NORTHERN POWERGRID

Environment Report

2021–22

We distribute power to 3.9 million homes and businesses through our network of more than 63,000 substations and over 96,000km of overhead lines and underground cables, spanning almost 25,000 square km.

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1. Introduction

Our strong environmental performance and our investment in innovation continues to demonstrate our commitment to our region and customers.

1.1 Executive summary

The past year has seen us complete our extensive consultation with stakeholders on the targets we should be setting for the next price control period (RIIO-ED2) to make sure we are an enabler of net zero targets across our region and that we deliver the outcomes our customers want to see across 12 key performance areas, including our own environmental performance, climate resilience, and innovation, among others. The proposals we developed in response to this feedback were included in our final ED2 Business Plan published in December 2021[1].

This year we have been committed to making a difference in our region through our environmental initiatives. 2021–22 was another solid year, all of our ED1 business plan commitments remain on track and in most cases, ahead of schedule. We have set stretch targets for business carbon footprint (BCF), SF6 losses, oil loss, cable replacement and under-grounding cables in Areas of Outstanding Natural Beauty (AONB).

While the relaxation of COVID-19 restrictions has increased business travel, we have embedded the enduring benefits of hybrid working with 40% lower emissions than 2019–20. We expect 2022-23 to out-turn marginally higher at an overall level.

Our 2021-22 performance of 101kg lost was ahead of the 112kg target we set in our ED1 business plan, however, was a step back on prior year performance. This was due to three units of switchgear that were leaking.To mitigate further losses we have brought forward the replacement of these units.

Our business plan envisaged £52m of additional smart grid reinforcement would be required on the network. To date we have invested a total of £25.3m – the forecast levels of investment have not yet been required as we have seen a lower uptake in low carbon technologies (LCTs). We are however continuing to get our network ready for future rapid uptake. We' are in the process of replacing looped-service cables (the cable used when two properties share a single electricity supply) to enable the installation of LCTs such as heat pumps and EV chargers. In the period to date, we have replaced over 16,000 of these at a cost of over £13m. We are also freeing up capacity on our network through voltage reduction at our major substations. This has released 4.4GW of capacity in the ED1 period to date.

We are also progressing well with the £53m Green Investment programme that we agreed with our regulator in 2021 that will help accelerate progress to Net Zero and provide vital regional economic stimulus.

Enabling the transition to meet the net zero emissions' target for our region is a major part of our focus. Innovation underpins the development of services for our customers and our support for the wider energy system transition to low carbon economy. We spent £1.7m across 25 dedicated innovation projects (37% of our Network Innovation Allowance); lower than in recent years. The benefits to customers of innovation however rose notably. In the ED1 period to date, our innovative solutions have now delivered benefits to customers in excess of £47m.

Our draft ED2 business plan was published in July 2021, including our DSO strategy, and was then updated in our final plan in December 2021. This set out a detailed set of initiatives to deliver DSO functions in 2023-28 and meet Ofgem's baseline expectations. It was extensively stakeholder tested.

Key facts

Environment and innovation in 2021–22

55MW
of renewable generation connected in 2021–22

44%
reduction of our carbon emissions compared to our ED1 baseline

£1.7m
invested in 09 innovation projects in 2021–22

88.9km
Total length of overhead lines removed from National Parks and Areas of Outstanding Natural Beauty

[1] Available from: https://ed2plan.northernpowergrid.com/sites/default/filesdocument-library/NPg_Our_business_plan_for_2023_28.pdf

1.2 Our business

We are Northern Powergrid. We are responsible for the network that takes electricity from power stations and smaller generators to 3.9 million homes and businesses across the North East, Yorkshire and northern Lincolnshire. We are here 24 hours a day, seven days a week, 365 days a year to make sure that the electricity you need gets to you safely, whenever and wherever you need it.

If, for any reason, your power gets interrupted, it will be us who come to fix it and we will respond night or day.

We have c.2,450 employees responsible for more than 63,000 substations and over 96,000km of overhead power lines and underground cables, spanning c.25,000 square km.

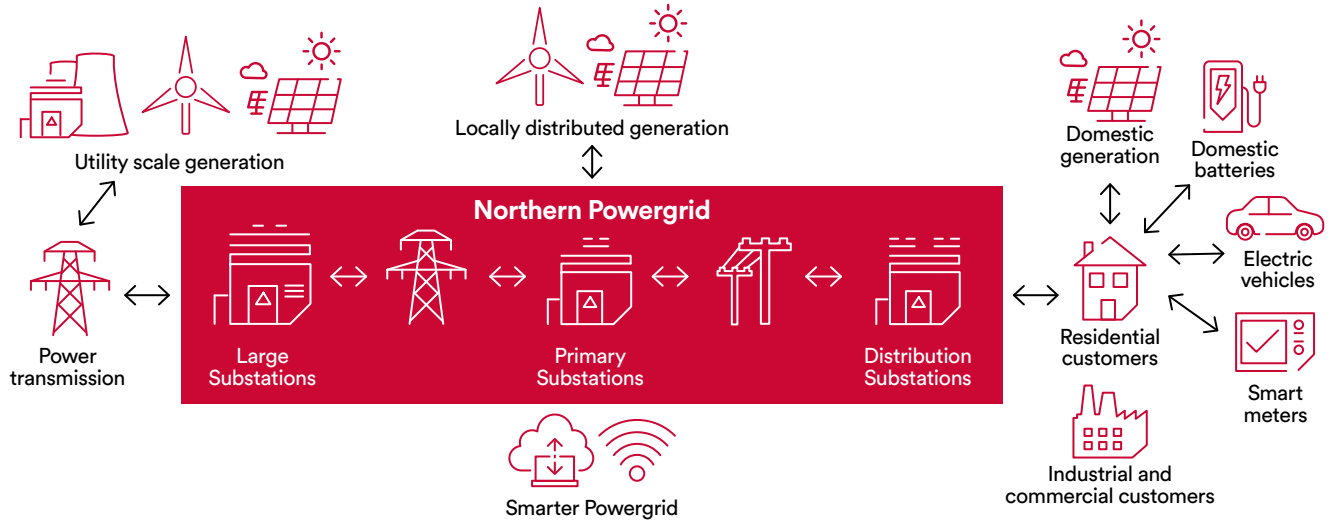
The amount of revenue that we recover from our customers is defined by Ofgem through a price control review process and our performance is monitored on a yearly basis, from 1 April to 31 March. The current eight-year period is called RIIO-ED1 and lasts from 2015 to 2023[2].

We are committed to promoting environmental awareness, best practice and legal compliance among all our staff. We take our environmental responsibilities seriously and manage the environmental impact of our activities very closely. This includes our carbon footprint, the risk of noise, water and land pollution, waste recycling and caring for wildlife. We also manage the visual impact of our overhead lines, balancing the requirements of running our network with our stakeholders' expectations.

Our regional structure enables our teams to best serve the local needs of our customers

[2] For more information, refer to: ofgem.gov.uk/network-regulation-riio-model/riio-ed1-price-control

Where we fit in the electricity industry



1.3 Purpose of the report

Environmental Respect is one of six core guiding principles for all Berkshire Hathaway Energy companies, including Northern Powergrid. We recognise the wider role and the impact our activity can have in the communities where our customers live and work because we live and work there too.

We believe our reputation and the trust held by our stakeholders, be they customers, special interest groups, the energy industry or partners, should be nurtured and this report shows how we turn words into deeds.

This report aims to provide stakeholders with an account of what we are doing to address environmental matters, including our role in the transition to a low carbon future. Throughout the year we meet with our stakeholders to discuss what they would like us to do; here, they are able to read about the progress we have made. We describe all of our innovation activity to provide stakeholders with a single source of information, even if it is not all directly related to the environment. We also provide the data and information that we submitted to our regulator as part of our annual regulatory reporting cycle. This information is included in the annexes to this report as well as published on our website, accessed using the links on this page.

The information presented in this report meets the guidance issued by our regulator. Significantly, the structure of the report is consistent with those produced by other Distribution Network Operators (DNOs) to aid comparison and cross-referencing between companies. If you have any views or additional questions, get in touch at yourpowergrid@northernpowergrid.com.

Environmental Respect

We are committed to using natural resources wisely and protecting our environment for the benefit of future generations. Our Environmental RESPECT Policy details this commitment in the areas of Responsibility, Efficiency, Stewardship, Performance, Evaluation, Communication and Training.

Associated documents:

— **Annexes 1 to 7 to the Environment Report 2021–22,** October 2022 – this is a copy of our submission to the regulator and consists of data tables.

— **Detailed commentary associated with the annexes to the Environment Report 2021–22, October 2022** – this is a copy of our submission to the regulator and consists of commentary associated with the data tables.

— **Cost benefit analyses** – these are numerous analyses that support net benefit calculations as submitted to our regulator.

All are available from https://www.northernpowergrid.com/your-powergrid/article/environment

— **The Stakeholder Annual Report, October 2022** – this report sets out the commitments we made and our progress against them, for the main areas of the business. It is available from: northernpowergrid.com/your-powergrid

Our performance measures*	2020/21 actual	2021/22 actual	2021/22 target	Annual status	ED1 target	ED1 status
Business carbon footprint (tCO_2e)	31,241	**33,498**	**55,081**	Achieved	30,689**	Ahead
Oil loss (litres)	29,055	**29,362**	**46,399**	Achieved	26,700**	Ahead
Overhead lines removed in AONBs (km, cumulative)	74.9	**88.9**	**85.7**	Achieved	114.0**	On Track
FFC replacment (km, cumulative)	176.5	**194.4**	**122.8**	Achieved	224.4**	Ahead
SF_6 lost to atmosphere (kg)	73	**101**	**112**	Achieved	90**	Ahead
Environment agency incidents (count)	6	**4**	**5**	Achieved	5**	Ahead
Street works quality (%)	92%	**91%**	**90%**	Achieved	90%	Ahead

KEY: ▲ performance has improved
▼ performance has worsened
▶◀ no change

* Reflects our ED1 business plan target unless otherwise stated.

** Reflects a forecast that exceeds our original ED1 Business Plan target.

*** Our smart meter intervention target is based on achieving an agreed level of service on Ofgem's 2% assumption of defect rates for all smart meter installations. The defect reports we have received is more than twice of the forecasted amount. Therefore, although we have formally missed the target, our performance is measured against a significantly higher report volume.

2. Managing our environmental impact

2.1 Introduction

We are committed to minimising the impacts our activities have on the environment. About a third of the total length of our cables and lines is overhead, and we work with our stakeholders to minimise the visual impact of these assets in National Parks (NPs) and Areas of Outstanding Natural Beauty (AONBs). Some of our cables are filled with oil, and we report here on what we're doing to reduce the risk of leakage.

We also explain how we manage our carbon footprint, particularly that coming from our use of the SF_6 gas, and losses from our network. Finally, we provide an overview of our climate change adaptation plans and highlight any specific activities taking place during the year.

