

Delivering your future electricity transmission system

National Grid Electricity Transmission's
business plan 2021–26



Please be aware that there is a complementary document that provides an explanation and reason for each redaction contained within this plan on our website.

Executive summary

Navigating our plan against Ofgem's business plan guidance

Our regulator, Ofgem, the RIIO-2 challenge group and the independent stakeholder group for our company have asked that we clearly show how our stakeholder-led plan aligns with Ofgem's business plan guidance categories. We do this in the table below.

Ofgem guidance section	Relevant parts of our plan	Ofgem guidance section	Relevant parts of our plan
 Track record	<ul style="list-style-type: none"> • Chapter 4: Our track record. • Each of chapters 7 to 14 includes a section 2 summarising our track record. • Annex ET.04: T1 performance. • Annex ET.09: Our performance. 	 Modernising energy data	<ul style="list-style-type: none"> • Annex A14.07: IT investment and digitalisation strategy
 Business plan commitment	<ul style="list-style-type: none"> • Executive summary: Our Board assurance statements. 	 Enabling whole system solutions	<ul style="list-style-type: none"> • Chapter 5.2 on whole systems • Chapter 7: Ongoing transition to the energy system of the future. • Chapter 8: Easy to connect to and use the network. • Annex A7-8.03: Whole systems.
 Minimum requirement	<ul style="list-style-type: none"> • Annex ET.10: Business plan guidance minimum requirements matrix. 	 Managing uncertainty	<ul style="list-style-type: none"> • Each of chapters 7 to 14 includes a section 7 on how we will manage risk and uncertainty. • Annex ET.12: Uncertainty mechanisms. • Annex A14.14: Real price effects and ongoing efficiency.
 Consumer value proposition	<ul style="list-style-type: none"> • Chapter 5: on the consumer value proposition. • Annexes ET.07 to ET.07C on the consumer value proposition. 	 Innovation	<ul style="list-style-type: none"> • Chapter 12: Being innovative. • Annexes A12.01 to A12.03. • Each of chapters 7 to 13 includes innovation in section 5.
 Giving consumers a stronger voice	<ul style="list-style-type: none"> • Chapter 6: Giving stakeholders and consumers a stronger voice. • Engagement logs for each stakeholder priority. • Each of chapters 7 to 13 includes a section 3 explaining how our proposals are based on the outcomes of our engagement. 	 Competition	<ul style="list-style-type: none"> • Chapter 5.1 on competition. • Early and late competition are in Chapters 7 and 9. • Native competition is in Chapter 14.
 Meet the needs of consumers and network users	<ul style="list-style-type: none"> • Each of chapters 7 to 13 includes a section 4 explaining how we are meeting the needs of consumers and network users in "Our proposals for the T2 period". • Annex ET.08 on outputs. 	 Forecasting and scenarios	<ul style="list-style-type: none"> • Chapter 2: the route to net-zero emissions. • Chapter 3: The common energy scenario and managing uncertainty. • Chapter 7: Ongoing transition to the energy system of the future. • Chapter 8: Easy to connect to and use the network.
 Maintain a safe and resilient network	<ul style="list-style-type: none"> • Chapter 9: Safe and reliable network. • Chapter 10: Protect the network from external threats. • Annexes A9.01 to A9.20 and A10.01 to A10.11. • Annex A16.02 on workforce planning. 	 Cost information	<ul style="list-style-type: none"> • Chapter 4: Our track record • Chapter 14: Our total costs and value for money. • Annexes A14.01 to A14.20. • Each of chapters 7 to 13 includes cost information in sections 5 and 6. • Investment Decision Packs. These include our engineering justification reports and cost-benefit analysis (CBA). • Our business plan data templates and associated table narratives.
 Deliver an environmentally sustainable network	<ul style="list-style-type: none"> • Chapter 2: The route to net zero greenhouse gas emissions. • Chapter 7: Ongoing transition to the energy system of the future. • Chapter 11: The environment and communities. • Chapter 12: Being innovative. • Annexes A11.01 to A11.11. 	 Financial information	<ul style="list-style-type: none"> • Chapter 15: How our plan should be financed. • Annexes A15.01 to A15.01G.

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Executive summary

Welcome to our business plan from the Chair of our board



Nicola Shaw
Chair of National Grid
Electricity Transmission

Electricity is vital to our modern lives. At National Grid Electricity Transmission we have the privilege to provide this essential service to you. We are rightly proud of the quality of the service our dedicated team has provided to you up to now, including high levels of reliability, helping reduce greenhouse gas emissions and protecting your electricity supply against external threats. But we are restless to provide an even better service to you going forward.

We have carried out our largest ever engagement exercise with our customers, stakeholders and consumers for this business plan. You provided us with clear feedback on what is important to you: a reliable and resilient network that can support the changing energy system, while keeping bills low. You also want us to care more about the communities we work in and be more open in explaining our performance.

For the first time, we have built our business plan around your priorities. We hope this will make our plan easier to understand and clearer on what we will deliver and why it matters to you. This represents an important further step in our organisation being more customer-focused and open.

Your top priority is having a reliable electricity supply. We can reassure you that reliability is at the heart of this plan.

Our plan covers a crucial period when we all expect rapid change in the energy system to dramatically reduce carbon emissions to achieve the UK's net-zero target by 2050. Our plan highlights specific opportunities within the regulatory framework, to enable and accelerate

the UK's progress to net zero. We are putting forward collaborative, innovative, and whole-system solutions to support policymakers. We are reinforcing this with commitments to reduce our own emissions to deliver the UK's net-zero target and ensure no one is left behind in the energy transition.

We know that budgets are tight and that the cost of our plan matters to you. We have extensively challenged the cost of this business plan. We have benchmarked our costs against similar companies and tested our costs in the market place. The result is that we can deliver the investment required to maintain a reliable and resilient network, while keeping flat or reducing our part of energy bills, excluding inflation. In independent testing, 87 per cent of consumers (household and business combined) found our plan and its bill impact to be acceptable.

A theme we picked up from our engagement is that you don't just care about what we deliver but how we deliver it. We agree. We will continue with the deep levels of engagement we have used to develop our business plan in the future. We will work together with other organisations to achieve the best whole-system solutions to reduce carbon emissions.

Two independent stakeholder groups of experts have challenged our plan to make sure we are addressing your views. I would like to thank all of you, including the stakeholder groups, for the time and effort you have committed to creating and improving our plan.

Net zero

Our target is to reduce our own direct greenhouse gas emissions to net zero by 2050.



Executive summary

1. Executive summary

The key messages from our business plan are

- We have listened to you extensively and built our business plan around our stakeholders' and consumers' priorities. Independent stakeholder groups have challenged our plan and how well it reflects your priorities.
- Our business plan helps reduce the energy system's greenhouse gas emissions. We also propose flexibility and innovative options to help deliver the UK's net zero by 2050 target.
- We are proposing to invest **£7.1bn** to deliver this plan. This is 18 per cent higher in annual terms than in the current period, because we are investing more in the network to make it reliable, resilient and low-carbon.
- We have fully built in the benefits of our successful innovations and efficiencies from the current period, saving you at least **£707m**.
- We have challenged ourselves hard to reduce our costs further through rigorous benchmarking and are committing to finding a further **£383m** of efficiency savings.
- We are proposing a package of measures to improve the environment and to support vulnerable consumers and disadvantaged communities.
- We provide evidence for why adjustments are required to Ofgem's proposed financial framework to make sure our plan is sustainably financeable across a range of credible future scenarios.
- Our plan delivers the outputs and services you have asked for while **keeping flat, or reducing, our part of energy bills**, excluding inflation. We estimate our plan will cost **£23.60** on the annual average household energy bill.

£383m

of future efficiency savings

£7.1bn

of investment

£23.60

Cost of this plan on the average annual household energy bill



The route to net-zero emissions

We have developed our business plan since July in the context of the government's legislation for the UK to achieve net zero greenhouse gas emissions by 2050. Reducing greenhouse gas emissions has also been a key theme coming out of our stakeholder engagement.

This plan covers a crucial period for investment to help deliver the UK's net-zero target. The route to net-zero emissions is not yet clear but our business plan is flexible enough to deliver the investment needed in the 2020s.

Giving stakeholders and consumers a stronger voice

We have built our business plan around your eight stakeholder priorities and three consumer priorities.

Over the last two years we have carried out our most extensive engagement exercise ever. We have engaged with over 1,000 individuals covering all our main stakeholder groups. We have also listened to over 11,000 households and over 750 business consumers through meetings, focus groups and surveys.

We have provided more information about our emerging ideas for our business plan to you than ever before. And we thank you for your feedback.



Executive summary

Your priorities

What you've said

As consumers, you've told us:

- I want an affordable energy bill.
- I want to use energy as and when I want it.
- I want a sustainable energy system.

As stakeholders, you've told us your eight key priorities as set out in the outer ring of the diagram below.

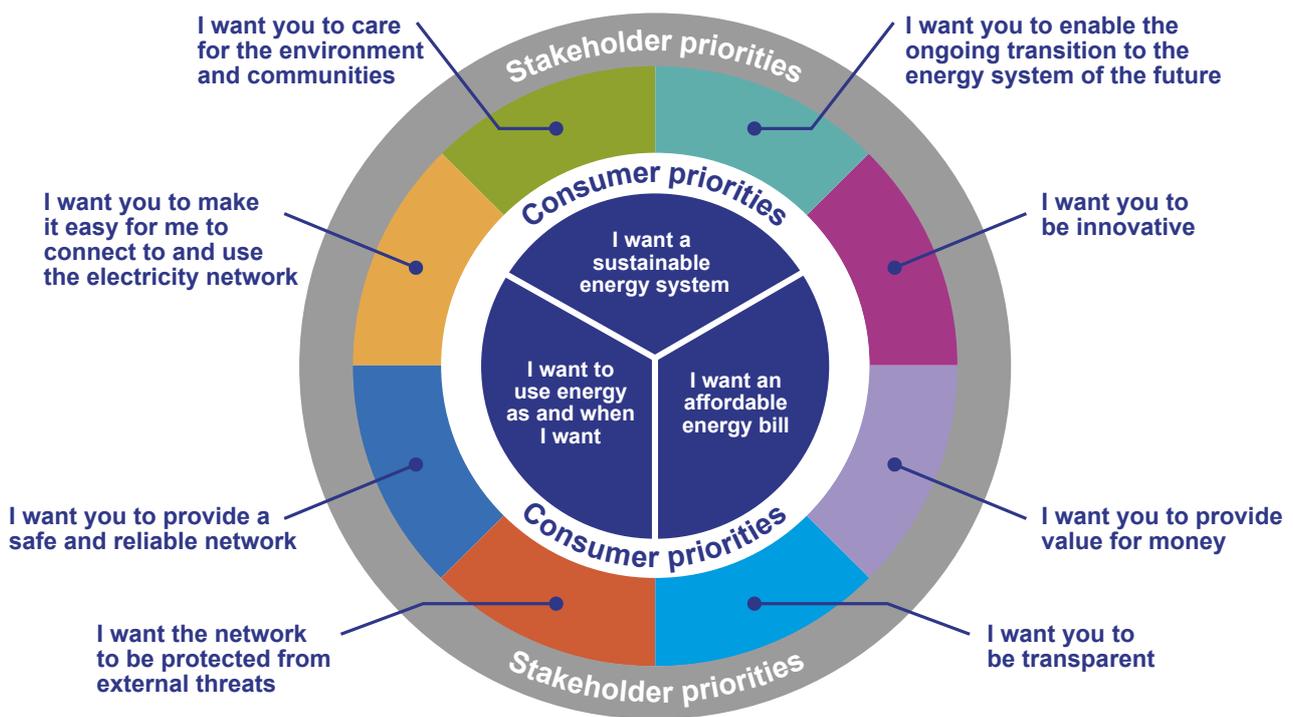
Your views have made a genuine difference to our business plan as we explain throughout this document and in the "what's changed" section.

In some areas our stakeholders have different views, for example, on how far our environmental commitments should go. We have had to make trade-offs to produce our plan and, where we have done so, we explain how we reached our view.

The independent stakeholder group has challenged us to take full account of your views and balance them appropriately.

Later in this executive summary, we explain how our plan delivers against your priorities.

Figure 1.1: The stakeholder and consumer priorities underpinning our plan





Executive summary

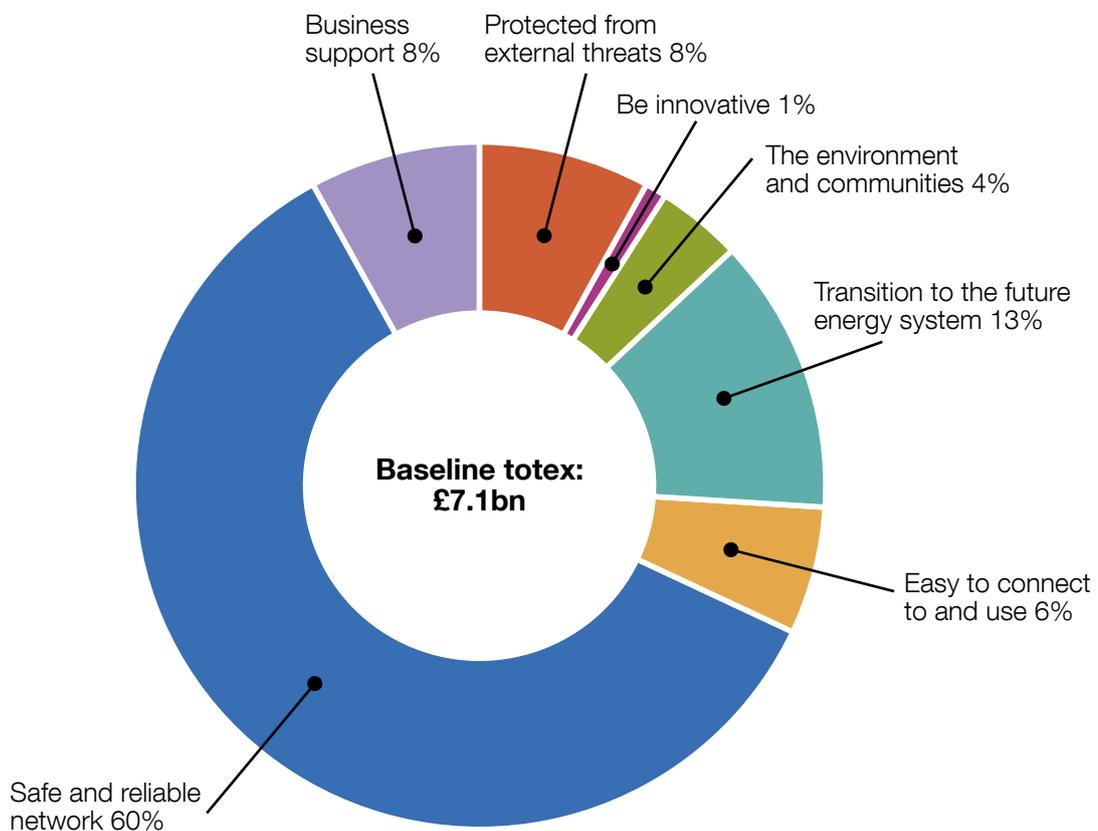
The cost of our business plan

The baseline total expenditure (totex) in our business plan is £7.1bn for the five-year period from 2021–22 to 2025–26.

The diagram below shows how our forecast baseline expenditure breaks down across your stakeholder priorities. The diagram also includes our business support costs, such as IT, finance and human resources that help us deliver against your priorities. Independent experts have benchmarked these costs to make sure they are efficient.

We have reduced our totex by £0.3bn since our first draft plan on 1 July. This reduction reflects that we have included £81m of efficiency savings into this plan as we signalled we would do in our July plan. We have also removed some expenditure from our baseline plan due to updates to Ofgem's guidance and as we have done more work on our cost-benefit analyses.

