every publication and use this to improve the DNOA process and ensure the data we publish is relevant and valuable. A number of questions on the DNOA process can be found on NGED's website:

nationalgrid.co.uk/network-strategy/distribution-future-energy-scenarios/distribution-network-options-assessment

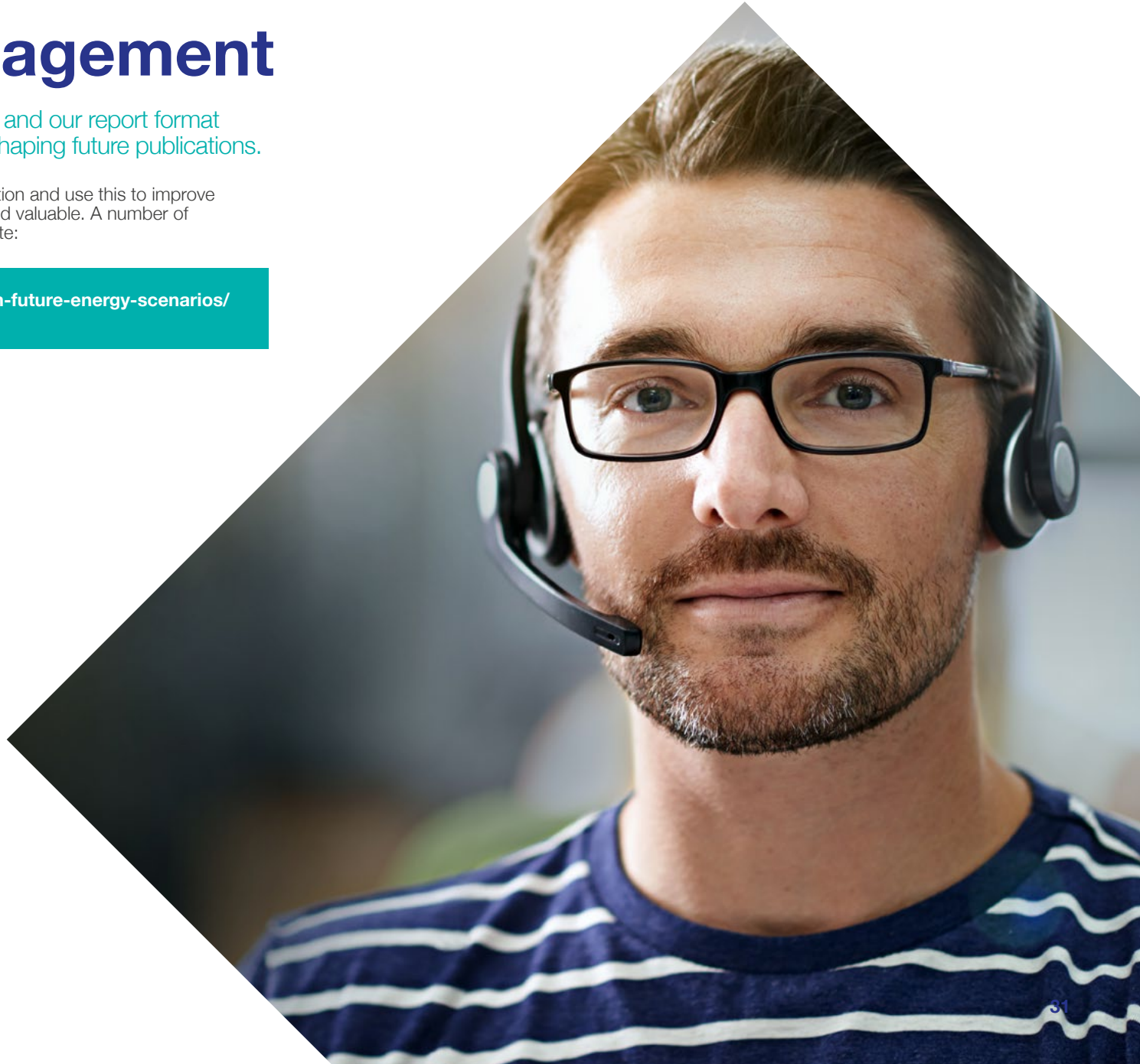
We are keen to get your feedback

It is important that we get a broad range of stakeholders' opinions and we are keen to get your feedback.

Responses should be returned to:

Forecasting and Capacity Team
National Grid Electricity Distribution
Feeder Road
Bristol
BS2 0TB

Or emailed to:
nged.networkstrategy@nationalgrid.co.uk



National Grid Electricity Distribution plc.
Avonbank
Feeder Road
Bristol
BS2 0TB

nationalgrid.co.uk

February 2023. BLU27136/JA