Figure 1: Designated areas in our regions (National Parks and Areas of Outstanding Natural Beauty)

2.2 Visual amenity: Moving overhead lines underground to reduce their visual and environmental impact

Overhead electricity lines can have an impact on the appearance of the landscape and affect local wildlife. It's our statutory duty to bear in mind the purpose of NPs and AONBs (collectively known as 'Designated Areas') and conserve the biodiversity within them. We have a special programme of work dedicated to removing overhead lines selected by stakeholders and replacing them with underground cables in these Designated Areas. Four NPs and five AONBs fall either partly or entirely in our two licence areas. The lengths of overhead line within each area as of 31 March 2022 are shown in Figure 1.

	Designated area and stakeholder	Length of overhead line (km) – March 2022
1	North Yorks Moors	1,157
2	North Pennines	710
3	Nidderdale	575
4	Yorkshire Dales	585
5	Northumberland	342
6	Howardian Hills	256
7	Northumberland Coast	83
8	Lincolnshire Wolds	435
9	Peak District	200
	Total	4,344

In 2021–22 we spent £1.39m in Yorkshire and £1.50m in the North East[3] and put 14.0 km of overhead lines underground. Although progress during the year was impacted by the knock-on impact of COVID pandemic, we remain on track to deliver our original business plan commitment of 97.9km with a stretch forecast of 114km set by 2023.

[3] For more information about costs and length of cables undergrounded, refer to Annex 1 (our annual submission to the regulator).

Our stakeholder engagement and support

We work closely with stakeholders from each of the NPs and AONBs so that together we can improve visual amenity for the communities who live in and visitors who travel to these beautiful areas. Our programme steering group, made up of representatives from our stakeholders and members of our design, wayleaves and delivery engineer teams, meet up twice a year to identify and prioritise projects and discuss any other issues including policy development and publicity.

We maintain day-to-day control over this work and provide regular feedback to stakeholders. We appreciate that many of our stakeholders are facing pressures on their resources so we support them as best we can and work efficiently as we deliver this important work together.

Our strategy for project assessment and delivery, including analysis of costs and benefits

Our undergrounding programme is designed to meet the needs of representatives from the Designated Areas. We're aiming to make it easy for them to access the information and expertise they need to make an informed choice.

We invite representatives from the Designated Areas to state their preference for underground schemes, in line with the jointly agreed Assessment and Stakeholder Participation Policy. The stakeholders draw up a priority list of potential projects taking into account the characteristics of each site and the visual and environmental impact of the overhead line. This leads to each site being given a Stakeholder Rating which, alongside our own engineering wayleaves and value-for-money assessment, results in a project either progressing to authorisation or being deferred or cancelled. It's a thorough methodology which helps our stakeholders make informed decisions. For simplicity, we only report the resulting score in Table 1, where you will find the status of projects proposed by stakeholders.

114km

Overhead line removal forecast in Designated Areas by 2023

14km

Length of overhead lines removed in Designated Areas this year

Table 1: List of schemes progressed by stakeholders against the 2015–2023 budget

Designated Area	Location	Length of line (km) for undergrounding	Stage in the process	Stakeholder Rating*
Howardian Hills	York, Bulmer Village	1.5	5 – Complete	36
	Cawton	0.4	5 – Complete	60
	Crambe	0.2	5 – Complete	28
	Low Easthorpe	0.6	5 – Complete	98
	Ganthorpe	0.3	5 – Complete	39
	Nunnington West	0.3	5 – Complete	45
	Grimstone Top	1.2	5 – Complete	60
	York – Oswaldkirk 1	1.9	4 – Construction in progress	45
	Welburn	0.7	1 – Proposed for design and feasibility	36
	Howardian Hills AONB Total	**6.9**		
Lincolnshire Wolds AONB	Tealby Village, Market Rasen	2.6	5 – Complete	135
	Stainton Le Vale	1.1	5 – Complete	126
	Grimsby, Irby	0.4	5 – Complete	105
	Market Rasen, Stainton Le Vale	0.6	5 – Complete	
	Hatcliffe – Waithe Beck	0.8	5 – Complete	48
	Hainton	4.0	5 – Complete	162
	Donington on Bain Mill to Welsdale Bottom	2.6	5 – Complete	288
	Louth. North Elkington	3.9	5 – Complete	204
	Donnington Station 1482, Louth	2.6	4 – Construction in progress	
	Methodist Chapel, Claxby Village	0.1	3 – Confirmed by stakeholder and ready to deliver	
	Market Rasen, Benniworth Donnington	4.8	2 – Proposed and awaiting land consents	
	Market Rasen, Claxby Village	5.2	2 – Proposed and awaiting land consents	
	Withcall to Pokes Hole	2.7	1 – Proposed for design and feasibility	288
	Lincolnshire Wolds AONB Total	**31.3**		
Nidderdale	Otley, Higher Carr	2.9	5 – Complete	
	Otley, Clifton Village	2.3	5 – Complete	90
	Weston, Eastwood Cottages	1.7	5 – Complete	10
	Ripon, Fearby	0.7	5 – Complete	
	Harrogate, Ramsgill	0.5	5 – Complete	
	Harrogate, Middlesmoor	0.5	5 – Complete	
	Harrogate, Wath	0.4	5 – Complete	
	Keighley. Denton Village	0.2	5 – Complete	150
	Harrogate, Thornthwaite	0.2	5 – Complete	
	Studley Royal	0.5	5 – Complete	
	Studley Roger West	0.1	5 – Complete	
	Fountains Abbey – Various Sites	5.6	4 – Construction in progress	375
	Studley Cafe and Pheasantry SS's	1.2	4 – Construction in progress	
	Fountains Centre	0.5	4 – Construction in progress	
	Timble	1.4	2 – Proposed and awaiting land consents	252
	Fewston Institute, Harrogate	1.3	2 – Proposed and awaiting land consents	
	Upper Austby Farm, Ilkley	1.1	1 – Proposed for design and feasibility	
	Nidderdale Total	**21.2**		
North York Moors National Park	Saltburn, Hinderwell	0.8	5 – Complete	30
	Coxwold	0.6	5 – Complete	39
	Thorgill, Rosedale	0.3	5 – Complete	36
	Thimbleby	0.4	5 – Complete	
	Wass	0.4	5 – Complete	27
	Kildale	0.5	5 – Complete	18
	Rosedale Chapel	0.2	5 – Complete	33

*Stakeholders assess the impacts and benefits of a scheme using a consistent methodology which gives some consideration to the characteristics of the site and of the overhead line, as well as to the visual and environmental impact of the latter. The resulting scores are reported here as an indication of the prioritisation that the scheme is likely to be given relative to others in the same Designated Area. A higher score suggests the site has been given a higher prioritisation by our stakeholders (scores range between 10 and 420, with a median score of 115).

Table 1: continued

Designated Area	Location	Length of line (km) for undergrounding	Stage in the process	Stakeholder Rating*
North York Moors National Park	Thirsk, Boltby	0.8	5 – Complete	36
	Pickering, Low Dalby	0.7	5 – Complete	18
	Over Silton	0.6	5 – Complete	144
	Hinderwell West	0.2	5 – Complete	
	Fylingdale Sw – Hawsker Sea View	3.4	5 – Complete	391
	Hawsker York	0.2	5 – Complete	120
	Silpho	0.5	5 – Complete	126
	Danby Castle	0.3	5 – Complete	306
	Farndale Lowna	0.3	5 – Complete	280
	Ayton Garth	0.3	5 – Complete	209
	Ayton Yedmandale	0.2	5 – Complete	209
	Ainthorpe Davidson and Ainthorpe Brook	0.6	5 – Complete	110
	Pockley	0.6	5 – Complete	108
	Ainthorpe East	0.2	5 – Complete	110
	Ellerby 1	0.3	5 – Complete	108
	Mickleby	0.7	5 – Complete	77
	Staithes Bank Top SS	0.2	5 – Complete	272
	Newholme	0.4	5 – Complete	420
	Low Dalby Beck	2.0	5 – Complete	224
	Rosedale Chapel	0.1	5 – Complete	
	Dunsley village	0.3	5 – Complete	420
	Wass	0.1	5 – Complete	
	Egton Bridge West	0.2	5 – Complete	168
	Ellerby 2	0.1	5 – Complete	108
	Cowesby	0.4	5 – Complete	100
	Newholme North SS	0.2	5 – Complete	
	Whitby, Kildale Percy	0.3	5 – Complete	
	Hawsker Summerfield	0.2	5 – Complete	100
	Boulby Brow	0.2	5 – Complete	
	Danby	1.0	5 – Complete	110
	Hawsker and Hawsker West	1.3	5 – Complete	99
	Port Mulgrave	1.9	5 – Complete	238
	Thornton Dale Westgate S/S	0.4	5 – Complete	160
	Thornton Dale	0.7	5 – Complete	160
	Nether Silton	0.7	3 – Confirmed by stakeholder and ready to deliver	
	North York Moors National Park Total	**23.9**		
North Pennines	County Durham, Rookhope Village	1.3	5 – Complete	
	Consett, Muggleswick	0.3	5 – Complete	
	County Durham, Consett	0.3	5 – Complete	
	Hexham, Catton Village	0.6	5 – Complete	13
	Middleton Teesdale	0.5	5 – Complete	15
	Westgate West SS, Bishop Auckland	0.3	5 – Complete	
	St Johns Chapel	0.5	5 – Complete	110
	Newbiggin Teesdale	0.1	5 – Complete	15
	County Durham, Rookhope Village	0.4	5 – Complete	
	Eastgate	0.9	5 – Complete	156
	Co.Durham,Yellocksike	0.5	5 – Complete	130
	Eastgate	0.2	5 – Complete	
	Co.Durham, Ireshopeburn	1.4	5 – Complete	168
	Ireshopeburn	0.0	5 – Complete	
	Rookhope Head	3.8	5 – Complete	
	North Pennines AONB Total	**11.1**		
Northumberland Coast AONB	Howick Village	0.7	5 – Complete	144
	Beadnell	0.3	5 – Complete	144
	Northumberland Coast AONB Total	1.1		

*Stakeholders assess the impacts and benefits of a scheme using a consistent methodology which gives some consideration to the characteristics of the site and of the overhead line, as well as to the visual and environmental impact of the latter. The resulting scores are reported here as an indication of the prioritisation that the scheme is likely to be given relative to others in the same Designated Area. A higher score suggests the site has been given a higher prioritisation by our stakeholders (scores range between 10 and 420, with a median score of 115).