Figure 1.2: A breakdown of the baseline costs of our plan by stakeholder priority



We have only included more certain costs in the baseline funding we are requesting. Our baseline totex is high-cost confidence (a RIIO-2 regulatory term) because:

- we have benchmarked our costs against international comparators;
- we have challenged the vast majority of our costs against our past track record;
- the vast majority of our costs are subject to competitive processes; and
- we have excluded uncertain costs from our baseline and proposed more and improved uncertainty mechanisms to accommodate uncertain costs that might occur in the T2 period, reflecting changing consumer needs.



Executive summary

The future is uncertain, but our plan is flexible

Our business plan uses a baseline forecast built on the common energy scenario. This is a view of future energy demand and supply patterns that we have developed with the other energy network companies (see chapter 3 for more details).

We have considered low and high-cost variations on our plan to show the differences in the outputs we would deliver for consumers.

The RIIO-2 Challenge Group has asked us to present a **low-cost variation** to our plan. It uses historical actual expenditure to set a cost ceiling for our operating costs, network reliability, resilience and the environment along with an efficiency improvement of 2 per cent per year in these areas.

This low-cost variation would reduce our baseline expenditure to **£4.9bn** for the T2 period, but does not deliver the primary outputs that our stakeholders have asked us for. Most importantly this variation would result in a very significant deterioration in network reliability, no investments to support communities or the environment and would create risks to achieving the UK's net zero target in the future. We do not consider this variation is a desirable outcome for consumers. It is a tool for exploring the consequences of lower totex. We set out this variation and the implications for consumers and stakeholders in more detail in Annex ET.11 RIIO-2 Challenge group totex sensitivity analysis.

We have also tested a **high-cost variation** to our baseline plan, that costs **£10.1bn**. This scenario consists of the £7.1bn baseline plus:

- us, rather than competing businesses, carrying out some large construction projects that are in the common energy scenario adding £1.45bn;
- uncertain customer-related expenditure such as harmonic filters, adding £0.46bn;
- the Hinkley Seabank project, adding £0.43bn; and
- additional visual impact and urban improvement projects (subject to stakeholder views) and currently uncertain cyber security expenditure, adding £0.62bn.

In addition to the high-cost variation we also have flexibility mechanisms that would allow us to deliver faster if decarbonisation accelerates towards meeting the UK's net-zero target.

We know the future will likely turn out differently to the common energy scenario. **We have built flexibility into our plan.** Our plan includes uncertainty mechanisms to adjust our outputs and revenue up or down to make sure consumers only pay for the outputs we deliver. Our plan also has whole system uncertainty mechanisms for where it is currently unclear which party is best placed to deliver the best outcome for consumers. Chapter 7 and annex ET.12 provide more information on our proposed uncertainty mechanisms.

We are investing more in the network in the T2 period

Our total business plan expenditure is increasing by 18% from the T1 to the T2 period, on a comparable annual basis. Even so we are reducing the costs of operating our business in real terms during the T2 period by finding ways to become even more efficient. The increase in expenditure is because we will be investing more in our network infrastructure, for two main reasons:

- The age and condition of the transmission network means more of it is due for replacement in the T2 period than in the T1 period on a comparable annual basis. Replenishing these assets is essential to providing consumers with the reliable network they need for the future as we all become more reliant on electricity to achieve net-zero greenhouse gas emissions.
- The threat posed by cyber attacks on our systems and all electricity networks is evolving. We must invest more in technology and infrastructure to protect against the cyber threat to a highly resilient transmission network for consumers.





Executive summary

Delivering your priorities



We will enable the ongoing transition to the energy system of the future (chapter 7)

£936m

expenditure over five years

We are proposing £936m of expenditure over five years in our baseline plan for enabling the ongoing transition to the energy system of the future.

The main outputs we will deliver for you are:

- We will invest to increase network capacity by 22.5 giga-watts (GW), which will avoid system operation costs of at least £250m per year.
- We will invest in equipment and technology to support the electricity system operator (ESO) to operate a net-zero carbon electricity system by 2025.
- We are proposing to lower the cost of the energy transition by enabling flexible, competitive, whole system and non-build solutions.
- We are proposing strategic network options to accelerate the UK's progress towards net-zero greenhouse gas emissions.

Consumer benefits

Our outputs will allow the UK to make progress towards a net-zero energy system at the lowest total cost for bill payers. We will help reduce greenhouse gas emissions, benefitting future consumers and society more broadly. We will make sure the electricity network can still deliver electricity where and when it's needed to consumers even as the energy system changes.



We will make it easy for you to connect to and use the electricity network (chapter 8)

£417m

expenditure over five years

We are proposing £417m of expenditure over five years in our baseline plan for making it easy for you to connect to and use the network.

The main outputs we will deliver for you are:

- We will connect 15.3 GW of customer capacity, providing the UK with clean power, flexible storage and access to clean and cheaper power from Europe.
- We will invest in additional transformer units to provide more network capacity for our demand-side customers.
- We will provide an agile service tailored to suit the needs of our rapidly changing customer base. We will do this by investing in our customer relationships and support systems.
- We are proposing output delivery incentives (ODIs) to manage outages better and deliver faster connections.

Consumer benefits

By linking up new generators to the network more quickly and efficiently we can help increase wholesale electricity market competition, putting downward pressure on costs for consumers. We will help reduce greenhouse gas emissions, by connecting low-carbon generators, benefitting future customers and society more broadly. We will improve our customers' experience by more effectively meeting their needs, which will help the whole electricity system run more smoothly, potentially lowering costs for consumers.



Executive summary



We will provide a safe and reliable network (chapter 9)

£4,287m
expenditure over five years

We are proposing £4,287m of expenditure over five years in our baseline plan to provide a safe and reliable network.

The main outputs we will deliver for you are:

- We will deliver world-class levels of safety and maintain our service reliability of 99.9999 per cent.
- We will invest to renew and modernise 6 to 19 per cent of our different network asset types to maintain reliability for future generations.
- We will deliver three major electricity cable projects in London, Sheffield and North Wales to maintain security of supply.
- We will divert our river-crossing on the Tyne to support growth in manufacturing (including wind turbines) in the North-East of England.

Consumer benefits

Our outputs will make sure that we protect the public from harm. We will maintain our current high levels of reliability so that electricity is available whenever and wherever current and future consumers want it.



We will protect the network from external threats (chapter 10)

£555m
expenditure over five years

We are proposing £555m of expenditure over five years in our baseline plan to protect the network from external threats.

The main outputs we will deliver for you are:

- We will improve the resilience of our business IT systems and operational technology to cyber attacks.
- We will replace the 1,850km of fibre optic cable and related equipment at 274 sites that support the transmission network.
- We will improve protection of 100 (nearly one third) of our operational sites from the risk of flooding due to climate change.
- We will deliver the expected new government standard for a Black Start recovery in the case of a full or partial shutdown of the network.

Consumer benefits

Our outputs will make sure that your electricity supply will be better protected from cyber attacks, physical attacks and extreme weather events. We will also be able to restore your electricity supply more quickly in the case of a full or partial shutdown of the network.



Executive summary



We will care for the environment and communities (chapter 11)

We are proposing £255m of expenditure over five years in our baseline plan to care for the environment and communities.

The main outputs we will deliver for you are:

- We are identifying and pursuing the best way to reduce our scope 1 and 2 carbon emissions by at least one third, in-line with a path to net-zero.
- This will involve brave leadership on the SF₆ insulation gas, increasing the number of electric vehicles in our fleet and sourcing 100 per cent of our metered electricity from renewables.
- We will achieve net-zero construction emissions and 75% of our top 250 suppliers will have carbon reduction targets.
- We will increase the natural capital of our non-operational land by 10 per cent and improve our use of natural resources.

£255m

expenditure over five years

- We will use a stakeholder-led approach to reducing the visual impact of our existing assets in designated landscapes and to improving our assets in disadvantaged urban areas.
- We will support communities and wider society by providing educational and employment opportunities and by championing wage fairness through our supply chain.
- Together with our gas transmission business, we commit to up-skilling 6,000 people for the transition to the net-zero energy system, focusing on the lower-income communities we serve.

Our outputs for this priority will benefit current and future consumers by reducing greenhouse gas emissions, enhancing the natural environment and supporting communities.



We will be innovative (chapter 12)

We are proposing a programme of innovation projects that will support the delivery of our long-term strategic goals to provide a safe, reliable and resilient network, decarbonise energy networks and deliver value for consumers and society.

In the T2 period, we will continue to transform our culture to better deliver consumer benefits through our 'business as usual' activities, for which we are not seeking additional innovation stimulus funds.

To achieve consumer benefits in the T3 period and beyond, we are proposing an £84m programme of work funded through Ofgem's Network Innovation Allowance (NIA) provisions, with a compulsory contribution from us of 10 per cent.

The main outputs we will deliver for you are:

- We commit to create a more innovative, creative and performance-based culture across our organisation.

£84m

expenditure over five years

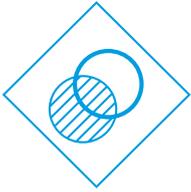
- We will explore how digitisation, artificial intelligence and data sharing could reduce our asset management costs.
- We will deliver a programme of innovation focused on reducing greenhouse gas emissions, such as finding and using alternatives to high-carbon materials on the network and opening up the Deeside innovation testing facility to all organisations.
- We commit to improve how we work with stakeholders on innovation, being more accessible, easier to work with and creating a joint innovation monitoring framework with all energy network companies.

Consumer benefits

Our outputs for this priority will benefit current and future consumers through lower costs, continued reliability of the network and quicker progress to a clean energy system.



Executive summary



We will be transparent (chapter 13)

We are proposing £1m of expenditure over five years in our baseline plan for transparency.

£1m

expenditure over five years

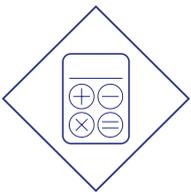
- To clearly show our commitment to this business plan we will make sure our leadership team's remuneration is linked to delivering the outputs in it.

The main outputs we will deliver for you are:

- In the T2 period, we will be clearer than ever on how what we deliver for you links to our financial performance.
- We propose that an independent stakeholder group will challenge us on our delivery of the outputs in our business plan and the clarity of our reporting.

Consumer benefits

Our outputs for this priority will mean consumers can see much more clearly what they are getting in return for paying our part of their energy bills. Consumers will benefit from an independent stakeholder group holding us to account for delivering against our commitments. A clear link between our leaders' pay and our delivery of outputs for you ensures our interests are aligned with yours.



Our total costs and how we will provide value for money (chapter 14)

The eighth of your stakeholder priorities is that we should provide value for money.

We recognise that budgets are tight, and we have challenged ourselves hard to reduce the cost of our business plan by £1.1bn or 13 per cent. As we explain in chapter 14, we use a range of techniques to make sure our costs are efficient, such as market testing and independent benchmarking.

We have built in the direct benefits of our past successful engineering and asset management innovations into this plan, saving at least £707m. We consider this is an underestimate of the savings because in many cases it isn't possible to quantify what the cost of our previous approach would have been.

We are also making several stretching commitments to **future efficiency savings worth in total £383m** as follows:

- We are committed to delivering the benefits of our stretching UK efficiency programme. This is an efficiency commitment of £200m.

£1.1bn

of past and future efficiency savings

- Independent specialist consultants have benchmarked our capital investment unit costs against similar international companies. While the benchmarking showed our plan is £100m cheaper overall than industry mean costs, we are committing to moving all the above-mean unit costs in our plan to the industry mean. This is an efficiency commitment of £43m.
- We are making a stretching commitment to improve the productivity of our operating costs and the costs in our capital plan that relate to our people by 1.1 per cent per year, almost three times the current UK productivity increase forecast. This is an efficiency commitment of £84m.
- We have benchmarked our business support costs. We will move all our support function costs to be upper quartile. This is an efficiency commitment of £29m.
- We will apply innovative solutions to address the life-limiting components of protection and control systems. This is an efficiency commitment of £27m.



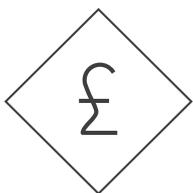
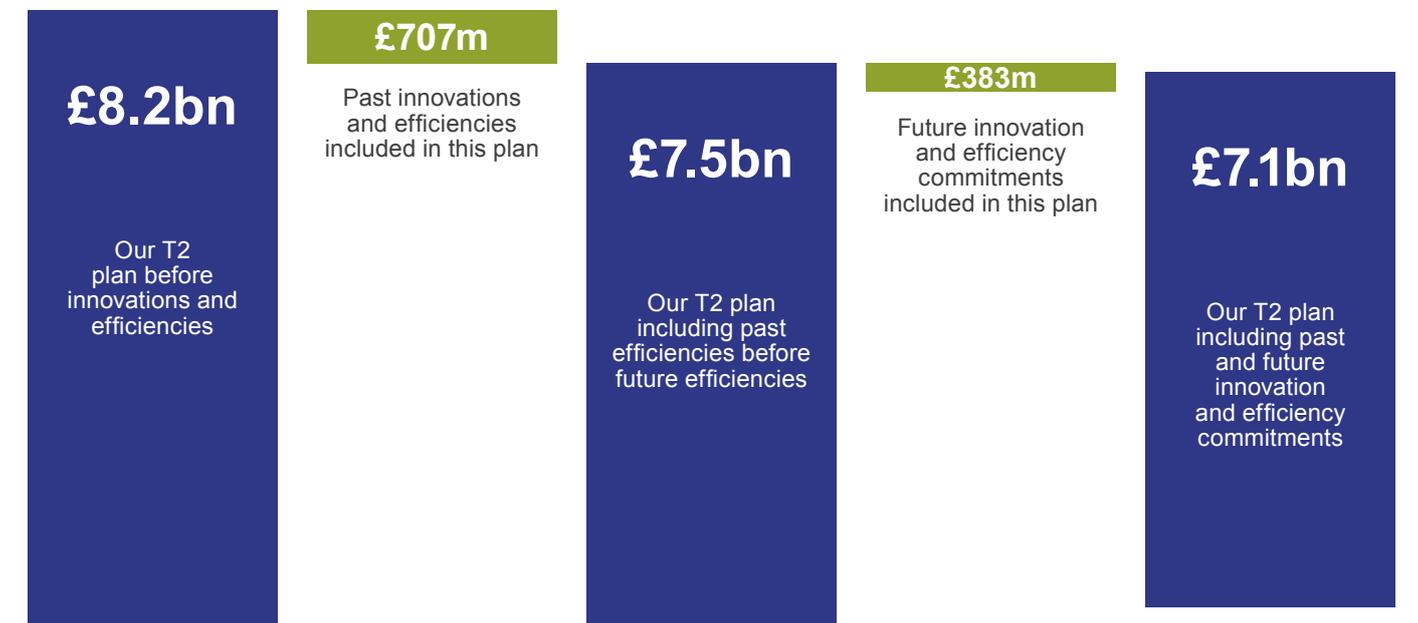
Executive summary

Figure 1.3 shows the £1.1bn of efficiencies we are committing to in the plan. They break down into £707m for building our past innovations and efficiencies into this plan and £383m for our commitments to future efficiency improvements in the T2 period.

We provide more detail on these efficiency savings in chapter 14.

We are committed to enhancing competition where it is in consumers' interest. In our plan we have identified the projects that meet Ofgem's early and late competition criteria. We are also committed to leveraging our scale, buying power and best practice to improve the value for money we achieve for consumers through our procurement process (which Ofgem calls "native competition"). See chapter 5.1 on competition for more details.

Figure 1.3: A breakdown of the efficiency savings in our business plan



How our plan should be financed (chapter 15)

Our stakeholders want us to take a leading role in ensuring a healthier and greener, net-zero future for the UK, while maintaining energy security at the lowest possible cost for consumers. The scale of this challenge is significant, requiring substantial investment in new technology and infrastructure to deliver clean electricity, transport, heating and industry: sectors which today make up 76 per cent of UK greenhouse gas emissions. It is vital that we have a regulatory framework that encourages

long-term investment and provides an adequate financial reward for the risks we take in leading the change.