Table 1: continued

Designated Area	Location	Length of line (km) for undergrounding	Stage in the process	Stakeholder Rating*
Northumberland NP	Ingram Village	0.9	5 – Complete	99
	Hexham, Tarset, Low Eals	0.5	5 – Complete	90
	Morpeth, Harbottle	0.3	5 – Complete	
	Rochester SS	1.2	4 – Construction in progress	220
	Carvoran Sw – Thirlwell Castle Sw	1.8	4 – Construction in progress	253
	Twice Brewed West SS	1.4	3 – Confirmed by stakeholder and ready to deliver	
	Tower Ties, Greencarts	1.4	3 – Confirmed by stakeholder and ready to deliver	
	Shield Vallum, Milestone House	0.5	3 – Confirmed by stakeholder and ready to deliver	
	Beggar Bog, Moss Kennels	0.8	3 – Confirmed by stakeholder and ready to deliver	
	Hareshaw Cottages, Hareshaw Head	3.3	3 – Confirmed by stakeholder and ready to deliver	
	Greenwood	0.6	3 – Confirmed by stakeholder and ready to deliver	
	Linhope	0.5	2 – Proposed and awaiting land consents	140
	Northumberland NP Total	**13.1**		
Peak District NP	Sheffield, Brown Hill Lane	0.5	5 – Complete	96
	Hope, Hope Sewage	0.3	5 – Complete	88
	Moscar	1.8	5 – Complete	
	Sheffield, Dunford Bridge	1.8	4 – Construction in progress	
	Sheffield, Redmires Road	1.5	4 – Construction in progress	
	Sheffield, Dunford Bridge, Harden Edge	3.1	4 – Construction in progress	
	Midhope, Stocksbridge, Sheffield	1.1	3 – Confirmed by stakeholder and ready to deliver	
	Sheffield, Bolsterstone, Heads Lane	0.6	2 – Proposed and awaiting land consents	
	Peak District NP Total	**10.7**		
Yorkshire Dales NP	Richmond, Whaw	0.3	5 – Complete	
	Marrick	3.5	5 – Complete	216
	Oughtershaw – Cam Houses	4.7	5 – Complete	390
	Barden Towers	0.8	5 – Complete	250
	Keld	2.2	5 – Complete	252
	Skipton, Dribbles Bridge House	2.3	4 – Construction in progress	
	Skipton, Eastby	1.5	4 – Construction in progress	
	Kilnsey Crag	2.6	3 – Confirmed by stakeholder and ready to deliver	
	Hebden, Garnshaw	1.9	3 – Confirmed by stakeholder and ready to deliver	
	Thornton Rust, Leyburn	0.4	2 – Proposed and awaiting land consents	
	Reeth North	0.7	2 – Proposed and awaiting land consents	
	Gayle and Gayle Blackburn	0.5	1 – Proposed for design and feasibility	160
	Yorkshire Dales NP Total	**21.5**		
	GRAND TOTAL	**140.8**		

x9

National Park Authorities and Areas of Outstanding Natural Beauty stakeholders consulted

140 schemes

Undergrounding schemes being evaluated in National Parks and AONBs

* Stakeholders assess the impacts and benefits of a scheme using a consistent methodology which gives some consideration to the characteristics of the site and of the overhead line, as well as to the visual and environmental impact of the latter. The resulting scores are reported here as an indication of the prioritisation that the scheme is likely to be given relative to others in the same Designated Area. A higher score suggests the site has been given a higher prioritisation by our stakeholders (scores range between 10 and 420, with a median score of 115).

** This total includes a number of contingency schemes that may be not be delivered before 2023, hence the total length is higher than referenced in the section above.

2.3 Oil leakage

Our target

Our strong management of oil leakage continued into 2021–22 and we have maintained a 47% reduction in the period to date. Our performance in this area is reflective of a combination of cable replacement, installing oil containment bunds at substations sites and use of PFT4 technology to locate leaks. We are also continuing to trial self-healing cable fluid additives.

Our strategy for reducing and mitigating the environmental impact

Our management of fluid-filled cables compares well with other electricity DNOs in the country, although our exposure is still high because we have more fluid-filled cable on our network than most of the other DNOs.

We're addressing this through our fluid-filled cable replacement programme. We have committed to replacing 134km of fluid-filled cables by 2023 to reduce the overall risk. We've already exceeded our original target, having removed 194.4km so far. We're forecasting an additional 29.8km by the end of ED1 period. In 2017–18, we set out a stretch forecast to our original ED1 commitment, providing for the replacement of additional 72km of fluid-filled cable. We plan to remove an additional 18km on top of that stretch forecast which will see the removal of 224km by 2023 – 68% more than originally planned.

Our participation in the innovation project research into self-healing fluid additives this year has seen us proceed to a field trial which we are working on with other network operators. We introduced the additive into an out of commission cable where the fluid pressure is being remotely monitored and appears to be slowing. Refinements were required to the injection process which provided valuable information on the practicalities of the onsite handling required. The final step of this trial, once the pressure has stabilised, is to perform a joint on the cable to gain further practical knowledge and see visual proof of the self-healing properties. This year saw the completion of the field trial element of the innovation project research into self-healing fluid additives.
The additive was successfully introduced into an out of commission cable, visual proof of the self-healing properties was observed at a joint position and onsite handling experience was gained. Further, the field trials highlighted that the concentration of fluid needed to be increased to achieve healing to counteract the dilution effect within the cable. Investigation is now underway to understand the operational compatibility of the fluid at this new concentration level.

- All major GB electricity utilities have fluid-filled cable circuits on their distribution networks. These are mostly of the low pressure fluid-filled type, typically designed to operate at 1–4 bar pressure. Over time these cables may begin to leak cable fluid and subsequently the cable pressure may drop and the cable insulation system (fluid impregnated paper or paper-polypropylene laminate) may eventually fail. In some cases the leaks may cause environmental contamination.

- This innovative solution seeks to exploit the use of naturally occurring, environmentally friendly resins which, when added in measured quantities to the fluid in our cables, congeals around a variety of sheath defects and minor leaks, sealing the cable to prevent further fluid loss therefore reducing the loss of fluid.

Our performance

Any fluid leak from our cables is classed as an environmental incident and we have thorough procedures in place to report these incidents to the Environment Agency and deal with them quickly and effectively to minimise the impact. To ensure effective remediation we have a 24-hour environmental response support contract in place to attend for any and all environmental incidents as required.

In 2021–22, we achieved a 47% reduction in oil/fluid lost to ground against our ED1 business plan baseline We're working to continue to reduce the number of reportable events ahead of our phased plan and we expect the number of these incidents to keep decreasing over the rest of the regulatory period to 2023.

In 2021–22, we incurred preliminary costs on oil mitigation measures as part of our programme to replace transformer bunds. Following a programme of surveys we identified 148 bunds across Yorkshire and the Northeast that are in need of remedial work. We are trialling innovative solutions to provide effective oil bunding of power transformers, such as polyurea coatings and integrated flood defence with oil sumps. Trial outcomes will be used for oil mitigation programme delivery from 2023. Our oil mitigation works would normally include:

- Remedial works at substations to ensure the integrity of the bund wall that retains any oil leakage and prevents contamination of the surrounding area.
- The installation and replenishing of oil spill kits which act as a temporary 'first aid' solution until the leak can be resolved or the plant replaced. All our field staff working with oil-filled equipment have had spill kit training and they carry spill kits in their vehicles.

Figure 2: Reportable environmental events

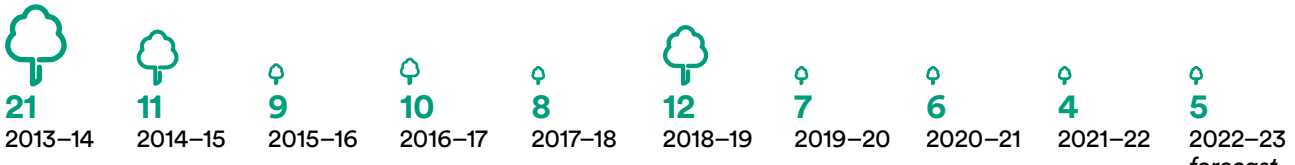
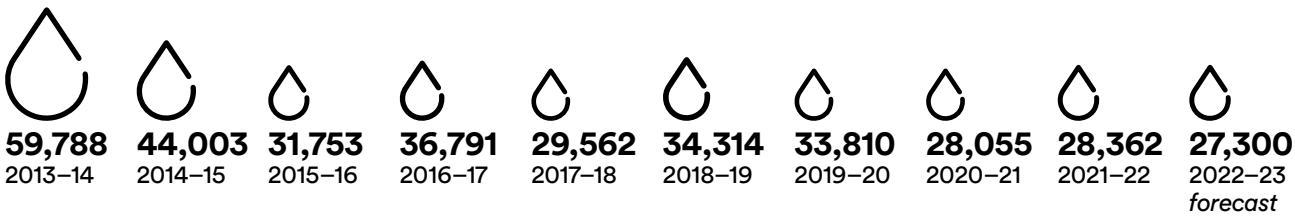


Figure 3: Leaks to ground (litres)



[4] PFT cost-benefit analysis table is published on: https://www.northernpowergrid.com/your-powergrid/environment.

Looking forward, we will continue to look for new ways to reduce our environmental impacts so we can outperform our targets. To help us achieve that, we have set a headline environmental goal to reduce the amount of oil/fluid lost in 2022–23 to less than 27,300 litres. To make this happen, we will:

— continue our progress towards replacing 224.4km of fluid-filled cable network by 2023.
— continue to pre-dose selected fluid-filled cables with perfluorocarbon tracer chemicals to speed up leak locations.
— continue to trial the 'self-heal' additive to fluid-filled cable circuits to evaluate the performance of the product.

Our performance in ED1 to date is strong and, looking forward, we expect this to continue.

2.4 Carbon impact and climate change

In the context of the climate emergency and the national net zero target, carbon reduction continues to be key area of interest and a clear priority for all our stakeholders. In this section, we focus on what we are doing to reduce carbon in our business operations including those of our supply chain. In section 3, we go to describe how we are facilitating society to decarbonise more rapidly with increased electrification.

2.4.1. Business carbon footprint

Our internal carbon footprint continued to fall during the Regulatory Year 2021–22 and so did the carbon footprint of Northern Powergrid combined with our contractors. If we exclude the contractors' contribution, our internal carbon footprint for 2021–22 was 14,467 tonnes, which is 1.6% lower than the previous year. We report our business carbon footprint in accordance with the Greenhouse Gas Protocol as shown in Table 2[5] and also comply with the Streamlined Energy & Carbon Reporting requirements.

Overall, at the end of the Regulatory Year 2021–22, we had already achieved a 49% carbon reduction against our ED1 business plan baseline, significantly exceeding our business plan commitment of a 10% reduction in ED1. In December 2021 we had our science-based targets verified by the science-based targets initiative for a 15-year period to 2035. We continue to innovate across the business to reduce our carbon footprint including reducing fleet and business mileage and continuing to introduce electric vehicles and low emission vehicles in our fleet where possible or practical. We continue to use telematics systems in fleet vehicles[7], and investigating new insulating mediums in the equipment we purchase. In 2021–22, we continued to see a reduction in our business travel as a result of continued working from home. We will continue to use virtual meetings alongside face-to-face meetings to keep business mileage to a minimum. We expect these initiatives will contribute to further reductions in our carbon footprint over the coming years.