Within our plan, we provide evidence that Ofgem's proposed financial framework, including the use of 4.3 per cent cost of equity, does not enable us to maintain our current financial resilience and reduces our ability to take risks and innovate in a critical period of whole-system change. Ofgem's proposed framework reduces our bill impact in the short term, but will increase total energy bills in the medium and long term. We set out an alternative, sustainable financial framework which reduces our impact on consumer bills in the short, medium and long term, yet still incentivises investment at a time when it will be critical for the UK in achieving a net-zero future.



Executive summary

The impact on bills

The impact on household bills

Our annual average cost on a household electricity bill in the current regulatory period is just over £24 (in 2018-19 prices).

We will deliver our plan while **keeping flat or reducing our part of the household energy bill**, excluding inflation.

This is the result of:

- a lower return for the investors in our company compared with the current price control period;
- a reduction in average household use; and
- our strong commitments on efficiency, which have reduced the cost of delivering our outputs compared to what it would have been otherwise.

Our estimate of the cost of this plan on the annual average household bill is around £23.60 (in 2018-19 prices). This is a bill reduction of about 55p per year, or 2 per cent of our part of the average annual household consumer's bill.

We discussed low-totex and high-totex scenarios above. Using these scenarios and both Ofgem's and our proposed financial packages implies a range of approximately £21 to £25.50 for our part of the average annual household bill.

£7.1bn
of investment

£23.60

Cost of this plan on the annual average household bill

87%

of respondents find our plan to be acceptable

The impact on industrial, commercial and our direct customers' bills

The effect of this plan on industrial, commercial and our direct customers' charges will depend on their location, the type of contract they have and their energy use.

Customers have told us that we should give them visibility of our revenue trends over time. This will allow them to calculate their own specific bill impacts. The electricity system operator (ESO) has published its forecast for Transmission Network Use of System (TNUoS) charges over the T2 period. Our proportion of these tariffs is 58 per cent. Using the figures set out in this plan we estimate that our part of TNUoS will be broadly flat compared with the average level in the T1 period (before inflation).

Acceptability of our plan

An independent research organisation carried out acceptability testing on our business plan. 87% of consumers (household and business combined) found our plan and its bill impact to be acceptable.





Executive summary

What's changed

This is our final business plan. We have made several changes from our second draft plan in October to reflect challenges from our stakeholders, the independent stakeholder group, the independent RIIO-2 challenge group and updates to Ofgem's guidance.

What's changed

The main changes we have made to our business plan since October are:

- Reflecting the government passing its net zero target into law and your feedback, we are building further flexibility into our plan. We are proposing more uncertainty mechanisms to adapt to different routes to achieving net zero. We are proposing a net-zero uncertainty mechanism to allow new investment in the T2 period. We have strengthened our commitments to reduce our own emissions (see chapters 2 and 11).
- To explain how we will manage uncertainty in the T2 period we have provided more detail on our uncertainty mechanisms and summarised our approach in chapter 3.
- We have reduced our baseline totex by £0.1bn since our second draft plan. This reduction reflects the net effect of several changes. The main ones are: reducing the baseline due to the delay to HS2, including the costs of outputs to facilitate four potential late model competition projects; and an adjustment resulting from cost benefit analysis of two substation site strategies.
- We have explained more clearly how our T1 performance benefits consumers in our T2 plan.
- As requested by Ofgem and the RIIO-2 challenge group we are using a financial package with a cost of equity of 4.3 per cent to test our plan. We are also testing our preferred package with a cost of equity of 6.5 per cent, which is essentially the same as in our July first draft plan (see chapter 15).
- To justify our plan, we have provided more detail on how we have benchmarked our costs and more detailed breakdowns of our costs. We have added in our unit cost analysis, and provided asset-level condition information in our supporting evidence to provide greater justification for our plan.
- We have strengthened our innovation strategy, following feedback from stakeholders and obtained board support for our strategy (see chapter 11).
- For the consumer value proposition (CVP), we have added in monetised values (see chapter 5.4).
- We have defined more outputs, for example in the reliability chapter for "non-lead" assets. These provide certainty for us and stakeholders about what we will deliver (see annex ET.08).
- We have estimated the financial size of our output delivery incentive (ODI) package and provided more detail on the bespoke ODIs we are proposing in chapter 5.3.
- We have included more information on competition, including an overview of our approach in chapter 5.1.
- We have drawn out more clearly the whole system elements of our business plan (see chapter 5.2).
- We have added commitments reflecting our responsible business strategy such as upskilling 6,000 people and our employee volunteering focussed on low-income communities by the end of the T2 period.
- We provided more detail on our proposed engagement approach for T2 and we have included our future stakeholder engagement strategy as a standalone annex.
- We have included the final results of the independent acceptability testing of our plan. 87 per cent of consumers (households and businesses combined) find our overall plan and its bill impact to be acceptable.
- We have included Board assurance statements for our final plan.

We have changed our plan based on your feedback





Executive summary

Our Board's assurance statements

The Board of National Grid Electricity Transmission has been fully involved in developing this business plan and has provided review and challenge to ensure the evidence and assurance demonstrate that the plan is of a high quality. The Board has been actively involved in defining the nature and approach of the assurance carried out on the plan and in reviewing the findings of the assurance programme. This page summarises the assurance processes that we have carried out and the statements our Board feels confident to make as a result.

Our plan uses accurate, high-quality information

We have carried out a programme to make sure that our Board members have the information and confidence they need to assess the quality of the plan.

We have a strong control and assurance culture built on the tough rules that apply to us such as the London Stock Exchange listing rules and the UK's corporate governance code. Our RIIO-2 assurance plan builds on these strong existing assurance systems.

We have performed a full risk assessment of our RIIO-2 business plan and designed an assurance plan appropriate and proportionate to the level of risk.

We have mapped supporting evidence and assurance results to the statements below to give the Board confidence to make them.

We have engaged an external expert consultancy to independently review and advise us on our risk assessment and planned assurance approach. That firm has also reviewed how we carried out our assurance programme and has given its views to the Board on the validity of the statements below based on the evidence they have reviewed.

Our assurance statements

The following assurance statements are made by the Board with reference to this document only ("the Company's Business Plan"), as submitted to Ofgem on 9 December 2019:

- The Board owns the overall strategy and direction of the Company's Business Plan.
- The Board is of the opinion that the Company's Business Plan is accurate and based on high-quality data. The Board has reached this conclusion through implementing an overall strategy for data assurance and governance that has sought to deliver a Business Plan that is accurate and based on high-quality data.
- The Board has challenged and satisfied itself that, in the opinion of the Board, expenditure forecasts included in the Company's Business Plan are robust and efficient.
- The Board has challenged and satisfied itself that, in the opinion of the Board, the Company's Business Plan is ambitious.
- In the opinion of the Board, the Company's Business Plan represents good value for money for existing and future electricity consumers as a consequence of it being a robust, efficient and ambitious plan.
- The Board has sought to implement a strategy to satisfy itself that the Company's Business Plan achieves stakeholders' trust and confidence and is of the opinion that this is achieved as a result of the high levels of transparency and engagement with stakeholders during its development.

For details of the level of assurance given over the financeability of the Business Plan and key definitions in relation to these statements see annex ET.05 Assurance report.

Signed, the board of National Grid Electricity Transmission plc:



Nicola Shaw

Nicola Shaw
Chair



David Wright

David Wright
Director Electricity
Transmission



Chris Bennett

Chris Bennett
Director Regulation



Alan Foster

Alan Foster
Chief Financial Officer



Cathryn Ross

Cathryn Ross
Sufficiently
independent director



Clive Elphick

Dr Clive Elphick
Sufficiently
independent director



Alexandra Lewis

Alexandra Lewis
Treasurer



Part 1

The context for our plan

The context for our plan

2. The route to net-zero emissions

We see net-zero greenhouse gas emissions as both a huge challenge for the UK, and a great opportunity. We believe in a future that is clean, green and thriving, where nobody gets left behind. We know we have a crucial role to play in enabling the acceleration towards net zero, while minimising the cost of this for consumers and developing critical skills for people. We are ready to lead in accelerating this transition, designing and delivering transformative, innovative engineering to help solve cross-sector challenges at scale across the country. To face this challenge, it will be essential that we all work together. The next page shows a vision of our journey to net zero with our commitments to enable the transition, as well as what's needed from policy makers, regulators, and other network companies, to deliver at the pace needed.

Our commitments for net zero

Electricity decarbonisation

We are committed to maintaining our focus on consumers' and stakeholders' priorities through our journey to net zero. For example, we will not compromise on system reliability, affordability or transparency. We will be ready to respond to an acceleration of new low-carbon connections during this price control period. We will make sure we can deliver outputs at pace, including a step change in connection delivery speed. We have also developed a series of robust, cost-reflective, automatic mechanisms to deal with up to £1.8bn of future uncertainty and provide flexibility in volume, pace and whole-system solutions. We must make £0.6billion of critical investments in the existing network to deliver net-zero system capability, and to drive down costs. This will include whole-system collaboration and innovation to develop cross-sector solutions.

Transport decarbonisation

Without the rapid development of fit-for-purpose charging infrastructure, the uptake of electric vehicles could be delayed. We will work alongside Government and industry to overcome these cross-sector challenges for electric vehicle infrastructure, deliver cleaner air for our communities, and support solutions for decarbonisation of wider transport, such as rail and shipping.

Heat decarbonisation

We recognise that the future of the heat is likely to develop as a mosaic of technologies which could include electrification and hydrogen. To support this evolution, we will proactively engage in the debate and facilitate innovation projects to make sure the electricity transmission network is ready for the transition.

Our own emissions

We will achieve net zero for our scope 1 and 2 emissions by 2050, with interim targets of a 50% reduction by 2030 and 34% by 2026, from a 2018/19 baseline. Our stakeholders have been clear that they expect us to go faster; we share this ambition and are working hard to find ways to accelerate. The biggest single contributor to climate change we have is SF₆. We will provide brave leadership with targeted investments to replace leaking SF₆ equipment and tackle the challenge. See our Net-Zero Journey for further commitments. We will also move towards a 100% alternative fuel fleet by 2030 and 100% renewable electricity for our own use, with a 20% increase in energy efficiency for our offices by 2026. For our full set of emissions commitments, please see chapter 11.

What's needed from policy makers by 2021

It's clear that we need to work together on the solutions. The country needs a clear policy framework to fairly distribute the costs of decarbonisation across households, tax-payers and businesses and we welcome the Treasury's proposed review of this issue in 2020. A standard carbon pricing methodology would ensure whole-life environmental impacts are appropriately considered for investments. This would sit alongside funding for critical net-zero investments and a confirmed approach to whole-system solutions across energy companies. A flexible, ex-ante price control framework is also needed to deliver net zero. In addition to our proposed uncertainty mechanisms, an agile anticipatory investment process would help to fairly allocate risk and funding to the parties best placed to deliver solutions, and enable a faster, more cost-effective transition for consumers. And finally, there needs to be a workable early competition model to attract the right capital at the right rate of return, giving consumers confidence they are securing an economic and efficient deal across the whole-life of large projects.

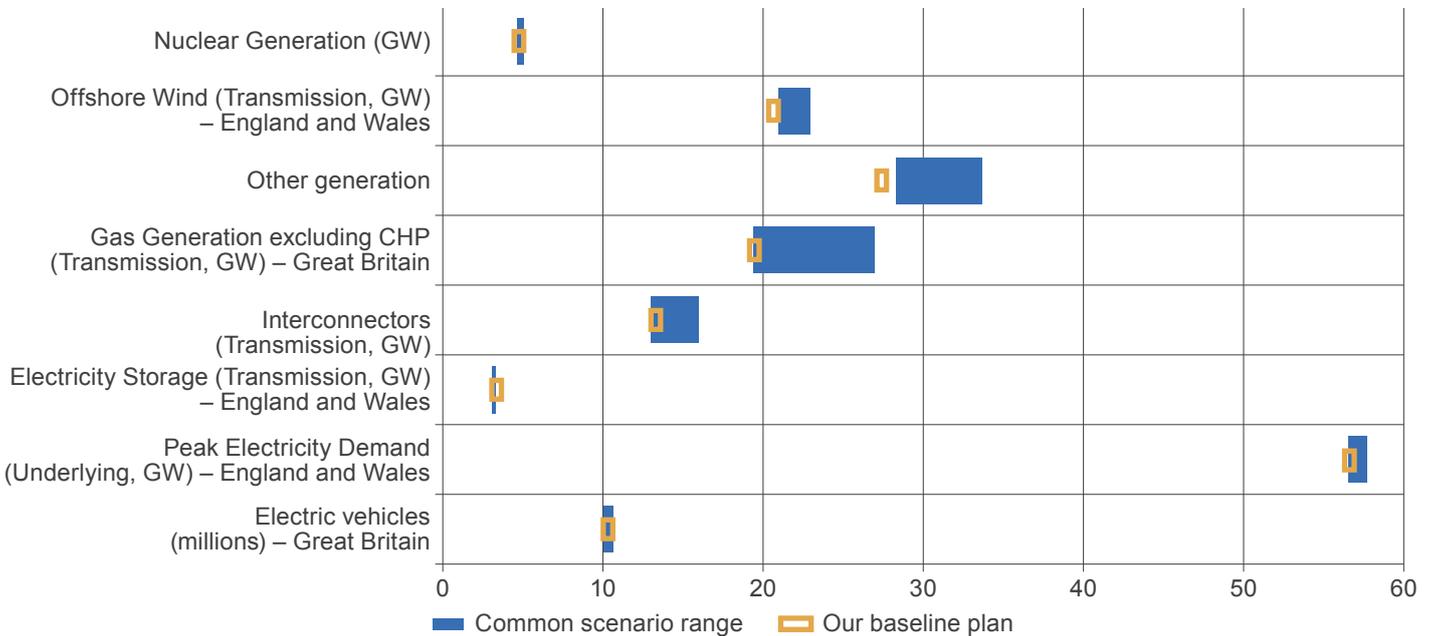
The context for our plan

3. The common energy scenario and managing uncertainty

We have built our business plan using the minimum values in the Energy Networks Association (ENA)'s Common RIIO-2 Scenario report as a benchmark. This is an Ofgem requirement. The purpose of the common energy scenario is to make sure the different network companies' business plans are based on a consistent view of the future.

The figure below shows that the main assumptions about the future in our baseline plan lie at, or below, the bottom of the ENA's common scenario range. The assumptions below the range reflect the need for us to build a self-consistent scenario for England and Wales.

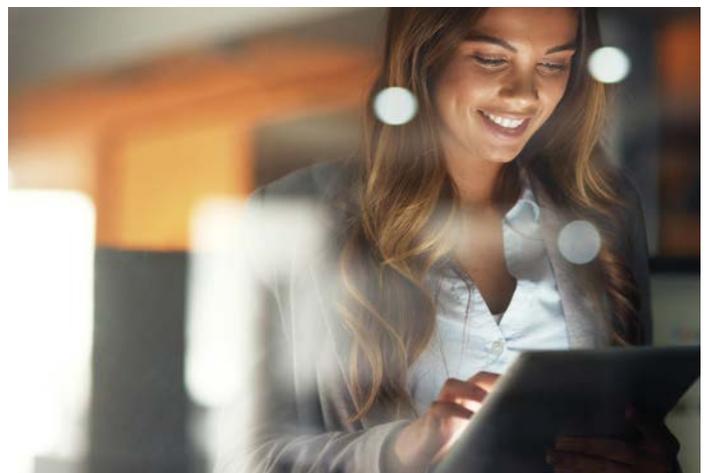
Figure 3.1: Our baseline and the common energy scenario ranges for 2030



We know the future will more than likely turn out to be different from the common energy scenario. For example, the scenario does not assume a reduction in greenhouse gas emissions large enough to deliver against the UK's commitment to net zero by 2050.

We are working with other network companies to define an energy scenario that support the UK's net-zero target and to estimate the costs of it.

Our plan includes a number of uncertainty mechanisms (UMs) to adapt to different future energy scenarios as we explain on the next page.



The context for our plan

Managing uncertainty

Our plan can flex to reflect changes during the T2 period

We have taken the following approach to managing uncertainty:

- We have protected consumers by only including costs with high certainty in our baseline and proposing uncertainty mechanisms (UMs) for less certain costs.
- Our UMs make sure that if the needs of consumers or our customers change from the assumptions in the baseline plan, our allowances change so that we can invest in the outputs they need.
- Wherever possible our UMs retain the incentive for us to reduce our costs and share the cost savings with consumers.
- Our UMs are designed to allocate risk to whoever is best placed to manage it.
- Some of our UMs are designed to provide flexibility and optionality to facilitate whole-system solutions within the price control period.
- Some of our UMs are designed to adjust funding to reflect changes in externally driven requirements.

Table 3.1: The uncertainty mechanisms in our plan

Category of UM	Purpose and example
Changing energy system	
UM7-1: Boundary capability	We propose several UMs that automatically adjust our baseline allowances up or down at pre-defined efficient unit cost allowance (UCA) rates to reflect how customer-driven requirements turn out differently from the common energy scenario.
UM7-2: Facilitate competition (pre-consents)	
UM8-1: Generation connection	
UM8-2: Demand connection	
Facilitate whole-system outcomes	
UM7-3 System operability (voltage)	For some activities it is not currently clear which party is best placed to deliver the best outcome for consumers. Our whole-system UMs allows us to change the approach during the price control period to achieve the best outcome for consumers. For example, our harmonic filtering UM allows us to provide harmonic filters if we can do this more cheaply than our customers.
UM7-4: Protection and control	
UM7-5: Whole systems co-ordinated adjustment mechanism	
UM7-6 Harmonic filtering	
UM7-7: System operability (other ESO requirements)	
UM8-3: Low voltage rebuild (embedded generation)	
Protecting against external threats	
UM10-1: Extreme weather	There are several areas of our plan that reflect regulatory or government-driven requirements to protect the network against external threats. These UMs allow us to put only the certain requirements in our baseline and change our allowances when new requirements become clear.
UM10-2: Physical security	
UM10-3: Cyber security IT	
UM10-4: Cyber security operational technology (OT)	
UM10-5: Black Start	
UM10-6: Ensuring a resilient electricity network	
Net zero and stakeholder projects	
UM11-1: SF ₆ replacement	Some of our UMs propose a route to seek specific project funding from Ofgem within the T2 period for certain projects that are currently uncertain or unknown. For example, stakeholder driven visual impact mitigation projects or projects to meet any new net-zero requirements.
UM11-2: Visual impact provision	
UM11-3: Urban improvement provision	
UM11-4: Net zero	
Market indexation	
UM14-1: Real price effects (RPEs)	We have UMs that link some cost allowances and financial metrics to market-driven price changes, to reduce forecast error and ensure our allowances reflect external market conditions. These UMs include real price effects (RPEs), cost of debt indexation and indexation of part of the cost of equity.
UM15-1: Inflation indexation of RAV and allowed return	
UM15-4: Cost of debt indexation	
UM15-5: Cost of equity indexation	

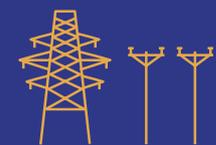
Further information

We provide more details on our uncertainty mechanisms in section 7 on “risk and uncertainty”

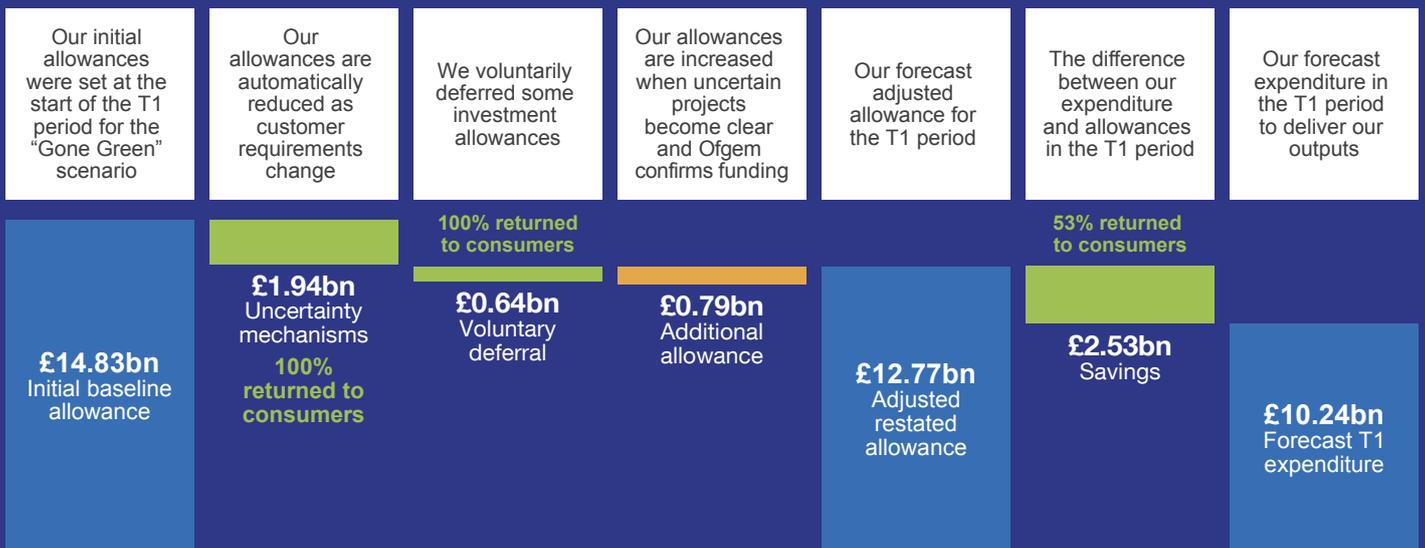
in each of chapters 7 to 13. We also provide more information in annexes ET.12 Uncertainty mechanisms and ET.12A Uncertainty mechanisms snapshot table.

4. Our track record

In the first six years of the T1 period (2013-14 to 2020-21) we have delivered all our outputs, and outperformed them in some cases, at a significantly lower cost than expected at the beginning of the period. We have shared these savings with consumers and we will start the T2 period as an efficient business. All the efficiencies and innovations we have delivered in the T1 period are fully built into this business plan. We provide more information in annexes ET.04 and ET.09 and section 2 of chapters 7 to 14.

 <p>Upgrading our network We are investing over £4bn to make sure we provide world-class reliability for future generations.</p>	 <p>Protecting the electricity network We are protecting 90 sites from external threats to keep your electricity supply secure.</p>	 <p>High levels of reliability We are delivering world-class network reliability of 99.9999 per cent energy supplied.</p>	 <p>Delivering a cleaner energy system We are connecting and facilitating 12.6 GW of clean generation.</p>
 <p>Lower greenhouse gas emissions We have trialled the use of 30 electric vehicles to support the transition to alternative fuels.</p>	 <p>Improving the natural environment We have enhanced the natural environment at 30 of our sites.</p>	 <p>Highest-ever customer satisfaction Our connection customers' satisfaction has increased to 8 out of 10.</p>	 <p>Investing in communities We have awarded £1.24m in grants to community projects.</p>

We have saved consumers money in the T1 period while still delivering our key outputs



Our financial return

Reflecting our excellent performance so far in the T1 period we have earned a financial return (called the return on regulatory equity) of 10.5 per cent (adjusted for RPI). This consists of: 7 per cent for our allowed equity return; 1.9 per cent for costs outperformance; 0.5 per cent for output and innovation incentives; 1.6 per cent for our debt performance and -0.5 per cent for our tax performance.

5. Cross-cutting themes

5.1 Competition

There is an urgent need to legislate to create an early competition regime to help deliver net zero at lowest cost for consumers

We strongly support increased competition in electricity transmission wherever it can deliver benefits for consumers.

Native competition

We already use competitive tendering to achieve value for money for consumers on the vast majority of our expenditure delivered by third party contractors. This is called 'native' competition because it is a form of competition run by us to facilitate the delivery of our obligations and outputs at competitive costs.

We set out our native competition plan in chapter 14 of this business plan. The plan explains how we go further than the minimum legal requirements to get the best value out of our procurement processes and supplier base. For example:

- we continue to introduce new suppliers to our processes to increase competitiveness, improve standards and lower costs; and
- we do not favour any particular technology and we encourage innovative solutions from suppliers and contractors.

Early competition model for large infrastructure projects (>£50m)

For some of our large, separable transmission infrastructure projects there is a potential for parties other than us to deliver benefits for consumers through innovation in technology and design. This could be achieved by running a competition allowing third parties to bid for the development, delivery and operation of such infrastructure from an early stage.

To deliver net-zero greenhouse gas emissions by 2050 at lowest cost we think it is essential and urgent for Ofgem and the government to establish a competitively appointed transmission owner (CATO) early competition model. The CATO model would provide a statutory framework, with licensed entrants, that is the only approach that can achieve the benefits of competition while making sure consumers are protected.

We commit to working with stakeholders to develop a CATO early competition model for large, separable transmission infrastructure projects.

We have identified projects in our business plan for the T2 period that might be suitable for third party competition at the £50m threshold defined by Ofgem for early competition. We have identified £3.4bn worth of potential candidates for early competition.

Late competition in the provision of large infrastructure projects (>£100m)

Ofgem has also set out requirements to identify late competition candidate projects. These are projects where third parties bid for the delivery and operation of projects for which we have already completed the development and consenting phases.

The independent electricity system operator (ESO) has assessed our business plan against the relevant Ofgem contestability criteria and found four projects, with expenditure of £1.4bn in the T2 period (£5.1bn total project costs), that meet Ofgem's criteria for late competition.

Table 5.1: Projects the ESO has assessed meet Ofgem's late competition criteria

Project	Total cost
South London to south east coast	£■■■bn
Torness to Hawthorn Pit	£■■■bn
Peterhead to Drax	£■■■bn
Central Yorkshire	£■■■bn

These projects have gone beyond the point for early competition, so we have included the costs of completing the project development and consenting phases in our baseline plan (£182m) as an output. This will make it easier for Ofgem to consider late competition for these projects.

5. Cross-cutting themes

5.2 Whole systems

Achieving net-zero greenhouse gas emissions by 2050 at the lowest possible cost for consumers requires a whole-system approach to be taken across power, heat and transport. We think an important part of whole-system thinking is valuing flexibility, keeping options open and seeking to optimise where there are trade-offs between different parties.

We have built our plan in this way and are making proposals that facilitate whole-system solutions. The key ones are as follows.

A whole-system approach across power, transport and heating

Our plan includes options and flexibility to accelerate the decarbonisation of transport, power and heating:

- a network option for ultra-rapid electric vehicle charging at motorway service areas to help overcome range anxiety, which is currently a barrier to electric vehicle take up;
- uncertainty mechanisms (UMs) that facilitate the increase in demand associated with the uptake of electric transport, or approaches to heating that might have an impact on the electricity network, such as hydrogen production or heat pumps;
- UMs that facilitate the connection of low-carbon generation and enable the system operator to signal the investments required to enable it to operate a zero-carbon power system by 2025; and
- an option to build the onshore transmission network around the east coast of England to significantly reduce the whole-system cost and disruption to local communities of connecting new offshore wind farms in the North Sea to the network.

Some of these proposals require Ofgem or the government to establish a new anticipatory investment framework to enable the investment in infrastructure.

Whole-system optimisation to reduce total costs for consumers

The ESO is seeing a rising trend in system balancing costs, running to hundreds of millions of pounds each year. We are proposing a new approach to help reduce these costs where, on a targeted basis, transmission owners can provide flexibility in investment options, system access and enhanced network capability to the ESO. The ESO would weigh up the additional costs of these options against the reduction in constraint costs allowing it to make choices that reduce total costs for consumers. We estimate this new approach could save up to £200m of constraint costs annually.

Keeping options open

There is a value to keeping whole-system options open where it is not currently clear who could provide the best solution for consumers. Where our engagement activities have highlighted scope for this, we have reduced our baseline totex plan:

- by £184m by excluding costs to maintain compliance with security standards where whole-system alternatives could exist; and
- by £105m for low-voltage substation re-builds where alternative approaches could avoid the need.

We are also proposing UMs that allow us to provide transmission solutions to these issues, but only if they represent the best whole-system solution for consumers.

Innovation

Our innovation strategy for the T2 period focuses on whole-system solutions to decarbonisation. We propose exploring opportunities with other industries (such as transport, steel and cement) to drive decarbonisation, as well as finding a viable alternative to the greenhouse gas SF₆ that we use on our network, which could be deployed worldwide. We are also opening up our Deeside centre for innovation to allow cross-sector research and trials of technologies to allow whole-system innovations to be applied more quickly.

**Up to
£200m**
of possible
annual constraint
cost savings

£289m
reduction in our
baseline plan to
allow for whole-
system solutions

5. Cross-cutting themes

5.3 Output delivery incentives (ODIs)

We are using outputs extensively in our business plan so that consumers and our stakeholders can see what we will deliver for them.

For some of our outputs there is a benefit to consumers and our stakeholders of us outperforming our targets. For these, we are proposing output delivery incentives (ODIs) to align our incentives with those of consumers and stakeholders.

The table below shows the nine ODIs in our plan with a description of how they benefits consumers. The table includes an estimate of the maximum penalty or reward we could incur based on our performance.

The first five ODIs are common ODIs, that Ofgem has developed and consulted on. These apply to all three transmission owners in Great Britain.

This is a tougher ODI package than in the T1 period because the maximum penalties are higher and the targets are more challenging.

Table 5.2: The ODIs in our business plan with their financial range

Output delivery incentive (ODI) and purpose	Common or bespoke	Maximum penalty (% of base revenue)	Maximum reward (% of base revenue)
Quality of connections survey – incentivises us to improve our service to connection customers at the key moments that matter to them through the connection process.	Common	-0.6	+0.6
Energy not supplied – incentivises us to take additional actions to minimise the interruptions to energy supply on our network.	Common	-3	+0.14
SF₆ and other gases leakage – incentivises us to reduce the leakage of insulation and interruption gases that contribute to climate change.	Common	-0.34	+0.34
Timely connection offers – penalises us if we do not provide connections offers within 90 days.	Common	-0.5	0
Infrastructure projects engagement – encourages us to carry out good-quality stakeholder engagement for infrastructure projects.	Common	Non-financial	
Environmental scorecard – incentivises us to outperform the stretching commitments in our environmental action plan, and penalises us if we don't deliver them.	Bespoke	-0.25	+0.25
Outage management – incentivises us to manage outages better with the customers affected.	Bespoke	-0.4	+0.4
Accelerating low-carbon connections – incentivises us to deliver connections with shorter lead times where customers want them and where it reduces carbon emissions.	Bespoke	0	+1.0
Stakeholder satisfaction – encourages us to continually improve the way we engage with our stakeholders.	Bespoke	Non-financial	
T2 total		-5.1	+2.7
T1 total (for comparison)		-4.3	+2.3

5. Cross-cutting themes

Our bespoke ODIs

Bespoke ODIs are the ones that we have developed for our business, based on the views of our stakeholders in our engagement with them on our business plan.

In the table below we provide more information on the targets and incentive rates we are proposing for our bespoke ODIs. We provide more detail on all the bespoke and common ODIs in annex ET.06.