2.4.2. Sulphur hexafluoride emissions (SF_6 emitted)

Sulphur hexafluoride (SF_6) gas has been used in a number of industries across the world for many years, including the energy industry where it is a commonly used insulator in high voltage electrical equipment and originally introduced as an alternative to oil. It is also a potent greenhouse gas – one tonne of SF_6 gas is equivalent to 22,800 tonnes of CO_2.

Industry and equipment manufacturers are already taking action to avoid the release of SF_6 to the atmosphere and to promote recycling. We have a strong record of deploying technology to tackle climate change and are also proactively supporting manufacturers to develop effective and reliable alternatives to SF_6 including conducting trials of alternative gas technologies. There are few economically viable substitutes for SF_6, so we expect to continue to use it until suitable alternatives are developed by the equipment manufacturers. We anticipate we will be investing in more such alternatives, provided they are economically and technically viable – for example, we have recently approved plans to replace two SF_6 132kV circuit breakers which will be our first that contain no SF_6, using vacuum and air as the insulating media instead.

The nature of SF_6 means it's important to keep the amount that leaks out of our equipment to an absolute minimum to minimise our carbon footprint. We monitor all SF_6 losses on a daily basis by measuring how much we have injected back into the equipment to replace gas which has leaked into the atmosphere. We report our SF_6 gas losses as one of our environmental key performance indicators. We estimate that annually 0.2% of the total SF_6 volume escapes into the atmosphere (refer to Table 38)[7].

If we discover, either by a remote pressure alarm or on-site inspection, that some gas has leaked, then we schedule maintenance and repair work. If the leak is persistent and maintenance and repair options aren't stopping it, we invest in replacing the equipment.

Our state-of-the-art infrared cameras are able to detect very small quantities of SF_6 gas leaking from equipment. This has enabled us to accurately pinpoint leaks and we saw reductions in our gas loss of 33%. However, our gas loss has steadily increased again due to three specific assets that have been assigned for replacement in mid-late 2022. We routinely use our forward looking infra-red (FLIR) camera that is able to detect SF6 leaks within its spectrum range. This has enabled us to reduce our gas loss by nearly half in the period, saving over 1,000 tCO_2e of greenhouse gas emissions being released to atmosphere. As a result, we expect to see SF_6 losses reduce to 50kg in 2022/23.

[5] Further information is provided in Annex 2 (a copy of our annual submission to the regulator).

Table 2: Our carbon footprint 2021–22[6]

Greenhouse Gas Protocol classification	Emission sources	Tonnes CO_2e[9]
Scope 1 – sources owned or controlled by the company	Gas used for heating buildings	258.75
	Operational travel (own fleet vehicles)	4,038.98
	Leakage of SF_6	2,315.45
Scope 2 – from the generation of purchased electricity, heat and steam	Electricity used in buildings	1,621.68
	Electricity used in substations	4,079.14
	Losses from our network	435,460.40
Scope 3 – all other sources	Network losses from purchased electricity[7]	504.49
	Business travel (car, rail, air)	1,648.20
	Operational travel (contractors' fleet vehicles)	7,707.48
	Fuel combustion (contractors' use of small generators)	11,323.50
Total*		**468,958.06**
Total (excluding losses from our network)*		**33,498.06**
Total (excluding losses from our network and contractors)*		**14,467.08**

* The totals might differ slightly due to rounding.

Table 3: Summary of performance in SF_6 leakage

SF_6 bank (kg)	37,252
Estimate of SF_6 emitted (kg)	102
SF_6 emitted as a percentage of SF_6 bank (%)	0.27%

[6] For more information about our carbon footprint, reported separately for North East and Yorkshire, refer to Annex 3 (a copy of our annual submission to the regulator).
[7] Telematics cost-benefit analysis table is published on: https://www.northernpowergrid.com/your-powergrid/environment
[8] For more information, see Annex 2 (a copy of our annual submission to the regulator).
[9] Tonnes of carbon dioxide equivalent.

2.4.3 Distribution losses

What are distribution losses?

Electricity networks incur electrical losses when transporting power. In 2021–22, roughly 6% of energy entering our distribution network was lost before it reached our customers. These electrical losses that occur on the distribution network are referred to as 'distribution losses', or often just 'losses'.

It is important to reduce losses because there is an environmental and an economic cost associated with them, accounted for in consumers' energy bills and the carbon footprint incurred to produce the energy that is lost. That is why reducing losses on distribution networks can have a significant effect on reducing the overall CO_2 emissions.

There are two main types of distribution losses:

- **Technical losses** – the natural effect of network equipment heating up while transferring electricity. These losses vary in proportion to the amount of electricity transported and are an unavoidable consequence of the laws of physics, and can never be reduced to zero.
- **Non-technical losses** – losses that are primarily related to unidentified, misallocated, and inaccurate energy flows, in which the end user is unknown or the amount of energy being consumed is uncertain. These include electricity consumed by network operations (for example heating and lighting in substations), electricity theft and inaccuracies in metered and unmetered data.

Our strategy to manage distribution losses

We estimate that losses on our network this year amounted to 2,050GWh, equivalent to 468,958 tCO_2e (c. 93% of our carbon footprint – equivalent to supplying c. 707,000 homes with electricity[10]). We have a losses strategy in place, dedicated to monitoring and reviewing our options to reduce electrical energy losses that occur on our own network[11]. Our forecast is that losses will reduce by up to 9% between 2015 and 2023 thanks to the effect of the general energy efficiency improvements of our customers' equipment and our choices of transformers and cables. It is important to note that the uptake of low carbon technologies, deployment of customer flexibility, and the deployment of smart grid technologies to deliver a more flexible network creates a more complex picture. Some solutions will decrease losses. However, some other actions will increase losses, but deliver whole system carbon reduction through the connection of low carbon generation, making them worthwhile overall.

The investment profile associated with activities to reduce losses falls into two categories: ongoing programmes and one-off improvements.

Figure 4: The inside of a LV 300mm² cable used to reduce losses on our network

The main ongoing activities that we are implementing as part of our strategy are:

- **The policy of 'oversizing' conductors (relative to existing utilisation levels):** We install a minimum cable size of 300mm^2 at 11kV where practical (e.g. if bending radii and termination arrangements allow) and continue to install a minimum of 300mm^2 mains low voltage (LV) cables. Although these cables are of a larger capacity, the lifetime cost is lower than the smaller size option of 185mm^2, when taking into account the capitalised electrical losses within our designs (Figure 4). Using larger cables to deliver electricity will help us save up to 10,500MWh, enough to power over 3,600 homes[10] for a year. In this price control period, we have been investing in larger electricity cables in order to reduce energy losses. This has led to a cumulative saving of 6,161MWh to date (refer to Table 4; figure might slightly differ due to rounding). Oversizing conductors and transformers is also a cost-effective way of preparing the network for the future increase in electrical demand due to decarbonisation.
- **Accelerated asset replacement:** We undertook a cost-benefit assessment for pro-active replacement of our older (pre-1958) ground-mounted distribution transformers. We have been replacing these transformer units as part of synergies with other investment drivers such as asset condition. In 2021–22, this led to a cumulative saving of 1,143MWh (Table 4).
- **Sizing transformers for losses optimisation:** We will continue with our existing distribution transformer 'oversizing' policy for pole- and ground-mounted transformers with demand customers connected. However, for distribution transformers with dedicated solar or wind generation connected, we do not oversize the transformer as the intermittent generation profiles do not justify the cost for an increased transformer size.

Losses Discretionary Reward

Ofgem introduced the Losses Discretionary Reward (LDR) with an aim to encourage all DNOs to undertake additional actions to better understand and manage electricity losses on their networks on four criteria: understanding of losses, stakeholder engagement, processes to manage losses, and innovative approaches to losses management.

The reward was divided into three tranches between 2016 and 2021. Ofgem decided not to financially reward any DNO for its performance. We remain committed to delivering the remaining actions throughout this price control period, with improved understanding of impacts of losses on our network. This helped us shape our Losses Strategy for the next price control period in 2023–28, which is known as RIIO-ED2.

Other distribution losses management activities and learnings for RIIO-ED2

In 2021–22, we have been delivering actions spanning both our Losses Strategy and LDR. In addition to the activities already mentioned, we carried out the following activities, which have directly shaped our Losses Strategy for RIIO-ED2:

- **Stakeholder engagement:** We have been actively engaging with our stakeholders and communities to present and discuss our losses initiatives, with a key focus on ensuring that our RIIOED2 Losses Strategy meets and surpasses our stakeholders' expectations. We used a custom made animation to help educate customers on what network losses are and how they can be reduced. We also have a dedicated webpage on losses which we have updated with more information, news and updates on our activities www.northernpowergrid.com/losses.
- **Enhanced understanding of network losses:** We worked with Newcastle University on building a detailed and flexible electrical distribution network losses model. This builds on the analysis of present and future network operating scenarios and incorporating system and consumer data, along with consideration of both 'smart' and traditional network operation and management techniques.
- **Impact of battery energy storage system (BESS) on losses:** Our understanding on the impact of BESS on losses has improved through analysis of our own Rise Carr BESS and Distributed Solar and Storage Study (DS3)[12] projects. We have learned that BESS could either reduce or increase losses on our network, depending on its mode of operation. However, BESS should not be discouraged because it brings huge benefits in reducing the overall carbon levels to achieve net zero target, which far outweighs the losses impact of its operation on our network. This situation is akin to the operation of active network management schemes which provide low cost flexible connections for low-carbon generation but increase local network losses. The outcome of these analyses informed our strategy for RIIO-ED2, particularly with respect to our initiative to consider how losses are to be incorporated into optimising whole system flexibility.
- **Boston Spa Energy Efficiency Trial:** We are undertaking an exciting innovation project that is seeking to use smart meter data in near-real time to optimise the voltage received by our customers in the trial area. This should save customers money by increasing the efficiency of appliances within the homes and businesses of our customers. This whole system trial can therefore be thought of as tackling losses on the customer side of the meter; which we really think is important to working together to transition to Net Zero by focussing on the whole system. Whilst this innovation project has not yet concluded, we have set out ambition to rollout voltage optimisation within our RIIO-ED2 business plan.

[10] Assuming a median annual electricity demand of 2,900kWh based on Ofgem's Typical Domestic Consumption Values (profile Class 1). By comparison, a typical annual energy demand to provide a home with both heat and electricity is 14,900kWh.

[11] The existing strategy is available in full on our website document library at https://www.northernpowergrid.com/losses
We have also produced a losses strategy for our next price control period, RIIO-ED2 (2023–28) which is on Annex 4.5 of our Business Plan.