Table 5.3: Bespoke ODI targets and incentive rates

Bespoke ODI	Target	Incentive rate
Environmental scorecard	<p>The environmental scorecard uses seven targets from our environmental action plan covering:</p> <ol style="list-style-type: none"> 1. alternative fuel vehicles 2. reducing business mileage emissions 3. waste recycling 4. waste reduction 5. water use reduction 6. environmental value of our non-operational land 7. net environmental gain on construction <p>Full details are in annex ET.06.</p>	<p>The ODI involves scoring our annual performance from -14 to +14 based on how well we have performed against the seven targets from our environmental action plan.</p> <p>The incentive payment is linked to the score, with the maximum penalty of £4m for a score of -11 to -14 and the maximum reward of £4m for a score of +11 to +14.</p>
Outage management	<p>We propose a survey satisfaction score target of 7.7 in 2021-22 increasing to 7.9 in 2025-26. The target starts at a score 0.1 above our average performance in the three most recent years. The target ends at a score that is the highest score we have ever achieved. Customer expectations tend to increase over time so the same score becomes harder to achieve each year.</p>	<p>We propose an incentive rate of £0.6m for a satisfaction score 0.1 below or above the target. This is based on the proportion of outage survey responses in Ofgem's T1 common incentive. We are proposing a cap and collar on the incentive of £6.5m.</p>
Accelerating low-carbon connections	<p>For existing contracted customers, we propose the targets are the dates in their current contracts.</p> <p>For new customers the target is based on the common energy scenario average delivery time for generation connections of approximately 64 months, which might need adjusting for the particular type of customer.</p>	<p>The incentive rate is £2,088 per month early per MW of low-carbon generation. We have derived this from the government's traded carbon price for the years 2021 to 2025.</p> <p>This ODI is focussed on delivering an improved service and is therefore reward only. The ODI balances the penalties we face for a poor connection service under other parts of the RIIO-2 package. We are proposing an annual cap of 1.0% of our base revenue, which is just over £16m per year.</p>
Stakeholder engagement	<p>We will work with the independent stakeholder group to set targets for our stakeholder engagement for the T2 period, including a non-financial ODI.</p>	<p>Not applicable (non-financial incentive)</p>

5. Cross-cutting themes

5.4 Our consumer value proposition

Our business plan provides a large amount of value to consumers, including benefits from: enabling the transition to the low-carbon energy sector of the future; a highly reliable electricity supply; and supporting local communities. We are doing all this while keeping flat, or reducing, our part of the energy bill.

The consumer value proposition (CVP) covers the areas where we are going beyond Ofgem's requirements for our business plan and beyond business as usual activities to provide additional value for consumers.

An independent specialist consultancy has provided the values for those parts of our CVP we can monetise. These are summarised in the table below.

We have engaged with Citizens Advice and the stakeholder group on our monetised CVP and taken account of their views.

Table 5.4: Our monetised consumer value proposition

CVP item	Description	Monetised value (£m)
CVP1 – Optimisation of harmonic filtering	Saving consumers money by us carrying out harmonic filtering rather than our customers.	18.82
CVP2 – Whole-system alternatives to reactor investments	Saving consumers money by allowing for a whole-system alternative to reactor investment.	16.62
CVP3 – Whole system approach to low-voltage substation re-builds	Saving consumers money by allowing for a whole-system alternative to low-voltage substation re-builds.	9.48
CVP4 – Tougher energy not supplied (ENS) target	We are committing to a tougher energy not supplied target at no additional cost to consumers.	2.68
CVP5 – Caring for the natural environment	We are improving the natural capital value by 10% at our non-operational land at no additional cost to consumers.	14.67
CVP6 – Supporting local urban communities	We are proposing a new, innovative scheme to improve our assets in disadvantaged urban areas.	22.58
CVP7 – Developing alternatives to SF ₆	We are innovating to find an alternative for the SF ₆ insulation gas, which will reduce greenhouse gas emissions.	13.10
CVP8 – SO:TO optimisation	Saving consumers money by providing the ESO with flexible options to reduce whole-system costs.	84.88
CVP9 – Deeside innovation centre	Opening up our Deeside centre for innovation to allow cross-sector research and trials of technologies.	26.13
Total CVP		209

Added to the monetised CVP items are many examples of where our plan provides consumer value, but we cannot robustly quantify the value.

These examples cover areas such as providing leadership in sustainability, providing resilience advice to key network users and more sophisticated uncertainty mechanisms.

Further information

We provide more detail about our CVP in annexes ET.07 to ET.07C.



Part 2

Our plan built on stakeholder priorities

Chapter 6 provides details of our most extensive engagement exercise ever, building our plan on stakeholder priorities and our future engagement strategy.

Chapters 7–13 cover each of the stakeholder priorities in turn, providing more detail and explaining how stakeholders have influenced our plans. Each priority covers:

- 1 What the stakeholder priority is about
- 2 Track record and implications for T2
- 3 What our stakeholders are telling us
- 4 Our proposals for the T2 period
- 5 The justification of our proposals
- 6 Our proposed costs for the T2 period
- 7 How we will manage risk and uncertainty



6. Giving stakeholders and consumers a stronger voice

1. Our most extensive engagement ever

We have carried out our most extensive engagement exercise ever to make sure our business plan for the T2 period reflects what our stakeholders need and expect from us.

Over the past two years, we have gathered input from more of our stakeholders, from more segments, on more topics and through more channels than ever before, and we've done this by following a best-practice enhanced engagement process and using independent challenge and review to help us continually improve.

We have heard from over 1,000 individuals representing all of our main stakeholder segments. We have also incorporated the views of over 11,000 household consumers and over 750 business consumers from a combination of face-to-face meetings, focus groups, online consultations and bespoke research studies. We've included feedback from over 300 stakeholders from our satisfaction surveys and complaints process, and we have used consumer trend data and other third-party publications as additional sources of insight. We have used this input to build our plans with those they affect and, by broadening the scope and reach of our engagement, we can be more sure than ever before

Materiality: engaging on topics and issues that influence our decisions, actions and performance

Responsiveness: acting as a result of what stakeholders have told us

The AA1000 framework aligns with our strategy of:

- engaging our stakeholders on the topics that are most important and relevant to both them and us
- engaging only on topics where stakeholders can genuinely make a difference to our plans
- being clear upfront on the desired outcomes of each piece of engagement
- engaging with the right stakeholders, through the right channels through a coordinated and tailored engagement programme
- using stakeholder input to develop our plans, then sharing these plans with stakeholders to check we've understood their requirements.

Since adopting AA1000 in 2016, our engagement activities have been independently assessed against the standard by AccountAbility (the organisation which created AA1000) on an annual basis. Our assessment scores have increased year-on-year, with the latest assessment rating us at 74%. This places us in the top 15% of all companies assessed worldwide.

that our plans reflect, and will deliver, what our stakeholders need from us.

i. A robust strategy and approach

Throughout the process of building our T2 plans, we've been set a number of challenges by an Independent Stakeholder Group, and Ofgem have also set criteria that they expect us to meet. For the development of our business plan, this includes providing evidence of:

- robust and high quality engagement with stakeholders in designing the plan
- appointment of a company specific group
- effective engagement with this group and the RIIIO-2 Challenge Group.

We provide evidence of how we have met these criteria in sections 1 and 2 of this chapter, and our strategy for stakeholder engagement can be found in annex A6.01.

Following the AA1000 framework

Our engagement has been based on an outcomes-focused approach, following the AA1000 Stakeholder Engagement Standard, an internationally-recognised framework for stakeholder engagement excellence. This framework is based on the principles of:

Inclusivity: being accountable to our stakeholders and including them in our decision-making processes

Figure 6.1 Our engagement approach



ii. Ensuring high quality engagement

We recognise that simply following the AA1000 framework is not a guarantee of high quality engagement, so we've worked with others to understand what best practice looks like, and have sought independent scrutiny of our approach.

Learning from others

In building our enhanced engagement approach, we looked at where we need (and want) to be and what we needed to change to deliver what our stakeholders need



from us. By looking more externally, listening, and focusing on what all our stakeholders want from us, and by being more open, collaborative and flexible, we are creating plans which reflect our stakeholders' needs. For the first time, this has included talking directly to consumers away from our major project consultations. We have worked closely with a range of other organisations to learn from what they've done, both good and bad. These organisations include other energy networks, other industries (notably water and aviation) and consumer experts. We have also taken advice from expert consultancies who have supported other organisations with enhanced engagement programmes. We have used this knowledge to shape our engagement process.

Independent Stakeholder Group

The quality of our engagement has been challenged by an Independent Stakeholder Group, which has been meeting regularly since July 2018. The group is made up of senior representatives from consumer, environmental and public interest groups, as well as large energy users, large-scale and small-scale customers, and distribution networks, and it plays a key role in our enhanced engagement programme. Members were invited to participate based on their individual expertise and experience across a broad range of energy issues. The independent Chair had the final say on appointing members to the group. The group has been fulfilling two main roles:

- **Challenging and reviewing** how we engage with our stakeholders in developing our business plan. In doing this, the group has reviewed and challenged our detailed, topic-specific engagement logs and assessed us against their own engagement principles. These logs are a complete record (by topic) of the engagement we've carried out in building our plans, and what we've heard from our stakeholders as a result. They can be found as annexes to our topic-specific chapters.
- **Scrutinising our business plan.** This involves assessing the outputs we are committing to deliver, our costs, our proposed incentives, and how we plan to deal with uncertainty in the T2 period. The group is checking that these reflect what our stakeholders have told us by reviewing and challenging the 'golden threads' we've created between the stakeholder insight we've received and what we have included in our plans. The group will report their views to Ofgem.

They have pushed us hard to go beyond industry norms for engagement, and as a direct result of the group's challenge and feedback:

- we increased the scale of our engagement, following early feedback that the group expected us to be doing more
- we now think about all of our plan in terms of current and future consumer benefit, including for the vulnerable and fuel poor
- we have offered options on topics that we might not previously have considered

- we have included deliberative research and acceptability testing in our consumer engagement programme, allowing us to ask more specific questions around options
- we have simplified the language we use when talking to stakeholders.

For more information on the Independent Stakeholder Group, please see the set-up report in annex A6.02.

RIIO-2 Challenge Group

In addition to the Independent Stakeholder Group, whose focus is just on National Grid, Ofgem has appointed an independent challenge group to further scrutinise networks' plans and approaches, and provide a public report from the perspective of energy consumers. We have been engaging with this group, particularly regarding their expectations of what we should include in our T2 submissions, and have used their challenges to improve our plans, including:

- re-writing chapter 15 *How our plan should be financed*
- clearly linking the benefits of T1 innovation and outperformance to our T2 plan
- showing more information on cost trends and the reasons for differences between the T1 and T2 periods.

Additional third-party challenge and review

At appropriate points throughout our engagement process, we commissioned independent assessments of our activities, and used the learning from these to help us improve. We have also used third parties to check that we've engaged a relevant, representative sample of stakeholders on each topic, and that we've correctly translated their views into our plans. More details can be found throughout this chapter, and in annexes NGET_A6.03 Truth Reports and NGET_A6.07 Frontier Golden Thread Assessment.

Leadership involvement within our business

Our stakeholder-focused approach is supported by leadership at all levels within our organisation, up to and including our Board and CEO, and many senior leaders (including Board members) have been personally involved in our engagement activities, including meeting customers, consumers and the independent stakeholder groups face-to-face to understand first-hand what they expect us to deliver. Our non-executive directors have also attended meetings of the Independent Stakeholder Group. Our internal governance processes have been changed to ensure that stakeholder evidence plays a key part in the decision-making processes for the development of our T2 plans.

iii. Reflecting the needs of consumers

One of our main challenges from the Independent Stakeholder Group was that we needed to do more to engage directly with consumers (both household and business). This has helped shape our consumer engagement, which has also been the subject of review and challenge by Citizens Advice.



At appropriate points in our engagement programme, we have used direct consumer research and engagement to understand exactly what the end users of the energy we transmit need and expect from us. Much of this has been shaped by what we've learned from talking to our peers in the water industry. We've tried to find innovative ways of talking with consumers, and we've supplemented this with third-party consumer research, such as cultural trend analysis. This is something we've never done before and it will continue to be part of our ongoing engagement approach. Details of specific consumer-focused activities can be found in section 2, including how we have targeted harder-to-reach consumer segments.

iv. Converting insight into plans: our decision-making framework

One principle of the AA1000 standard is **responsiveness**, which means we need to act as a result of what stakeholders have told us, and, for our T2 submissions, this means creating plans which genuinely reflect what we've heard. Details of how we've developed our plans from the insight we've obtained can be found in each of our topic-specific chapters. In some cases, this was a straightforward process because we were working with a limited number of stakeholders and/or there's a consensus amongst them about what we need to do.

However, for some parts of our plan, stakeholders have provided different views, and so we have developed a decision-making framework to help us draw the right conclusions from our engagement. We created this framework after taking advice from a range of organisations who have worked with others on similar projects, and what we learned is that there is no exact science to triangulating different inputs. Instead, we developed a principles-based approach, which is simple, transparent and flexible to adapt to different topics and sources of input.

This involves looking at all the input we've received, from stakeholders, consumers, research studies or secondary sources, and assessing it against a set of principles to determine how we shape our plans. This is done on a topic-by-topic basis. Throughout the chapters of our plan, we have explained how we have done this and (where applicable) the trade-offs we have made, to provide transparency around the process and a clear link between what stakeholders have said and the content of our plan.

The decision-making principles we have used are:

- **Impact:** where stakeholders are impacted more heavily by a particular topic, their views are given more weight
- **Recency:** recent evidence is given more weight
- **Robustness:** this covers several areas but (for example) insight from a more representative or more informed group of stakeholders would carry greater weight

- **Consistency:** although outlying views are always considered, less weight is given to a small number of conflicting views if the majority of other views are aligned (assessed in conjunction with impact)
- **Relevance:** more weight is given to inputs relating directly to the topic in question, than to more general insights

To check that we've applied these principles correctly, and that our proposals genuinely reflect what our stakeholders need from us, we commissioned an independent review (with Frontier Economics) of how we had translated stakeholder input into our plans. In particular, we asked them to test that a 'golden thread' exists between what stakeholders have told us and the content of our plan – their report can be found in annex NGET_A6.07 Frontier Golden Thread Assessment. This whole approach, as evidenced within this chapter and throughout the rest of our plan, means that our stakeholders, the Independent Stakeholder Group, the RIIO-2 Challenge Group and Ofgem can have confidence that we've followed a robust, best practice process of enhanced stakeholder engagement, and that our plans genuinely reflect what our stakeholders need us to deliver in the T2 period.

Examples of trade-offs

Trade-offs for each topic are included in the engagement table of each chapter. These include:

- **Chapter 7/8** We engaged on whether we should include the costs of maintaining SQSS compliance on voltage and fault levels in our baseline funding, or instead develop new uncertainty mechanisms that would only provide funding after a whole system process had been followed. Based on what we heard, we propose to forego the certainty of baseline funding to embrace the potential of whole system solutions to reduce costs for consumers. This reduces our baseline plan by £383m.
- **Chapter 9** Some stakeholders told us there would be less reliance on transmission in a decentralised future, while the majority of stakeholders wanted us to maintain (or increase) current levels of reliability. Our T2 plan balances these views to keep options open for a variety of possible futures. We also needed to balance the views of those who wanted to see reliability increase against the need to provide more general consumer affordability. Our proposal to create a tougher target for Energy Not Supplied (ENS), whilst maintaining proposed spend, was deemed by our stakeholders to achieve the right balance.
- **Chapter 11** For visual impact, there are polarised opinions from those most impacted, who feel we should do anything we can to avoid negative visual impact and are willing to pay for this, and those who are less impacted and don't want to pay. Whilst views are mixed, stakeholders support the current stakeholder-led approach, which assesses visual impact on a case-by-case basis, and so we



have proposed to continue the T1 approach into the T2 period.

2. Putting our strategy into practice: tailored and more detailed engagement

We recognise the importance of quality engagement with our stakeholders if we are to deliver what they need from us. Much of what we do can be shaped by what our stakeholders need and expect from us, so we've not just been sharing our plans and asking for feedback, we've involved our stakeholders from a much earlier stage than ever before – starting with establishing their priorities, and then working through each of these in more detail to build a plan that reflects their needs. We've tailored our engagement to make sure we're talking to the right people about the right topics, and we've used a broader

range of channels to ensure we're engaging with individuals in the most effective way.

At the start of the process, we set out a three-phase enhanced engagement programme. We then applied the strategy, approach and principles detailed above, including our learning from others, to create an engagement plan for each stakeholder priority topic. We identified this approach because it fitted well with the best practice we had seen elsewhere. Our approach starts broad to make sure we are not missing anything. We then focus on specific areas in more detail, so that by the end of the process, we have a plan that reflects what our stakeholders want from us. This approach allows us to show the clear link between what stakeholders have told us and what is in our plans.

Figure 6.2 – the three phases of our enhanced engagement programme



Phase 1: establishing stakeholder priorities

The first phase of our engagement focused on understanding our stakeholders' priorities. Through our existing engagement, we already had a good idea of what was important to them, but because the energy industry is changing significantly, we began a series of engagement activities in summer 2017 to check this:

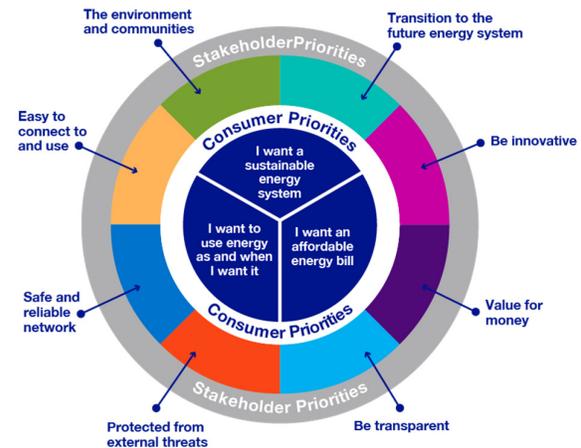
- we ran three workshops in different parts of the country (with 46 attendees) to listen to stakeholders and understand their priorities
- we held an online consultation (679 responses) using the same material to reach stakeholders who were unable to attend the workshops
- from these phase 1 activities, we established the eight stakeholder and three consumer priorities around which our plan has been based. We validated these priorities with our stakeholders throughout phases 2 and 3.

Phase 2: working with our stakeholders to build the detail of our plans

In the second phase of our engagement programme, we used stakeholder input to identify specific focus areas within each high-level priority. For each of the priority topics identified in phase 1, we used the AA1000 framework to plan a programme of engagement. Specifically, this involved:

- Identifying the sub-topics for engagement. By applying the principle of **materiality**, we engaged on topics that had been identified as an area of interest

Figure 6.3 Our consumer and stakeholder priorities



by stakeholders and/or that were an area where stakeholders could genuinely influence our plans.

- Following the principle of **inclusivity**, identifying the interested and impacted stakeholders, mapping them to understand their specific requirements in relation to each topic, then using this information to select the appropriate channel(s) for engagement.

We used a mixture of sources of insight, including direct engagement channels and secondary sources.



Giving stakeholders genuine options

An important change in the way we've engaged over the past two and a half years has been the development and discussion of options. Previously, we had been accused of not genuinely consulting with those we impact, so to make sure our plans are properly stakeholder-led and not just focused on what we think we should do, we developed and shared options with our stakeholders in phase 2. Our plans have then been built on what they prioritised.

Where options were not available (where we are bound by legislation, for example), we explained our approach and why we need to do what we do. Where there is a choice, we've also provided details of costs (including the impact on consumer bills), to allow stakeholders to make a more informed decision.



A voice for consumers

As we began to build the detail of our plan, we started to explore certain topics with consumers. For domestic consumers in particular, this brought its own challenges, given that the vast majority of the public is largely unaware of how the energy industry works and particularly of our role within it. We therefore worked with independent third parties and with consumers themselves to create simple, clear and unbiased context material that we could use at the beginning of any research or engagement activities. Consumers told us this really helped them to provide a more informed opinion on our plans.

We also recognised the need to ensure we included the harder to reach members of society in our engagement, particularly those who may be vulnerable and/or fuel poor. Many of our stakeholders tell us that there are limited expectations for transmission companies to interact directly with these groups, and that suppliers and distribution network companies are better placed to address their needs because they interact with them on a regular basis. However, we have been working hard to ensure we properly represent the needs of these specific consumers in our plans, so asked our research partners to consider in-home interviews to help reach them. Consumers can also be hard to reach because of mobility or connectivity issues, for example, so again we've made sure we include a mixture of face-to-face and online methodologies to ensure we're being inclusive. All of our quantitative consumer research included proportionate representation from low income households, and we've also made sure we have

representation from both urban and rural communities to highlight any potential differences in views or priorities. You can read more about how this research has shaped our proposals to support consumers in chapter 11 *We will care for the environment and communities*.

Willingness to pay research

Beginning in 2018, we led a piece of work with Scottish Power and SSE to conduct a willingness to pay study, covering a nationally-representative sample of 1,000 domestic consumers, plus 600 business consumers. The report from this research can be found in annex NGET_A6.04 Willingness to pay report.

We learned lessons from previous willingness to pay studies in the energy and water sectors to improve how we carried out our joint study. In particular:

- For the T1 period, willingness to pay research was only carried out in relation to the visual impact of transmission assets. For the T2 period, we provided more overall context and asked consumers for views on a wider range of issues that matter to them.
- For RIIO-ED1 and in recent water industry willingness to pay exercises, networks were criticised for inconsistencies in their research methodologies, and in how they had chosen to interpret the results. We commissioned a joint study with the other transmission owners to ensure consistency.

The study covered the topics of network reliability, resilience, visual impact, environmental impact, innovation, supporting communities, and facilitating future decarbonisation. We sought advice from Citizens Advice, Ofgem and the respective independent stakeholder groups as we developed the research approach. There was positive willingness to pay for all topics amongst domestic and business consumers.

Figure 6.4 Willingness to pay values for electricity transmission

	£/consumer/year	
	Domestic	Business
Risk of powercuts		
2 hours decrease in the hours of powercuts at a 1.5% probability	7.70	43.30
4 hours decrease in the hours of powercuts at a 1.5% probability	9.70	66.95
Fewer days to recover from a blackout	3.58	24.15
	(each day)	(2 days)
Undergrounding overhead transmission lines		
20 miles additional undergrounding in designated areas	6.87	45.02
20 miles additional undergrounding in other areas	6.46	45.90
Improving visual amenity of overhead transmission lines		
Additional visual impact work in designated areas	4.14	27.36
Additional visual impact work in designated and other areas	4.81	33.68



	£/consumer/year	
	Domestic	Business
Additional transmission site environment improved		1.68 (per site)
25 additional sites	8.92	
45 additional sites	10.78	
Investing in innovation		
Medium scale compared to small scale projects	2.38	10.56
Large scale compared to small scale projects	3.11	10.56
Supporting local communities		
Current level of activities	8.26	19.23
Current level of activities and additional funding to charities	8.46	19.23
Investing in EV charging infrastructure before definite need	9.55	32.38
Investing in infrastructure to connect renewables before definite need	11.78	38.89

Source: NERA analysis

Where applicable, the results from the willingness to pay study are informing our business plan, but we recognise there are limitations to this type of research for transmission networks, and therefore the willingness to pay values alone have not been used to determine our proposed levels of spend. It is one useful data set that we can triangulate with other consumer data to help inform our plans.

Other consumer research and engagement

Consumer experts on the Independent Stakeholder Group challenged us to think about different ways of engaging consumers, particularly when it comes to getting into detail on topics that affect them, but with which they are not very familiar. We worked with independent third parties who specialise in this type of work to develop a plan for research and engagement. This included listening to consumers face-to-face, with our senior leadership team attending two sessions to understand in more detail what consumers want from us. Hearing this first-hand is very powerful.

Considering the needs of future consumers

We also used cultural research and examined consumer trends to understand the needs of future consumers as well as current, and we ran a consumer focus group to understand views on whether current or future bill payers should pick up the cost of new investment.

A tailored approach for each priority

We applied our strategy and approach for each stakeholder priority, to make sure our engagement was appropriately tailored for each topic. Our phase 2 engagement included:

Transition to the future energy system

What we engaged on

- We used a range of published information to shape our engagement on this topic, which had the aims of:
 - informing stakeholders on an area with minimal analysis and debate in the public domain
 - gathering stakeholder views on their priorities and the future role of electricity transmission, including around the decarbonisation of electricity, transport and heat, and whole system solutions

- discussing the need for a transmission network in the long term, including how the T2 framework and our own business plans should deal with future uncertainty.

Who we engaged and how

- This topic is complex, and the interested and impacted stakeholders are varied, so we tailored our approach accordingly to include:
 - Initial workshops to introduce the topic at a high level (three workshops with 46 attendees representing all of our key stakeholder segments)
 - An online discussion document and survey to inform and consult (15 responses covering **customers, other networks, our supply chain and the ESO**)
 - Two webinars with 29 attendees covering **customers, other networks, our supply chain, interest groups and government**
 - Bilateral meetings with **other networks, BEIS** and the **ESO**, and working groups with the ENA to understand stakeholder views in more detail
 - Two further webinars covering future uncertainty
 - Meetings and bilaterals with **Demand Side Response and storage providers**
- We also engaged over 3,000 **domestic consumers** and 600 **business consumers** via our willingness to pay, acceptability testing and interactive online tool research on the specific topics of ultra-fast EV charging and investing in the network to facilitate decarbonisation

Easy to connect and use

What we engaged on

- Within this topic, we engaged on our customers' priorities of:
 - Improving the experience of connecting to the network
 - Minimising the impact of our work on those already connected to the network

Making our charges clearer and more stable for our customers

Who we engaged and how

- The target stakeholder audience for this topic is well defined as those who are already connected to the network or who may wish to connect in future, and we already engage with many of these stakeholders through our business as usual activities. This covers **large and small customers, other network companies and new business models**. Our engagement has included:
 - Talking to existing and prospective customers about their current experiences and future requirements through our customer journey work
 - Several hundred pieces of feedback from existing customers through our customer satisfaction surveys, net promoter (director to director) conversations and complaints process
 - Two customer charging seminars in Glasgow and London (114 attendees in total)



- An Electricity Transmission connections event with over 50 attendees
- Bespoke research with 12 existing and prospective customers, covering the areas of decarbonisation, small generation, electric vehicles and storage

Safe and reliable network

What we engaged on

- Reliability has consistently been flagged as our stakeholders' number one priority. We spoke to them about their future expectations for reliability of the transmission network, and about the options available to us in delivering this. This included:
 - Network risk, and how reliability targets should be set and measured (Network Asset Resilience Metric)
 - How we optimise our plan, including the role of innovation and whole system solutions
 - Asset intervention options
 - Energy Not Supplied (ENS) incentives.
- We see safety as non-negotiable (and previous stakeholder feedback has aligned with this), so we didn't engage on that topic

Who we engaged and how

- We engaged those who were impacted by or interested in the current and future reliability of the network. This included over 80 organisations and more than 3,600 domestic and business consumers through a mixture of tailored engagement channels:
 - **Ofgem and the other electricity Transmission Owners** through meetings and workshops
 - The six **Distribution Network Operators** through existing forums such as the Joint Technical Planning Meetings, workshops, webinars and bespoke one-to-one sessions
 - The **Electricity System Operator (ESO)** through one-to-ones
 - **other energy industry organisations** through trade associations, and a bespoke one-to-one with **Energy UK**
 - **Directly-connected customers** through director-level one-to-ones and via workshops, webinars and online consultations
 - Other interested parties including our **supply chain, academics, consumer groups, other interest groups, consultants and major infrastructure organisations** via workshops, webinars, surveys and consultations
 - **Consumers** (domestic and business) via willingness to pay, acceptability testing and interactive online tool research (both quantitative and qualitative), and future trend data.

Protected from external threats

What we engaged on

- For this topic, the requirements are largely set by government and the relevant authorities, so the opportunity for broad stakeholder input is limited. However, we engaged impacted and interested parties on the broader topic of resilience before working

closely with the relevant specialist organisations to define the detail of our plan. This approach was consistent with the views of the Independent Stakeholder Group.

- We covered the topics of cyber security, physical security, protection against extreme weather and Black Start, with the aim of understanding what our plan should be for each of these topics.

Who we engaged and how

- Our broad engagement took the form of a survey to understand requirements, followed by a workshop to facilitate discussion, with 39 attendees covering **political and regulatory stakeholders, other networks and the ESO, direct customers, our supply chain, academics** and other interested parties
- We led a piece of research on resilience with the Energy Research Partnership, covering broadly the same stakeholder segments as above, with the aim of understanding future resilience requirements
- We engaged with experts on specific topics:
 - We engaged on cyber security requirements through the Energy Emergencies Executive Committee for Cyber Security (quarterly), with representatives from **government** (BEIS and the National Cyber Security Centre), **Ofgem** and the **NIS Competent Authority, other network companies, customers and consumer bodies**
 - We are part of the Black Start Task Group set up under the Energy Emergencies Executive Committee. This meets quarterly and includes stakeholders from **government (BEIS) and Ofgem, other network companies, customers and consumer bodies**
 - We continue to work closely with **BEIS** and **CPNI** to understand the physical threat against our Critical National Infrastructure (CNI) sites and agree the sites which need to be protected
 - On the topic of extreme weather, we have engaged via an ENA working group, which includes **political and regulatory** stakeholders (including the Environment Agency), **network companies, interest groups, think tanks and academics.**
 - On Operational Telecommunications (OpTel), we have engaged with **SSE** and **Scottish Power** on consistency of standards and engineering approach. We continue to engage with the **ESO** to understand future OpTel requirements and with **CPNI** to ensure our approach meets the requirements for CNI
 - At a high level, we have engaged over 3,000 **domestic consumers** and 600 **business consumers** on this topic via our willingness to pay, acceptability testing and interactive online tool research (both quantitative and qualitative)

The environment and communities

What we engaged on

- This topic contains a number of sub-topics, so we first needed to understand which of these were most important to our stakeholders



- For the environment, we then engaged in more detail on these priority topics, to understand exactly what we need to deliver for each of them. These included:
 - Reducing our greenhouse gas emissions and overall carbon footprint, and the appropriate targets
 - Reducing waste
 - Improving the natural environment
 - Improving the visual impact of our assets, including whether or not there was support for a continuation of the T1 Visual Impact Provision (VIP) scheme
 - Our role in leading environmental sustainability across the industry
- For our role in making a positive contribution to society, we engaged on:
 - Our role in supporting local communities impacted by our work
 - Our role in supporting wider society, including those in vulnerable situations and/or fuel poverty
 - Promoting community benefit through our supply chain
- We also explored how stakeholders thought the above should be funded

Who we engaged and how

- There are certain segments of stakeholders who are especially impacted by or interested in these topics, but they also generate broader interest. We therefore created a tailored engagement programme to explore the detail with those most impacted, whilst making sure we also captured other stakeholder input through more general channels. This included:
 - Three broad workshops and an online consultation to understand stakeholders' priorities within this topic, with attendance/responses from 60 stakeholders representing organisations from **all of our key stakeholder segments** and over 600 **members of the public**
 - A further workshop and consultation focused specifically on this topic. We received input from 76 stakeholders covering our **supply chain, environmental interest organisations, Ofgem, consumer groups, other networks, academia and local communities**
 - Ongoing engagement with the **VIP Independent Stakeholder Advisory Group** (with representation from **interest groups and Ofgem**)
 - **Consumer** acceptability testing (including **vulnerable consumers**) for VIP schemes
 - A bilateral meeting and ongoing conversations with **Citizens Advice** to understand their expectations of our role with communities
 - Two nationally-representative **consumer** research studies (5,137 domestic and 621 business respondents in total) to establish priorities
 - A consumer listening session with 36 **members of the public** (talking directly with our director and senior leadership team)
 - Bilaterals with eight **investors** on the topic of Total Societal Impact (TSI)
 - Further engagement on TSI through meetings, focus groups, interviews and surveys, covering 30

senior **political and regulatory** stakeholders, 41 **employees** and 3,000 **members of the public**