[12] More information on these studies can be found on our losses webpage https://www.northernpowergrid.com/losses

— **Power Factor Advice:** Industrial and commercial (I&C) customers who consume significant amounts of reactive power will have something referred to as 'poor power factor'. The result of which is that these customers will suffer from high energy bills, and the poor power factor can increase losses on our network. We therefore created 'a guide to power factor' and then identified customers who could benefit from power factor advice, and contacted them, sharing this guide. In RIIO-ED2, we are now planning to further target key customers, and then using this learning to continually improve our advice.

— **Amorphous transformer trial:** We have collaborated with other DNOs and a transformer manufacturer to trial the super low-loss amorphous core transformers on our network. This trial helped us to allay technical concerns around brittleness, size, weight, harmonics and noise associated with this core technology, which has a superior efficiency compared to the Ecodesign[13] Tier 2 maximum losses levels for transformers that came into force in July 2021. We have successfully installed all planned units as part of the trial.We will continue to share key learning this year and best practice with other DNOs. The outcome of this trial and the associated cost benefit analyses we undertook informed our strategy for RIIO-ED2.

— **LV monitoring:** We have so far installed more than 1,500 units of low voltage monitors on our heavily loaded and likely losses hotspots. By the end of this price control period, we aim to have a total of 2,700 units installed, targeting areas that we analyse and identify in having high low carbon technology take-up in the future (which also likely to suffer from higher than average losses). Our RIIO-ED2 Losses Strategy seeks to utilise the data from LV monitoring, coupled with data from smart meters to enable enhanced analysis to better pinpoint areas with high technical losses requiring mitigating actions, along with an initiative to better use data to identify and manage losses due to electricity theft.

— **Network reconfiguration:** Since 2015, over 1,000 high voltage (HV) feeders have been assessed to optimise open points to balance load and customer numbers. In turn, this should reduce losses. In an extreme example when an open point is moved from an interconnected primary substation to the mid-point losses are reduced. An optimised typical feeder pair has estimated savings of 26MWh (or £1,300) per year. Our RIIO-ED2 Losses Strategy seeks to continue this initiative, where continuous improvement is critical given the significant changes to demand and generation on the network. This activity will be enhanced by our investment in enhanced data acquisition and analytical tools as part of our DSO strategy.

— **Energy Networks Association (ENA) Technical Losses Task Group:** Working collaboratively with all DNOs under this working group, we commissioned a study to investigate the impact of low carbon transition on technical losses. This study looked at the losses impact of low carbon technology growth and of the losses impact of smart solutions compared to traditional reinforcement. The use of smart solutions as an alternative to conventional reinforcement is expected to increase losses; however we will only implement smart solutions where they are economic from a whole system perspective. The group commissioned a project to inform the development of a potential losses incentive mechanism for RIIO-ED2 which was shared with Ofgem.

— **Staff training:** As part of a wider change management exercise driven by our Smart Grid Implementation Unit, all high voltage and extra high voltage design engineers have received formal training in how to incorporate losses into their designs. We have also embedded losses into the training module for our graduate and technical staff trainee training programme. We will continue to prioritise this exercise and will update our workforce with enhanced training utilising upgraded software and analytical tools.

Tables 4 and 5 show the estimated volume and impact of loss reduction activities[14].

Table 4: Summary of losses costs and benefits from activities in RIIO-ED1*

	Programme title	Regulatory Reporting Year 2021–22*			RIIO-ED1 (2015–23)
		Distribution losses justified costs	Estimated reduction in losses	Estimated resulting reduction in emissions	Cumulative reduced losses to date
		£m	MWh	tCO_2e	MWh
Yorkshire	Oversizing cables (300mm) HV	0.31	237	55	1,716
	Oversizing cables (300mm) LV	0.37	519	121	3,229
	Replacing distribution transformers (pre-1958)	0.06	66	15	722
Northeast	Oversizing cables (300mm) HV	0.15	113	26	772
	Oversizing cables (300mm) LV	0.15	207	48	1,520
	Replacing distribution transformers (pre-1958)	-	2	0	386
Total**		**1.03**	**1,143**	**267**	**8,345**

[13] The Ecodesign regulation is a European legislation that imposes a maximum level of losses for transformers sold from 1st July 2015 onwards. Ecodesign aims for two major objectives on the Transformer product: 1. to reduce electrical losses and 2. to clarify and make more visible indication of performance.

[14] More information, including the Cost Benefit Analysis, is provided in Annex 4 (a copy of our annual submission to the regulator).

[15] See ED2 Losses Strategy – https://ed2plan.northernpowergrid.com/sites/default/files/document-library/Losses_strategy.pdf

Table 5: Summary of amount of losses activities in regulatory reporting year and estimate for the following year[16]*

Programme title	Description of unit	Volumes in 2021–22*	Forecast volumes in 2022–23
Oversizing cables (300mm) HV	Length (Kilometres)	150	115
Oversizing cables (300mm) LV	Length (Kilometres)	207	140
Replacing distribution transformers (pre-1958)	Number of transformers	4	12

* The cable volumes for 2018–19, 2019–20 2020–21, and 2021–22 have been estimated based on the total asset movement data in our reporting to Ofgem.
** The totals might differ slightly due to rounding.

RIIO-ED2 Losses Strategy

Our vision (for losses) in RIIO-ED2 is to optimise whole system losses whilst facilitating net zero. We undertook a bottom-up review of all potential losses management initiatives, building on our success and learning to date, as well as that of other DNOs. The resulting Losses Strategy for RIIO-ED2[15] has many exciting new initiatives, including: Use of amorphous core transformer technology After our trials of the Super low-loss Amorphous Core Transformers during 2015–23, we have determined it provides the highest net present value to our customers when incorporating the societal cost of losses. With the exception a handful of scenarios, we aim to widely adopt amorphous core transformers.

Increasing use of both smart meter data and LV monitoring data energy (i.e. electricity and gas) theft across the UK is estimated to be valued at £400m each year. The smart meter rollout, together with our ambitious rollout of low voltage (LV) monitoring should enable us to better analyse LV network energy flows, and determine outliers that could be a tell-tale sign of energy theft. We plan to use the LV monitoring data together with smart meter data, to help identify electricity theft. We will be working with industry stakeholders to help drive this initiative forward.

Stakeholder Engagement

In RIIO-ED2 we plan to continue our strong engagement with our stakeholders by using 'customer service' and 'vulnerability' led initiatives to educate and inform our customers, continuing to develop and update our educational material based on stakeholder feedback. We will also continue to collaborate across the UK alongside collaborating internationally to share and learn from other experts.

Research and Development

We plan to continually follow new industry findings to inform our Losses Strategy to enhance losses on the network. Key development areas we continue to investigate include implementing learning from our micro-resilience innovation project. This includes innovative ways of managing losses, such as power factor correction, phase balancing, and using batteries to manage system loading. We also plan to investigate the potential of solid-state transformers (SST), currently applied in the LV Engine innovation project as well as considering other technologies.

Modelling improvement

With the improvements in data available to us through network visibility investments, coupled with our investment in a future-ready modeling tool (DSAT), we can move away from empirical techniques/estimates. Instead, we will be able to model and understand the losses across our network like never before. This will help us better understand losses across the network and to target Losses related interventions.

Losses cost benefit analysis

All DNOs under the ENA open networks platform has developed a common evaluation methodology (CEM) to make investment decisions when comparing flexibility products to traditional network interventions. However, DNOs currently do not have a consistent approach to assess losses. We plan to collaborate with the industry to ensure that the latest techniques are applied to the flexibility cost benefit analysis (CBA) model, and that any learning results in continuous improvement of the CBA model. Further to this, we will continue to review how we can better model the financial and environmental impact of losses so that as an industry, the true cost of losses is accounted for, and that any losses actions account for this true cost of losses.

Energy efficient substations

Our major substations, consume a significant amount of electricity; at roughly 13.5 MWh each, this is roughly equivalent to four 'typical' homes. We have roughly 800 major substations, therefore the energy efficiency of our substations is a key improvement area. We plan to apply BREEAM energy and carbon management standards (or similar, which resembles EPC), and implement appropriate recommendations to enhance the efficiency of our substations[15].

For further information on our initiatives and activities to manage losses, please visit our losses webpage at www.northernpowergrid.com/losses. We welcome questions or feedback, which can be emailed to us at losses@northernpowergrid.com.

[15] https://www.northernpowergrid.com/asset/0/document/5547.pdf
[16] We have here reported the activities where some of the costs incurred relate to managing distribution losses, but where losses are not the principal reason for the expenditure. This excludes activities that may help to manage losses but where distribution losses are not associated with the DNO's decision to undertake the activity and where any benefits of losses are purely coincidental (such as the product specification for new transformers, and the programme of voltage reduction which we report in Innovative Solutions). For an overview of all of our activities to manage losses, refer to our Losses Strategy located at https://www.northernpowergrid.com/losses

2.4.4 Climate change adaptation

The UK's climate is changing and weather events which we currently consider to be 'extreme' will become increasingly common. The climate change that will occur in the medium term has already largely been determined by greenhouse gas emissions, so we need to get ourselves ready to deal with the effect this will have on our weather patterns.

From flood defences and vegetation management, to improved weather prediction systems and increased staff availability, our climate resilience strategy[17] outlines the impact that we anticipate climate change will have on our business and, most importantly, how we propose to tackle it.

In our ED1 business plan, we committed to making our network more resilient to flooding by building new permanent flood defences in 141 sites and completing 15 sites that remained from the previous price control period.

Our programme is ahead of target. In 2021–22, we upgraded defences at 7 sites. This has taken our total number of permanent flood defence installations to 199 in ED1 to date, exceeding our original commitment (refer to Table 6).

Table 6: Annual number of permanent flood defences installed

2021–22 Actual	2022–23 Target	2015–23 Cumulative	2015–23 Stretch forecast
7	4	199	271

Since making our business plan commitment, there have been a number of severe flooding events that triggered a national review of flood resilience as well as causing us to carry out our own analysis. As a result, we have significantly expanded our programme during the RIIO ED1 period and expect to complete more than 270 sites by the end of ED1. We continue to re-assess the need for further upgrades in the coming years.

We published the Northern Powergrid third round Climate Change Adaptation report and risk assessment in December 2021. We continue to engage with third parties to fully understand the predicted impact of the climate on our industry and business. The findings of this work continue to contribute to enabling us to evolve our climate change adaptation plans. We continue to work with other organisations in our area to understand and inform regional adaptation plans.

2.5 RIIO-ED2 Environmental Action Plan

We will proactively seek to protect the environment through our investments and operations, working collaboratively with partners and our supply chain to deliver innovative, cost-effective solutions that reduce or eliminate environmental risk exposure. In doing so we will minimise carbon emissions, pollution and waste and, where possible, seek to enhance the local environments in which we operate.

In preparing our plan for the 2023–28 period we acted on feedback from our stakeholders who told us that they expect high levels of ambition when it comes to managing the impact of our network and asset base; both protecting the environment and reducing our business carbon footprint (BCF). Environmental protection was in the top quartile of stakeholder priorities; specifically, we heard:

- we should lead by example in reducing our own emissions;
- reducing SF6 emissions and oil leaks is important;
- we should reduce our BCF but via the most cost-effective means;
- biodiversity initiatives should be increased in terms of scope and scale; and
- visual amenity is valuable but not essential.

Consequently the Environmental Action Plan (EAP) we proposed and published in December 2021 delivers an ambitious set of outputs at a lower cost to customers through the use of innovative technologies and solutions. Reducing our internal business carbon footprint is a key priority and our proposed plan sets us on a path to be carbon net neutral by 2040. Ofgem is expected to provide a final determination on the ED2 price control review by the end of 2022.

Our Environmental Action Plan is located at: https://ed2plan.northernpowergrid.com/sites/default/files/document-library/Environmental_Action_Plan.pdf

[17] Available from: https://ed2plan.northernpowergrid.com/sites/default/files/inline-files/Climate_resilience_strategy.pdf

[XX] Environmental_Action_Plan.pdf (northernpowergrid.com)

3. Smart grids, innovation and our role in the low carbon transition

3.1 Introduction

Developing our innovation portfolio

As a company, we aim to improve our customers' experience through new understanding and processes across all parts of our business – both today and in the future. This year, we've made more progress on our mission to deliver new learning and in rolling out innovation projects into our everyday business. We currently have 27 active innovation projects, building on work that's already been done in the industry, to help us deliver our innovation strategy.

Changing markets and system operation

We are going through a revolution in the way that electricity is produced and consumed. Traditionally, the distribution network was designed for one-way delivery of electricity. Over the last few years, customers and the energy industry have made some big changes:

- **Decarbonisation of generation:** Less coal and more wind and solar are being used to power our homes.
- **Decentralisation of energy sources:** Electricity generation units are moving from the traditional model of large power stations on the transmission network to commercial and domestic generation connected to the local distribution powergrid.
- **Digitisation of technologies:** Most things are becoming 'smarter' in society (e.g. home entertainment and heating controls) and in industry (e.g. technology to automate processes and control network assets).

Traditionally, flexible electricity generation has been adjusted to meet demand (or use). However, low carbon generation is less flexible because the source is often weather dependent (for example, solar panels and wind farms) and is more intermittent. This means that the energy system needs to be more flexible to support customers by matching demand to available generation in a more dynamic network.

The industry is responding to this change by transitioning from a traditional DNO to a Distribution System Operation (DSO) model. For more information, please see either our final business plan DSO Strategy (December 2021)[18] or our earlier DSO v1.1 development plan (October 2019)[19]. DSO requires active management of the energy system in real time, agreeing contracts with customers to support the grid in flattening peaks of high demand on the system. A DSO means we will work with customers who are able to be flexible with when they generate or use electricity. In doing so we aim to support better utilisation of the existing low carbon generation, reduce system costs and improve overall energy system efficiency for all customers.

[18] Available from: https://ed2plan.northernpowergrid.com/sites/default/files/document-library/DSO_strategy.pdf

[19] Available from: https://www.northernpowergrid.com/DSO

Smart meter foundations

Although energy suppliers are leading the roll-out of smart meters, network companies have an important role to play in supporting the roll-out and using smart meters as the foundation of a future smart grid which will deliver an improved service for our customers. The national smart meter programme has continued to experience delays but we are working to minimise the impact of the lower than anticipated volume of SMETS2 meters and data quality issues. You can read more about this in section 3.4.

Drivers and priorities

Our commitment to operational excellence and customer service means that we are always looking for better ways to do things, at a reduced cost for our customers. Our role is to provide an electrical network that is fit for the future. As UK energy landscape is changing, our network must be flexible and responsive in order to accommodate more demand for renewable electricity sources and the increase in low carbon technologies like electric vehicles and heat pumps connecting to our network. We need to manage the energy system so it continues to provide a secure supply of electricity. Developing trends present both challenges and opportunities for the electricity system and we keep it under review to make sure our approaches and priorities remain appropriate. Changes are driven by technological advances and the need to reduce carbon:

- **Customer engagement** – our priorities need to be linked to those of our customers and stakeholders.
- **Security of supply and cost remain a top priority.**
- **Local and intermittent generation** – renewables or flexible peaking plant.
- **Decarbonisation of heat and transport** – a heat pump or an electric vehicle charger can double the peak load on a domestic property with most impact when clustered in the same location on the network.
- **Digitisation** – the pace of technological change is leading to a rapid increase of data and functionality to engage customers in an actively managed network.

About Distribution System Operation

By making the transition to a DSO, Northern Powergrid will deliver a set of balanced outcomes for customers through:

- creating a customer-led actively managed (and probably semi-autonomous) network.
- providing a cost-efficient, non-discriminatory and technology-neutral physical trading platform.
- supporting third parties in our region to participate in the electricity markets.

At Northern Powergrid, we want to be a leading voice in shaping the transition. Many of the projects we've worked on this year support this ambition – we're involved in activities that are scoping the future, pursuing low-regrets options (getting on with the transition) and building new capabilities.

Table 7: Low carbon technologies connected to our network in 2021–22

		Estimated capacity (MW)	Estimated volume
Load	Heat pumps	9	1,751
	Electric vehicle chargers	52	6,851
Renewable generation	Photovoltaic micro-generation	10	2,988
	Other distributed generation (mainly larger photovoltaic, onshore wind and biomass)	45	945

Our role in the low carbon transition

Carbon reduction targets have led to an increase in popularity for low carbon technologies (LCT) such as heat pumps, solar panels, wind turbines, and electric vehicles, with low carbon heat remaining an uncertainty. This places increased and new load on our network. Table 7 shows the amount of such connections on our network[20].

In terms of future volumes, the rate of LCT uptake is very sensitive to government policy and we expect the distributed generation trends to change depending on the market's ability to find profitable business models. In 2019, Feed-In Tariff was discontinued and we have seen a drop in PV connected to our network. Meanwhile, the plans to ban new petrol and diesel car sales were brought forward to 2030 at the latest and electric vehicle ownership has been steadily increasing.

These challenges are set against a backdrop of disruption to traditional energy markets where new entrants are blurring the established definitions of generators, suppliers, network companies, customers and other market participants. Added to this, customers expect that service standards and security of supply will continue to improve.

3.2 Progress of the innovation strategy

We are involved in innovation in various ways, either leading projects or working with partners. Projects are funded through different sources. We have access to the Network Innovation Allowance (NIA) through the regulator Ofgem, which is worth up to £29m (in 2012–13 prices) over eight years, and we can also benefit from specialist funding sources (such as Innovate UK) through partnering with universities or other industrial partners.

During the year, our innovation portfolio continued to be impacted by the disruption COVID-19 pandemic caused in the previous years, affecting the pipeline of new projects. The response to severe weather events and their aftermath during 2021–22 also had an notable impact on the delivery and the timelines of current projects.

In December 2020, we published a refreshed version of our ED1 Innovation Strategy[21]. Our strategic objectives remain highly relevant to stakeholder needs and fall into three broad areas:

1. **Decarbonisation.** There are many unknowns regarding how decarbonisation will unfold. Therefore, the opportunities for adding value through innovation – and the risks posed by not doing so – are high. For us, the task of addressing decarbonisation is two-fold: both decarbonising our own operations and facilitating the decarbonisation of the energy sector as a whole.
2. **Reliability and Resilience.** Reliability of our day-to-day service continues to be a top stakeholder priority and is ever-more important in an energy system more reliant on electricity. For the energy system transition to be successful, customers must be able to rely on electricity as it becomes an ever-more critical energy vector. This is especially true for our vulnerable customers.
3. **Value For Money.** We need to make sure that the energy system transition is as cost-effective as possible for our customers and does not unfairly disadvantage vulnerable customers or those on low incomes, building an affordable and fair energy system.

In a challenging year for the interactions needed to develop new initiatives, we have successfully started four additional projects to help us address our strategic innovation priorities[22].

We have made good progress on our innovation projects:

Our work related to **decarbonisation** is focused on both reducing the business carbon footprint of our own operations as well as the transition to a net zero energy system. In 2021–22 we:

- demonstrated that the use electric vans equipped with a battery payload as a cleaner, quieter method for restoring electricity supply after a power cut is cheaper than diesel generation in long term and cost-neutral over 18 months;;
- continued our Customer Led Distribution System[23] innovation project which is exploring how we can optimise value for our customers in the changing energy system as we progress to net zero emissions in 2050;
- continued to explore new ways to optimise the whole energy system (electricity/gas).

[20] For more information, refer to Annex 7 (a copy of our annual submission to the regulator).
[21] Our ED1 innovation strategy is available from https://www.northernpowergrid.com/asset/1/document/2496.pdf and our ED2 innovation strategy available from https://ed2plan.northernpowergrid.com/sites/default/files/document-library/Innovation_strategy.pdf
[22] For more information on our portfolio of NIA projects, you can refer to 2021–22 Annual Summary on: https://smarter.energynetworks.org/annual-innovation-summary/
[23] More information available from https://www.northernpowergrid.com/innovation/projects/customer-led-distribution-system-nia-npg-19

Reliability and resilience continues to be a top stakeholder priority and is ever-more important in an energy system more reliant on electricity. The winter storms emphasised the need to focus on this area and created a renewed interest in reliability and resilience. In 2021–22, we:

— commenced the on-site build to explore how the use of LCTs could provide a means to improve the capacity and resilience of the network through our Micro-Resilience project;
— successfully completed the trials of the remote access management system for all of our assets to improve their security and the safety of our colleagues;
— completed the specification of the requirements of the pole-mounted variants of the technology which should reduce interventions on the low voltage system, giving us a better view on when and where faults are developing, and allowing to intervene before the faults become permanent and impact our customers – now including the overhead lines in the scope of the project where they are adjacent to the LV system;
— started to receive the batteries for a project that provides batteries for vulnerable customers reliant on electrically powered medical equipment to avoid the negative effects of a temporary disconnection; and
— completed a project to improve the quality of resin mixing process to reduce faults associated with potted joints thus reducing the costs of operating the network.

Making sure our services provide **value for money** to our customers is one of our core priorities. In 2021–22, we:

— continued to pilot how we might ultimately utilise smart metering data operationally for the benefit of our customers, in particular, by using smart meter data for voltage control to reduce costs through Boston Spa Energy Efficiency Trial innovation project.;
— made progress with projects to access and utilise smart metering data;
— continued the development of a web-enabled tool[24] to allow customers to produce their own designs for straightforward connections to provide them with faster and more efficient customer service, co-designed with our stakeholders – see section 3.3 for more information; and
— the field use of small-scale unmanned aerial vehicles to help with routine network tasks and inspections moved into business-as-usual.

3.3 Roll-out of smart grids and innovation into business as usual

Customer flexibility roll-out

We continue to do what we can to identify opportunities for using customer flexibility in managing our network today, choosing flexibility where it is the most cost effective option.