- We engaged an additional 3,000 **domestic consumers** and 600 **business consumers** via our willingness to pay, acceptability testing and interactive online tool research
- This was supplemented through cultural research and other consumer trend data
- We held two webinars with **SF₆ experts from across the globe**
- We engaged on supply chain issues through ongoing discussions with our **partners**, peers in other industries, and through the Supply Chain Sustainability School

Be innovative

What we engaged on

- Stakeholders have identified the need to be innovative as one of our priorities, so we needed to understand what they wanted us to focus on, what we should try to achieve through our innovation projects, and how they thought a future innovation framework should operate
- We also engaged on our innovation strategy and how innovation should support the overall efficient delivery of our plan. This was a particular area of focus for the Independent Stakeholder Group

Who we engaged and how

- Our stakeholder audience for innovation (those impacted by or interested in this topic) splits into those who are interested in the outputs of innovation, and those who are involved in its delivery. We used a number of tailored channels to engage on this topic:
 - We used workshops to gather input into how we should approach our future innovation programme. These covered stakeholders from our **supply chain, other networks, think tanks and academics, customers, consultants and other industry organisations** (over 90 attendees across two workshops)
 - We met **Ofgem** and other interested parties in specific innovation-focused meetings
 - We discussed innovation with **generators and BEIS** in a bespoke meeting in February 2019
 - Once we had clarity on priority topics, we ran a series of six webinars to explain our proposals and gain feedback from stakeholders on whether or not these were correct, engaging with 41 stakeholders from **academia, other networks, our supply chain, customers, interest groups, government and Ofgem**
 - We hosted an innovation exhibition with other networks at the 2019 Utility Week Live event, with interaction with 26 stakeholder organisations from within and outside of the energy industry
 - We published a series of podcasts to help inform stakeholders about our current areas of focus
 - We covered innovation as part of our **consumer** research, through willingness to pay, our online interactive tool, and acceptability testing



Be transparent

What we engaged on

- Transparency is a theme that runs throughout the whole of our plan, so it has formed part of our engagement on all topics. In addition, we engaged specifically to confirm stakeholder expectations and understand what transparency meant to them

Who we engaged and how

- We've targeted our engagement at those stakeholders who are most interested in seeing transparency around what we do. This has included a number of specific meetings, workshops and conversations with **customers, consumer groups** and **Ofgem** to understand what they need and expect
- We have also engaged more broadly through a webinar, online publications and a consultation on our website to capture input from other interested stakeholders, as well as covering this topic in our broader, multi-topic engagement activities (including our phase 1 workshops and February 2019 playback consultation)

Throughout phase 2, the Independent Stakeholder Group challenged us to make sure we were talking to the right people in a non-biased and non-leading way, and that we were using the right channels as part of a tailored engagement programme. We also commissioned a specialist third-party organisation, Truth, to assess our approach and tell us where we could improve. As a result of their assessments, we improved the way we recorded stakeholder views at our workshops to ensure more usable insight, and addressed gaps in our direct customer engagement through additional engagement activities. The reports can be found in annex NGET_A6.03 Truth Reports.

In addition to the topic-specific engagement above, we consulted stakeholders on our proposed Output Delivery Incentives. Details can be found in annex NGET_ET.06 Output Delivery Incentives. We also engaged stakeholders on elements of the RII0-2 financial package (including the cost of capital and rates of return), but given the complex nature of this topic, our engagement was very targeted. We did not consider it appropriate to engage members of the public on this topic, because even after explanation, it is unlikely that consumers would have a full understanding, and therefore any views provided would have been largely uninformed. We did, however, engage Citizens Advice on this topic in their role as consumer representatives. This approach was agreed with the Independent Stakeholder Group, and details of our engagement on this topic can be found in chapter 15 *How our plan should be financed*.

Phase 3: publishing our business plans and asking for stakeholder views

We have made sure we are properly reflecting what stakeholders have told us in our plans by playing back the outputs from individual engagement activities, and also by playing back our latest ideas to address our stakeholder preferences at appropriate points throughout the process. This is about closing the loop, and showing

stakeholders how we have developed our plans to reflect what they've told us.

In our February 2019 playback consultation, we collated everything we'd heard on all eight stakeholder priorities, setting out our direction of travel based on stakeholders' views. We then consulted on this, to make sure we'd understood our stakeholders correctly, using a combination of channels. As far as we are aware, this is the first time an energy network company has consulted on its direction of travel for the whole of its business plan. We incorporated feedback from this consultation into our July 2019 draft plan, and invited further feedback following publication of that draft plan. For our October and December plan updates, we've highlighted the changes we've made as a result of what we've heard. We communicated these to all of our stakeholders in mid-October, and will do so again in December.

Towards the end of the plan development process and following the submission of our October 2019 plan, we commissioned an independent assessment by Frontier Economics of how we had converted stakeholder insight into our plan. Frontier's report can be found in annex NGET_A6.07 Frontier Golden Thread Assessment, and we have addressed their suggested areas for improvement in this updated plan.

Acceptability testing

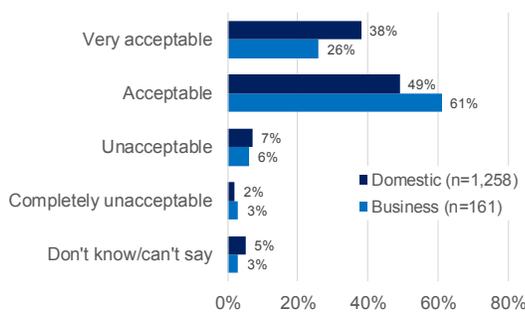
Once we had published our draft plan in July 2019, we used the information within it to carry out acceptability testing amongst consumers. In order to get as clear a picture as possible, our approach included:

- a quantitative research study covering a nationally-representative sample of 1,258 domestic bill payers
- a quantitative survey of 161 business consumers, looking at results from different company sizes and energy user types
- qualitative research with a cross-section of members of the public (two focus groups plus 14 interviews)
- further qualitative research amongst domestic consumers to explore the quantitative results in more detail (six focus groups, 48 attendees)
- a nationally-representative study of 1,000 domestic consumers, which used an interactive online tool as a more gamified way of explaining our plans and asking what choices consumers think we should make

All results were positive, both in terms of the acceptability of our plans and regarding respondents' feedback on the format used for the research. There were high levels of support amongst domestic and business consumers (87% for each), and across subgroups within both the domestic and business sample.



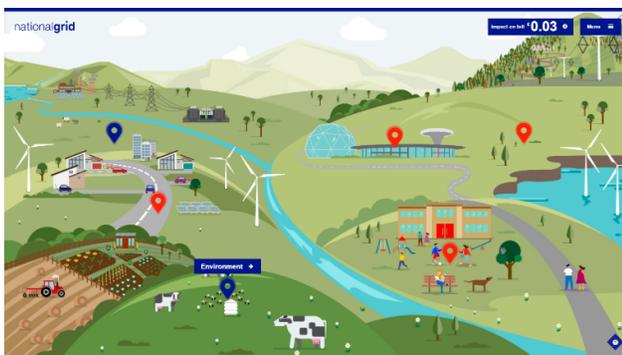
Figure 6.5 Acceptability testing of overall plan



From our interactive online tool (sample size = 1,047), results showed that:

- respondents added an average of £1.44 to their annual electricity bill as a result of the options they selected
- 57% selected options which added £1.25 or more to their bill
- 8% selected options which reduced their overall bill
- 67% said they currently receive value for money from National Grid, 7% said they do not.

Our interactive tool



The full results from the online tool research and acceptability testing study can be found in annexes ET_A6.05 Interactive Online Tool Research Report and ET_A6.06 Acceptability Testing Reports. Results from both of these studies have been used as further sources of insight in our decision-making process.

3. Our commitment to enduring stakeholder-led plans

Our stakeholders have told us that the opportunity to input into and help shape our annual business plan updates is something they would like (and expect) on an ongoing basis. They expect this to be a genuine two-way engagement process. We outlined our proposed enduring approach in our July and October plans, and

since then have continued to develop it, along with our stakeholder engagement strategy (see annex ET_A6.01), with details provided below. We will further develop and embed this approach as we move towards the start of the T2 period.

Our draft business plan is our most stakeholder, customer and consumer focused to date, so we want to build on this in the T2 period. **We are committing to continuing an enhanced stakeholder engagement programme indefinitely**, outside of the price control preparation process. We will make sure we engage with our stakeholders continually on both our short-term and long-term plans, and not only when there is a regulatory need to do so. We expect to adopt our improved process for the first time during our 2020/21 planning cycle (during the T1 period), producing our first stakeholder-led business plan update under this process in early 2021.

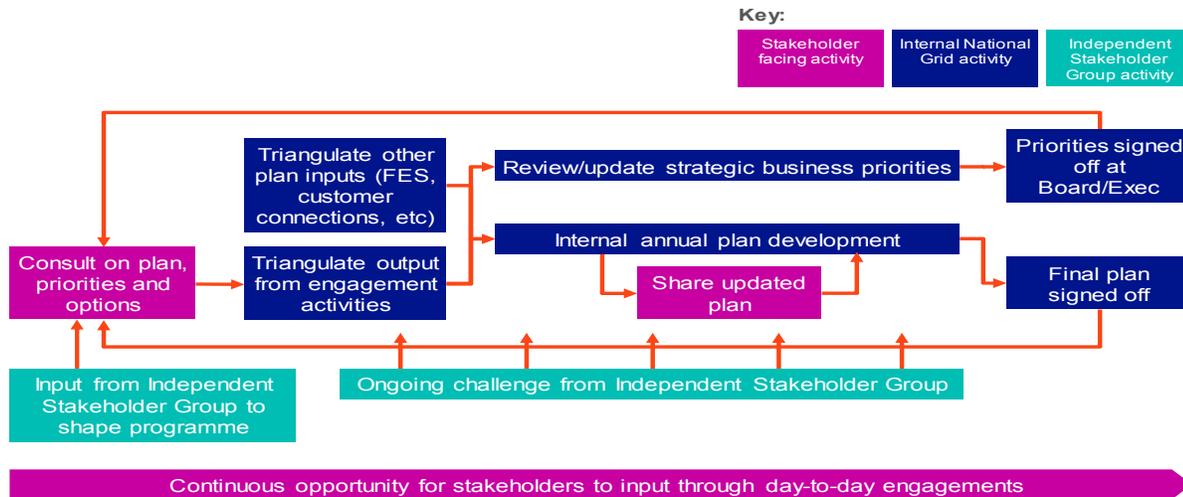
We've adopted as simple an approach as possible to changing business-wide processes, focusing on two main areas of change.

1. We have reviewed our existing business planning process to see where and how we can introduce stakeholder input, so that the end product is a plan informed by stakeholders' needs. In doing this, we will make sure we are open with our stakeholders, explaining why we are not able to consult on some areas of our plans, and where we do consult, providing genuine balanced options to choose between.
2. We are introducing the more complex behavioural and cultural changes to our business that are required to support this process change, focusing on why a stakeholder-led plan is important and therefore why our employees need to do things differently. Much of this can be linked to the AA1000 framework. We have already begun this process but it takes time, so we are dedicating more resources to making this happen as we move towards the start of the T2 period. We will also widen the coverage of the annual health check assessment to gauge how well we are embedding the changes across all parts of our business.

Our proposed ongoing business planning process for the T2 period, and how stakeholder input feeds into it, is shown below:



Figure 6.6 Our annual stakeholder-led business plan update process



This shows that:

- the previous year’s updated business plan will be our starting point for the next year’s update
- we will **collaborate** with our stakeholders – the outputs from our main stakeholder engagement activities, planned for the first quarter of each year, will be combined with other inputs to create a draft updated business plan
- we will be **transparent**, and share this draft update with stakeholders every autumn to make sure we’ve correctly reflected their input
- our draft plan will be updated and approved through our internal governance process
- we will also use stakeholder insight to inform and, if necessary, revise our strategic business priorities
- although we’re setting out a timeline, we’re always ‘open for business’ if stakeholders want to talk to us – we’ll be in ongoing dialogue with our stakeholders across a range of topics.

Addressing Ofgem’s business plan guidance criteria

Ofgem has set out its expectations for networks’ enduring approach to stakeholder engagement. These are listed below, along with details of how we will meet and go beyond them. Further details can be found in our stakeholder engagement strategy in annex NGET_A6.01.

Ofgem criteria:

- Our approach must be strategic
- There must be senior level buy-in and engagement running through all levels of our organisation
- We must be responsive to stakeholders’ up-to-date needs and ensure that these are incorporated into the day-to-day operation of the business

We will follow our stakeholder engagement strategy and we will review and update this strategy on an annual basis. We will use stakeholder insight to shape our business at a corporate, **strategic** level, and in our **tactical**, day-to-day activities. Our CEO and UK

Executive Director have personally committed to updating our strategic business priorities on an annual basis to reflect the latest stakeholder insight. We will also review and update our Electricity Transmission priorities on an annual basis to reflect what our stakeholders need from us – NGET board members have personally signed a stakeholder charter committing to our engagement strategy on an individual and collective basis. Specifically, they have committed to:

- approving our stakeholder-led business priorities on an annual basis
- tracking and monitoring key stakeholder engagement performance metrics twice a year
- support the ambition and approach outlined in our stakeholder strategy
- being actively involved in stakeholder engagement activities
- assuring that responsibility for engagement is embedded across our business, and business leads understand their engagement responsibilities and have the tools, skills and capabilities to deliver

We are making stakeholder insights a more prominent part of our governance and decision-making processes. For Electricity Transmission, this will include our Electricity Transmission Director and senior leadership team reviewing the latest stakeholder insight at their Exec meetings and making decisions on the back of it. Our board members and Exec team will continue to meet stakeholders, including consumers, face-to-face to better understand what they need from us.

At a more tactical, operational level, we will further embed the AA1000 standard across our organisation to help deliver our business objectives, and will follow our strategy to engage on the topics that stakeholders have identified as their priorities. Engagement will be centrally coordinated but will be the responsibility of employees across the business



– this process has already begun with the engagement we've carried out as part of our T2 submissions. We will continue to use independent assessments against the AA1000 standard to monitor how well we are embedding this process, and an Independent Stakeholder Group will provide further challenge and assessment (see below).

Our annual process, shown above in figure 6.6, includes specific engagement activities to ensure we remain up-to-date with what our stakeholders need from us. This includes a formal check at the start of each year's business plan update process to confirm/update stakeholders' priorities, plus more detailed, topic-specific conversations throughout the year to enable us to respond to changing requirements. We will use our stakeholder relationship management system to record interactions and insights, and share these with those who need them as decision-making input. In section 1.iv above, we provided details of the decision-making framework used for our T2 engagement. We propose to continue using the same principles and approach to help convert insight into plans throughout the T2 period.

Ofgem criterion:

- Our approach must incorporate and build on best practice from RIIO-1 and from other industries

Much of our future approach will be based on the process we've followed over the past two years as we've built our T2 plans. We are taking what we've learned from this process, including challenges from the Independent Stakeholder Group, best practice gained from working with others (both within our industry and from other sectors), and feedback from independent assessments, and building on this and new stakeholder feedback to continuously improve. We will work with the relevant experts to help us do this.

We propose to retain an Independent Stakeholder Group to hold us to account

One of the best ways of ensuring we maintain our stakeholder focus is for an independent group to hold us to account, just as they have done in our T2 plan preparations. The high-level role of the group would be to continue to challenge our engagement activities, scrutinise our business plans and verify our annual reporting, including our preparation for the T3 period. The group would keep us accountable and ensure we deliver what our stakeholders want from us. As it is independent, the group itself would define the specifics of how they wish to do this. We will also engage Ofgem and other stakeholders on the nature of the group's enduring role. On a periodic basis, members of the group would change to ensure continued independency and to provide the opportunity to bring fresh perspectives. We propose that the group continues to have a strong consumer voice.