A stakeholder consultation exercise in the year around a Network Options Assessment validated our proposals for action to be taken at two rural major substations – Normanby by Stow and Burton Pidsea. We identified that flexibility services were uneconomic and we proposed using a relatively low cost voltage regulation smart solution. This was supported by our stakeholders following an open and transparent consultation.

In the year we conducted two expressions of interest processes to signpost the 19 major substations where we may need to take action in the 2023-28 period due to the anticipated growth in demand for electricity. We engaged with 52 different organisations and established a firm foundation of market interest ahead of the tender that is taking place in 2022/23.

We published our second Flexibility Procurement Statement in March 2022, setting out our expectations for flexibility requirements for the coming year and giving stakeholders the opportunity to comment on our plans.

It is commonly recognised that our demand for electricity will increase as we strive for net-zero carbon emissions, e.g. for heat and transport such as electric vehicles. The bulk of our network was built between 1950 and 1980, when a significant amount of the power demand was from heavy industries, such as mining. Much of this power-intensive industry no longer exists. As a result, our network currently does not have many capacity constraints and major system risks are rare. This may change in the future, but at present is in stark contrast to other regions, where the need to procure flexibility may appear to be higher than on our own network, meaning that new capacity must be brought online or made available through flexibility before the load from heat and transport can be significantly increased. Any flexibility Northern Powergrid does need, we are committed to procuring at the lowest cost and highest return. This is because all costs are passed onto our customers, and we want to only buy flexibility that will reduce the bills for our customers. We also remain committed to investing customer flexibility or network reinforcement when we have a proven constraint on the network rather than investing significantly ahead of need.

We continue to develop standardisation on how we approach flexibility in collaboration with other DNOs through the ENA Open Networks initiative.

Roll-out of innovation into business as usual

Delivering innovative change is the only way we can continue to serve our customers and deliver the outcomes they value as the Innovation remains at our forefront. Innovation comes through a number of ways – from changes to how we run our business every day to collaborating with external parties and delivering projects we have funded through a variety of routes.

[24] Our AutoDesign tool is available from: https://www.northernpowergrid.com/auto-design

Delivering price or performance benefits to customers and society more broadly remains our focus in innovation, and innovation trials are simply a step along that journey. Inspired by new ideas promoted by third parties or by other network operators, and basing our decision on cost-benefit assessments, we deploy new solutions as standard practice. In 2021–22, we deployed (or continued to deploy) eight such solutions, and report on them in Table 8[25].

The connection of renewable energy was one of our main focus areas again this year and we connected a further 55MW. Our innovation in this area has progressed as set out in Table 8.

Distribution Future Energy Scenarios

Over the last 10 years, we have seen a reduction of the electricity demand from our network. In the future, we expect it increase significantly, as electricity is used to power transport and heating. We are putting a variety of measures in place to help prepare for this – such as load monitoring equipment on our substations and improving our approach to network planning.

To manage the uncertainty around how energy demands could change in the future, we use a scenario-based approach. This includes modelling heat pump and EV uptake trends, among others.

Our Distribution Future Energy Scenarios (DFES) explore a set of possible future pathways and scenarios. While presenting a local view, our DFES use a common language (including pathway names and core assumptions) with the other DNOs and the National Grid ESO, who produces future scenarios for the whole of the UK.

We publish this information as open datasets, a spatial visualisation tool, graphs, and an overview document. We are committed to developing and improving this approach, and refreshing our DFES every year[26].

AutoDesign

In February 2020, we launched an online self-service tool for low voltage connections. The tool, AutoDesign[27] – awarded the 'game changer of the year' at the 2020 Network Awards – can provide a connection design and an indicative budget estimate within minutes, instead of the usual 10-day turnaround. The intuitive new system is underpinned by real-world network data to help users identify the best location for a new connection. Since its deployment, AutoDesign has been used over 4,300 times and has resulted in estimated gross avoided costs of over £372,000.

174MW

of battery storage capacity connected to our network – 30% increase from previous year

Flexible connections

We have made good progress with active network management (ANM) with four zones providing 433MW of contracted flexibility. ANM offers customers a cheaper, faster connection in a constrained area of the network, which enables us to curtail generation at peak times. We have developed an approach that can be rolled out to further areas and we have accepted customer connections for six further suitable areas, three of which are progressing through the engineering phase. We expect to have four ANM zones in operation by 2023 with an estimated 537MW of customer contracted flexibility.

Battery storage

As of April 2022, our Embedded Capacity Register shows that we had 174MW of battery storage capacity connected to our network (which has remained the same from last year); the accepted (but not yet connected) capacity has increased significantly since last year, rising to just over 1,660MW.

Rolling out the smart grid

Our £83m smart grid enablers investment was our flagship programme within our ED1 Business Plan – providing the base control and communications capability to deliver more active network control and customer solutions for different areas of our grid. So far we've invested £41.3m in ED1 to date on this programme and we remain in full-scale rollout. We are installing LV monitoring on our network (over 2,000 monitors to date) to improve visibility of power flows and enable us to target investment where it's needed most. We will continue to roll out further monitoring for the remainder of ED1, enhanced with fault monitoring through the Green Recovery programme, and into ED2. Whilst technical challenges and the impact of COVID-19 delayed the initial stages of our smart grid programme, we are now in full rollout and the programme continues to accelerate with 2,520 units installed on the network and £23.7m invested during the year. This took our total expenditure in ED1 to date to £65.0m on smart grid enablement.

Our ED1 business plan envisaged £52m of additional smart grid reinforcement would be required on the network (Figure 5). This level of investment has not yet been required as we have seen a lower uptake in LCTs than forecast in our plan; we are however continuing to get our network ready for future rapid uptake. We continue to be proactive with our smart grid investment including replacing looped services, the cable used when two properties share a single electricity supply, to mitigate potential issues as a result of future low-carbon technology (LCT) uptake. In ED1 to date we have replaced almost 18,000 looped services at a cost of almost £16.8m.

Voltage reduction

The purpose of this programme is to create voltage headroom on our network so customers can connect. In 2021/22, we have completed 5 sites releasing a further 45 MVA of generation capacity. Through ED1 we have now completed 497 sites and it is estimated that these actions have released 4,473 MVA of voltage headroom to date, allowing connection of more distributed generation such as domestic solar PV to the LV network fed from each primary substation.

[25] For more information on the cost and benefit analysis that guide our investment decisions, see Annex 6 (a copy of our annual submission to the regulator of related information). CBA tables are published on: https://www.northernpowergrid.com/your-powergrid/environment. For more information on network innovation projects, refer to www.smarternetworks.org/ We did not apply to Ofgem for a relevant adjustment for the purposes of the Innovation Roll-out Mechanism (IRM), hence we have not had anything to report on this measure.

[26] Available from: https://odileeds.org/projects/northernpowergrid/dfes/

[27] https://www.northernpowergrid.com/auto-design

[28] Available at: https://www.northernpowergrid.com/contracted-capacity-register

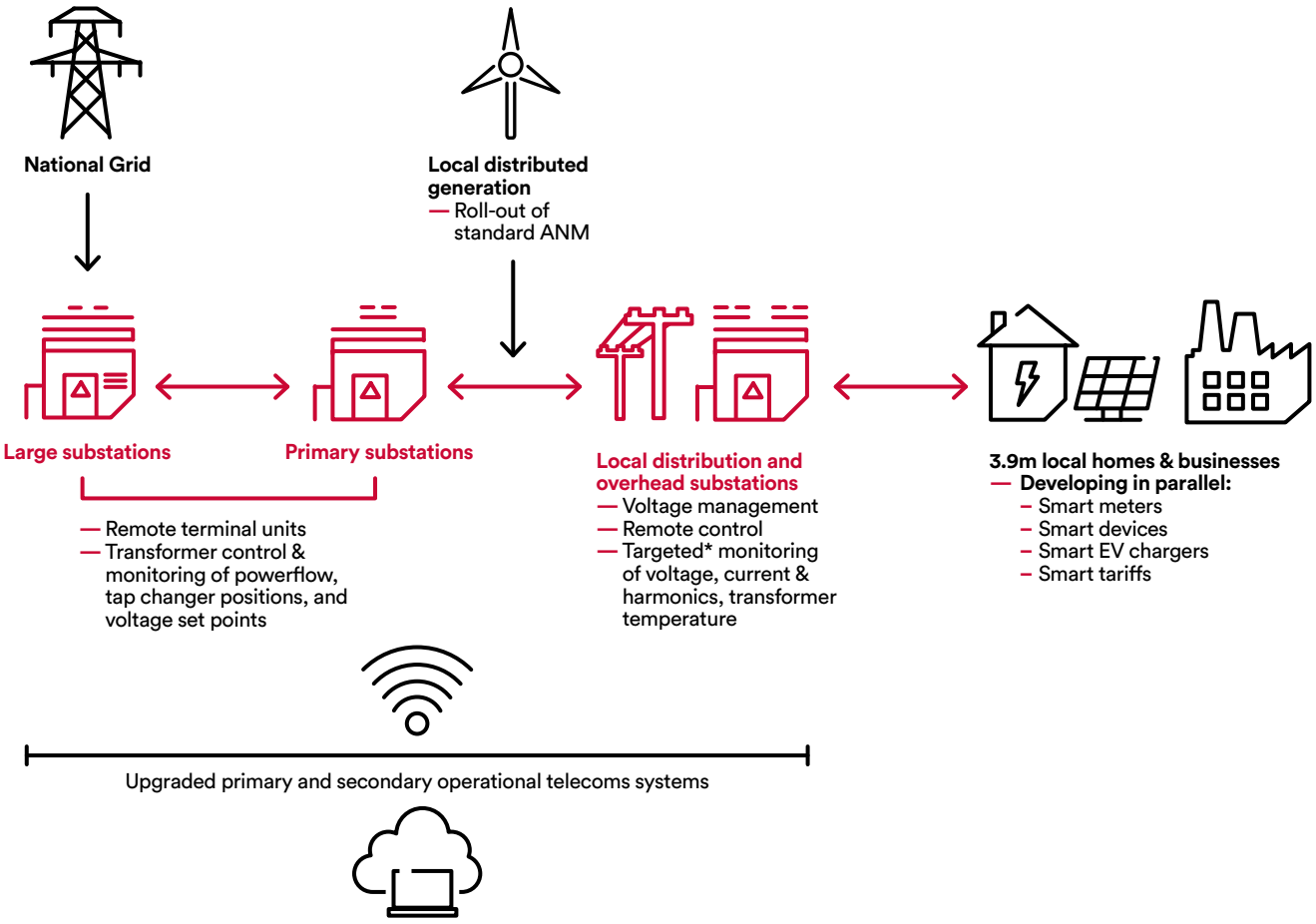
Table 8: Innovative solutions deployed

Innovative solution deployed (benefiting operational outcome)	Estimated benefits and impact 2021–22, resulting from the deployment	Deployment volumes 2021–22	Estimated deployment volumes 2022–23	Relevant innovation trial (when applicable)
Increase Network Capacity, Optimise Utilisation (Connections)				
Voltage reduction at primary Lowering the voltage on the HV networks creates headroom for the connection of rooftop solar panels on the LV system which would otherwise cause the voltage to rise above the upper statutory limit for penetrations greater than 30%.	Freed LV generation capacity: 45MVA	Deployed to 5 substations	38 substations	Customer-Led Network Revolution, Northern Powergrid and Voltage Reduction Analysis
Improve Connection Performance (Connections)				
Flexible connection agreements for generators Generation customers are offered an alternative connection quotation at a lower cost in exchange for occasional constraints on their export.	N/A	No new deployments this year	0	N/A
Autodesign is an innovative online tool that can help customers identify the best locations to secure new LV demand connections up to 210KVA. Customers are offered indicative connections costs in minutes rather than the usual 10 day turnaround.	Gross avoided costs: c. £0.18m	1,815	4,924	Autodesign: LV Connections Self-Service Tool
Improve Asset Life Cycle Management				
Transformer insulating oil online regeneration Treatment of the oil used as an insulator in a transformer to remove any acidity and moisture which extends its life.	N/A	Deployed at 9 substations	18	N/A
HV Circuit breaker retrofit Reduces capital investment compared to replacement and extends its life.	Gross avoided costs: £0.96m	24 retrofits	15	N/A
Improve Network Performance (Reliability and availability)				
LV technology programme A proactive approach to LV network intermittent faults by using new technology which will automatically restore intermittent faults and locate faulty kit.	Avoided customer minutes lost: c. 9.5 million Avoided customer interruptions: c. 4.3 million Gross avoided costs: £3.24m	No new units – continued redeployment of existing 1,081 (1,011 deployed during ED1) units	Continued redeployment of the existing units	The Smart Fuse, ENW
Automatic Power Restoration System (APRS) Identifies the location of faults on the HV network and speeds up resolution.	Avoided customer minutes lost: c. 775,500 Avoided customer interruptions: c. 147,200	Deployed to 56 substations	42	N/A
Improve Environmental Impact (Environment)				
SilentPower uses electric vans equipped with a battery payload as a cleaner, quieter method for restoring electricity supply after a power cut at single domestic or small business premises.	Avoided emissions: c. 30.72 tCO_2e Gross avoided costs: £0.17m	253 deployments	275	SilentPower

Smarter powergrid
A smarter network makes use of real-time information on network performance and energy consumption to respond to and manage demand and maintain a more efficient, affordable and low carbon flow of energy. By doing so, a smarter network will also enable the growth of new customer technologies such as electric vehicles, renewable generation and heat pumps, among others.

4,473MVA
generation headroom created by rolling out voltage reduction in ED1 to date

Figure 5: Smart Grid Enablers programme snapshot



Enhanced functionality:

— Greater visibility of network and asset operating conditions
— Enhanced network control systems and distribution analysis system to make informed decisions (such as deploying customer DSR)
— Improved data analytics (such as ability to predict faults leading to less disruption to supplies and detect EV connection hotspots)
— Secure and resilient operational communications links to receive data and issue commands
— New access to information about our customers' energy use

Customer benefits:

The ability to efficiently connect an increasing amount of low-carbon technologies whilst experiencing improved network resilience

* We are targeting LV monitoring at:
— Highly utilised & high loss networks
— Commercial centres
— LCT growth hotspots

3.4 Getting the most out of smart meters for our customers

The first smart meters were connected to the central meter reading services in Q4 2017. We ensured we had our system in place and our people ready to start delivering a better service to our customers from the moment the first smart meter was connected; we achieved that goal[29]. We have been regularly reviewing our processes to ensure we continuously look for ways to better utilise smart metering data as meter numbers increase.

3.4.1 Progress towards mass roll-out

The roll-out of smart meters has continued and we expect it to pick up pace over the next few years. We are continuing to support the roll-out of smart meters, in line with our business plan commitments and our smart meter roll-out strategy (see Figure 6).

The pandemic lockdowns during this period have impacted suppliers' smart meter roll-out activities. Technical issues with the national smart meter service have continued. A slower roll-out of second generation meters in our licence areas mean that the data, which we'll use to improve our network performance, isn't yet reliable enough, nor available in sufficient volumes, to be used operationally. This year we continued focusing on validating the data we received and working with other DNOs to assist industry parties to resolve technical defects relating to the format and delivery of voltage, outage and restore alarms.

3.4.2 Supporting the roll-out

The roll-out of the smart meters is being led by energy suppliers, but DNOs are essential enabler to the delivery of smart meters. We have:

- delivered defect repairs at customer premises in line with agreed industry service level agreements.
- been providing reports to energy retailers and their meter operators to provide visibility of our performance to ensure efficient resolution of any issues identified on our network that are preventing smart meter installations.
- extended the pilot of our online appointment booking tool for suppliers' agents, made enhancements and continued testing. The web tool will allow meter installers to arrange for defects to be dealt with directly with our service provider with the customer's agreement, allowing the installer to co-ordinate their return and avoid unnecessary disruption for customers.

Safety, planning and innovation underpin our approach to collaborating with energy suppliers and meter operators in order to make sure the UK's smart meter roll-out runs as smoothly as possible in our region.

- This year, we authorised almost 970 meter operator installers to work safely on our equipment, of which 41 of them having been accredited at our own training facilities.
- When meter operatives encounter an issue meaning installation cannot go ahead on the initial visit, we've ensured that we've got the manpower in place to resolve the defect as soon as we can.

Table 9: Smart meter installations in 2021–22

	North East	Yorkshire	Northern Powergrid
Smart meters deployed by suppliers in the Regulatory Year 2021–22	109,403	165,256	**274,659**
Total meters eligible for transition to smart	1,588,657	2,282,865	**3,871,821**
% penetration	6.9%	7.2%	**7.1%**

13,507 smart meter defects
resolved within target timeframes

274,000+ smart meters
installed by energy suppliers

[29] For more information on the smart meter roll-out, refer to the government website www.smartenergygb.org

Figure 6: A summary of our strategic plan to support the smart meter roll-out and maximise its benefits

Optimise and develop

— Support SMETS2 roll-out, continue defect resolution
— Start benefits realisation tracking
— Refine organisational structure
— Innovation projects – support early benefits

Integrate and innovate

— Systems Integration Roadmap defined
— Remaining smart meter process in place
— Deliver enduring integration projects
— Develop benefits tracking
— Innovation projects – wider benefits

3.4.3 IT and communications investment

We've been busy making all the necessary changes to systems and business processes. This year we:

— remained compliant with our security obligations and continued to make progress on a series of projects to make sure customers benefit by ensuring our systems are ready for all meters as they are enrolled into the national infrastructure. Table 10 summarises the smart meter IT and data costs that are passed through to our customers that we have incurred this year[30].
— worked with the suppliers who operate in our region to ensure the safety of roll-out activities.
— monitored our business processes and where necessary improved our working practices to deliver the most benefits for customers.

3.4.4 Actions we expect to take next year

In 2021–22, we expect to move from the Optimise & Develop phase to the Integrate & Innovate stage (Figure 6) as we expect meter volumes to increase from late 2020. We will be developing our process and organisational structure to meet the increased amount of work.

We look forward to progressing the benefit delivery actions that will underpin the customer benefits (Table 11) we are targeting. We will update the IT Gateway that we use to link to the national service so that we can communicate with SMETS1 early generation smart meters.

We are excited to be able to interact with those early generation smart meters that are being enrolled in the national service. We have started tracking benefits and will begin some innovation projects.

Table 10: IT and communications costs for 2021–22

	£m
Smart Meter Communication Licensee Costs (pass through)	4.3
Smart Meter Information Technology Costs	2.0
Elective Communication Services	0.0
Smart Meter Communication Licensee Costs (outside price control)	0.0
Total	**6.3**

Notes for Table 10

— Smart Meter Communication Licensee Costs: the charges paid by the licensee to the holder of the Smart Meter Communication Licence as a requirement for it to be a party to the Smart Energy Code.
— Smart Meter Information Technology Costs: any information technology costs that the licensee reasonably incurs and are necessary for them to use data from smart meters effectively for the efficient and economic operation and maintenance of its Distribution System.
— Elective Communication Services: Payments for discretionary data services purchased through bilateral agreements with the Data Communications Company (DCC). Elective Communication Services may be requested by the DCC's customers, however as at the end of the 2020–21 Regulatory Year the DCC had not entered into any bilateral agreements with its customers for Elective Services.

[30] More information is provided in Annex 5 (a copy of our annual submission to the regulator of related information) and in the 'Detailed commentary' document associated with it.

Table 11: Smart meter benefits actions in 2022–23

Actions	Benefits for customers
— Upgrade our IT systems to process smart meter data which may help us better understand power used by our low voltage electricity customers and how to measure network losses more accurately.	Avoided losses to network operators.
— Upgrade our IT systems to process smart meter data (including automated power cut alerts) and make it available to our operational teams. — Integrate alerts in the redesign of our operational process to allocate staff to power cut repairs.	Reduction in the length of power cuts.
— Upgrade our IT systems to process smart meter data (including automated power cut alerts) and make it available to our operational teams. — Integrate alerts in the redesign of our operational process to locate faults.	Reduction in operational costs to fix faults.
— Upgrade our IT systems to process smart meter data (including automated power cut alerts) and make it available to our operational teams. — Integrate alerts in our distribution network outage management system. Although levels of inbound calls may drop, outbound contact with our customers will remain high as we proactively update customers about power cuts and the time they can expect their power back on.	Better power cut communication.
— Upgrade our IT systems to process smart meter data (including automated voltage alerts) and make it available to our operational teams. — Integrate the information flowing from the data in the redesign of our network planning processes relating to new connection design, reinforcement design and voltage quality assessment.	Better informed investment decisions for electricity network reinforcement for quality of supply.
— Upgrade our IT systems to receive smart meter data (including automated power cut alerts). — Integrate alerts in the redesign of our operational process to allocate staff to power cut repairs. — Integrate the information flowing from the data in the redesign of our network planning processes relating to voltage quality assessment. This is particularly exciting as it is an area where we currently hold very little data, other than when a customer notifies us of a voltage problem.	Avoided cost of investigation of customer complaints about quality of supply.
— Progress our request to Ofgem for half-hourly consumption data from smart meters to help us better understand the usage profiles of low voltage electricity customers and explore ways to save money on network improvements.	Network capacity investment savings from electricity demand shift.

Contact us regarding our plan

We believe that our customers and stakeholders are the best judges of our performance. We always want to hear your views and opinions on the services we provide and your ideas for what we could be doing. If you would like to comment, you can contact us in a number of ways:

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(for power cut information and advice)

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