We would expect the group to provide challenge at the start of each year's engagement programme to ensure our plans are comprehensive, representative and

inclusive, and to challenge us on best practice and shape our engagement based on learning they have acquired from other sectors and organisations. Our UK Executive Director would regularly attend the group, and there would be ongoing NGET board-level attendance at every meeting to represent Electricity Transmission.

Ofgem criteria:

- Our approach must be proportionate
- We must be inclusive of all stakeholders, including hard-to-reach groups and existing and future consumers
- We must deliver value-for-money outcomes that stakeholders need

Our enduring engagement approach will continue to follow the AA1000 principles of inclusivity, materiality and responsiveness. We will engage stakeholders on the parts of our plan that have a material impact on them, and for which there are genuine options.

We will continue to ensure that we cover a representative sample of our stakeholders, including our direct customers and domestic and business consumers, and will continue to map these stakeholders so that we only engage with those impacted by or interested in a particular topic. We will ensure we include the views of **current and future** customers and consumers. Consumer engagement will continue to be nationally representative.

We will use multiple engagement channels, continue to listen to how our stakeholders would like to be engaged, and look for innovative ways to engage them. The nature of innovation means it's difficult to be specific about exactly what this will look like, but it will be a key part of our engagement approach. We will work closely with other networks and appropriate partners to identify opportunities for joint engagement and reduce the risk of stakeholder fatigue. We also include our employees as one of our stakeholder segments and will engage them on relevant topics, as well as continuing to communicate with them regularly through our range of internal channels.

We will further develop our consumer engagement. In the T2 period, it will include, but not be limited to:

- quantitative research with nationally-representative samples of household consumers, including acceptability testing and/or willingness to pay research where appropriate
- qualitative research to help shape quantitative studies and allow more detailed exploration of certain topics with targeted groups of consumers
- quantitative and qualitative research with business consumers of all types
- using consumer trend data and specific research studies to help predict future trends and make sure our plans balance the needs of current and future consumers



- using innovative approaches like interactive online 'gamified' tools to help explain who we are, what we do, and understand what consumers want from us
- consumer listening events to hear first-hand what consumers want from us.

We will broaden our coverage of **hard-to-reach and vulnerable groups** (both consumers and other stakeholders) by continuing to use a mix of channels and looking to find innovative ways of engaging.

Our enhanced approach to consumer engagement will allow us to test and check that we're continuing to deliver the outputs that consumers want from us, both during the T2 period and further into the future.

In section 2 of this chapter, we provided details of how we have checked whether consumers and our wider stakeholder population see our T2 plans as value for money. We will continue to do this in the T2 period by using a combination of quantitative and qualitative engagement methods, and by ensuring we engage on current and future costs as well as options when consulting stakeholders about our plans.

It's also important that our engagement activities themselves are proportionate and provide value for money. Our ambition is that the costs of our enhanced engagement programme will be heavily outweighed by the benefits we create as a result of our stakeholder-focused approach. We propose to use a model to deliver our engagement which includes some central coordination to manage the engagement and business planning process, but which mainly relies on employees across our Electricity Transmission teams to deliver this work on a day-to-day basis. Our estimated costs to deliver enhanced engagement across the T2 period are £760k per year. This covers the salary costs of a small 'central' team, the costs associated with running the Independent Stakeholder Group, and the costs associated with delivering additional engagement activities and carrying out the appropriate research studies, including the use of expert agencies and consultants where required.

These costs do not include 'business as usual' engagement activities, or the employee costs of delivering these. These activities and costs are spread across many teams and roles, and are covered in this plan within our overall opex costs. See chapter 14 *Our total costs and how we provide value for money*. For context, in 2018/19 we estimated that our **total** costs of engagement, including our business as usual stakeholder engagement activities, were around £3.7m. As a benchmark, Western Power Distribution, who consistently score highest of all network companies in the T1 stakeholder engagement incentive, estimated their costs to be £4.8m for the same period.

We engaged the Independent Stakeholder Group (and other stakeholders) about how these activities should be funded, with a consensus that a stakeholder

engagement incentive was no longer appropriate and that these activities should now be seen as business as usual. These costs are therefore part of our T2 baseline.

Ofgem criteria:

- We must be ambitious, with appropriate, well-evidenced and stretching performance commitments
- Our approach must be transparent, including how we will measure progress against commitments and the consequences for non-delivery

Measuring the impact of our engagement is a fundamental part of our strategy. We also need to measure how well we are delivering against the commitments we've made in this plan, and, to meet our stakeholder priority of being transparent, we need to communicate progress to our stakeholders (more details can be found in chapter 13 *We will be transparent about our performance*).

Our proposal for the T2 period is for the Independent Stakeholder Group to agree metrics and set ambitious targets, against which they would hold us to account, creating a reputation-only incentive relating to our engagement process and its outcomes. We are still more than a year away from the start of the T2 period, so we cannot yet be specific about details. However, we would expect targets to be based around the Stakeholder Group's engagement principles and to include these types of metrics:

- Quality/scope of engagement and how well we've embedded a stakeholder focus, e.g.
 - numbers of stakeholders engaged and appropriate representation of relevant segments/organisations
 - AA1000 health check score
 - stakeholder satisfaction with engagement process, e.g. using the Net Promoter System
 - % of business plan, appropriate topics engaged on
- Impact/outcomes of engagement
 - benefits to stakeholders driven by engagement (financial and otherwise)
 - plan/business decision changes made

Ultimately, the Independent Stakeholder Group would determine these metrics (ratifying any proposals that we make), set the relevant targets, and outline their expectations of how we should report and communicate them to our stakeholders, to ensure we are as open and transparent as possible. We will work with the existing group to develop a suite of metrics before the start of the T2 period. We expect these to include challenging targets around what we change as a result of our engagement activities and the stakeholder benefit, we create as a result.



7. We will enable the ongoing transition to the energy system of the future



What this stakeholder priority is about

This priority is about how we help the UK achieve net-zero targets by innovating to advance the decarbonisation of electricity supply, transport and heat at the lowest cost to consumers.

What you have told us so far

We welcome the Government’s decision to legislate for net zero by 2050 and the ambitious goals this entails. To make these goals a reality will require a collaborative approach across industry to accelerate decarbonisation and ensure the transition is fair for the consumer. You have told us that you want us to play a more proactive role in enabling the transition.

What we will deliver

Provide **a network that enables the transition to net zero by 2050**, reducing future system operation costs by between £20bn and £120bn depending on future energy scenario.

Enable **competition and new business models** to further minimise cost to consumers.

Deliver **electricity whole system solutions** by optimising across all network companies.

Enable **all energy whole system solutions** through a proposed approach to anticipatory investment and options for overcoming decarbonisation challenges, such as ultra-fast vehicle charging to overcome range anxiety and an integrated network for connecting offshore wind faster, cheaper and with less disruption. The activities required to deliver against these proposals are dependent on how the energy market and industry framework changes over time. We will

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification of our proposals
6. Our proposed costs for the T2 period
7. How we will manage risk and uncertainty

ensure we are ready to deliver whatever our customers require of us, but have built the detail of our plans for this priority on the minimum values/low end of the [Common Energy Scenario](#), as required by Ofgem. This scenario was put together with [input from our stakeholders](#) and in collaboration with other networks.

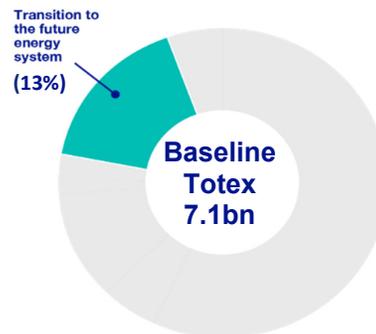
We are proposing a plan that can flex to deliver net-zero targets and is robust to future uncertainty through a suite of mechanisms that automatically adjust our allowances, ensuring consumers pay a fair amount however the energy system develops. Over 75% of expenditure for this priority is subject to such mechanisms and no uncertain spend is included.

To enable competition, we have not included £1.5bn of projects that meet Ofgem’s contestability criteria and, through taking a whole system approach with Distribution Network Operators and developing a unit cost allowance mechanism for reactors, our baseline is £184m less than it would have been for this priority.

All past engineering and asset management innovations and stretching commitments to future efficiency are built into the total cost of £936m for delivering these baseline proposals. This represents 13% of the overall business plan as reflected in figure 7.1.

Over 70% of the investment proposed for this priority has been subject to economic assessment through the Electricity System Operator’s (ESO) Network Option Assessment process and all areas of expenditure are supported by an investment decision pack justifying the need, scope and cost of our proposals.

Figure 7.1 Proportion of expenditure





1. What this stakeholder priority is about

As owner of the electricity transmission network in England and Wales, we enable decarbonisation and maintain security of supply at lowest cost to the consumer. We do this by:

- innovating **reinforcement** of the electricity transmission network
- enabling **competition in networks** and non-network solutions
- collaborating across organisational boundaries to enable **whole system solutions**
- proposing options that enable the decarbonisation of power, transport and heat
- developing **uncertainty mechanisms** that ensure our plan can flex to deliver net zero.

Consumer value proposition (CVP)

The CVP looks at the value we are providing above Ofgem's minimum requirements that we can robustly monetise. This chapter contains the following CVP items:

- CVP1: Optimisation of harmonic filtering (value of £18.82m)
- CVP2: Whole-system alternatives to reactor investments (value of £16.62m)
- CVP8: Optimisation with ESO to reduce whole-system costs (value of £84.88m)

For more detail, please see chapter 5.4 and the CVP annexes ET.07 to ET.07C.

Energy scenarios

The customer driven investments in this chapter depend on the changing needs of customers. We have built the detail of our draft plan using an England and Wales energy scenario based on our own market intelligence and specific [stakeholder engagement](#). This scenario has been constructed to stay within the minimum values in the Energy Networks Association (ENA)'s [Common Energy Scenario](#), as required by Ofgem. As this common scenario is not consistent with delivering net zero by 2050 and the industry code framework is inherently uncertain, our proposed uncertainty mechanisms are a critical enabler of the transition to legislated targets, at least cost to consumers, alongside our baseline totex plan. These mechanisms are set out and evidenced in Section 7 of this chapter, with more detail available in annex NGET_ET.12 Uncertainty mechanisms.

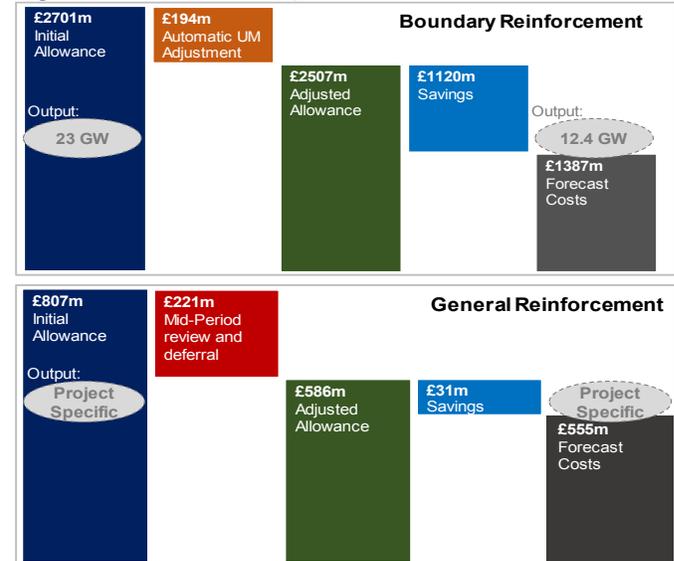
The costs to deliver this priority are primarily from network reinforcement to facilitate the flow of electricity between regions. Whilst our proposals are consistent with the Common Energy Scenario, they have been tested by the ESO against a range of future outcomes through the annual [Network Options Assessment](#) (NOA) process. We have also undertaken extensive analysis and [stakeholder engagement](#), confirming the ongoing need for electricity transmission in even the most highly decentralised futures.

2. Track record and implications for T2

2.1 Costs, outputs and allowances in T1

This priority can be split into costs and outputs related to **boundary reinforcements**, such as new/uprated circuits or network reconfigurations, and **general reinforcements**, such as certain voltage control equipment and site separation works. Initial forecasts included in the T1 period are shown alongside allowance adjustments and current forecasts for the 8-year period in figure 7.2.

Figure 7.2 T1 costs, outputs and allowances



Volume changes due to changing customer needs

The way energy is generated, transported and consumed is changing rapidly. Not all this change was anticipated when preparing our business plans for the T1 period. Whilst the level of decarbonisation has been broadly in line with expectations, the extent of decentralisation was not foreseen. This trend has reduced transmission reinforcement anticipated at the start of the T1 period.

Automatic adjustment of allowances

Ofgem developed a suite of mechanisms as part of the approach to dealing with risk and uncertainty at the start of the T1 period. These mechanisms adjust our allowances to ensure consumers only pay for what our customers need us to deliver. A mechanism for network reinforcements providing a unit cost allowance for each additional MW of boundary capability was put in place. Unit cost allowances for network reinforcement have adjusted our allowances down by £194m.

Cost changes through efficiency

Given considerable changes in the projects delivered versus those that were expected, it is not possible to define a baseline against which to specifically measure efficiency for customer driven work. Some examples are provided below.



T1 benefits are embedded into our T2 plans

In the T1 period, we took risks by innovating to reduce costs for consumers. This was achieved through a combination of cheaper solutions, reducing network costs, as well as through solutions that delivered network capacity more quickly, thereby reducing ESO system operation costs more quickly. We did this by:

- Deploying the first series compensation devices in Great Britain on the circuits from Scotland to England & Wales – *providing more capacity on these existing circuits and delivering system operation cost savings more quickly.*
- Working with a start-up company based in California to develop power flow controller technology (Smartwires). A world first at transmission voltage – *providing additional capacity at a lower cost (estimated saving of £387m in T1) and delivering system operation cost savings more quickly (not yet deployed).*
- Developing an approach that uses the correlation between the need for capacity and extra circuit cooling offered by the wind – *providing additional capacity at a lower cost (not yet deployed).*
- Installing the first offshore HVDC link to be run in parallel with the AC transmission network in Great Britain as a joint venture with Scottish Power Transmission – *delivering system operation cost savings more quickly.*
- Through smaller innovative solutions, lean asset design, asset reuse and improvements to industry codes – *providing additional capacity and security of supply at a lower cost.*

This innovation has not come without risk. We have experienced difficulties in the commissioning and reliable operation of all the new technologies we have deployed to date, delaying the benefits of these network enhancements. Challenges of this nature are to be expected when innovating, but do not undermine the significant, net consumer benefits delivered. We have therefore included these innovations in our T2 plan.

Whole system approach

Increasing levels of decentralisation and flexibility are offering new solutions to network issues and a greater imperative to optimise across organisational boundaries. Nevertheless, the concept of whole system planning is not a new one. Network companies and the ESO have traditionally worked together to coordinate business plans and identify the most economic solutions available. We are embracing potential whole system solutions in the T2 period by removing £184m of investment identified as required from our baseline plans and proposing new uncertainty mechanisms.

Our participation in the ESO's NOA, ongoing involvement in the Energy Networks Association's Open Networks Project and bilateral collaboration with Distribution Network Operators (DNOs) through Joint Technical Planning Meetings and, more recently, Regional Development Plans are just some of the examples of

where we have developed whole system solutions in the T1 period. The accompanying annex NGET_A7-8.03 Whole Systems provides further detail and specific examples.

Price control effects

Costs and allowances can also vary through price control mechanisms, such as costs incurred for outputs delivered beyond the second year of RIIO-T2.

2.2 Learning for the T2 period

The following key learnings from our experience in the T1 period have influenced our T2 proposals:

- Baseline plans built on the extreme of an energy scenario envelope (i.e. Gone Green) are likely to lead to significant revenue adjustments through uncertainty mechanisms. We have engaged stakeholders and other networks to agree a Common Energy Scenario, reducing this risk in the T2 period.
- Volume driver uncertainty mechanisms are essential to deal with energy uncertainty, but output definitions have been inadequate in areas. We propose evolving these to enhance cost-reflectivity and remove the need for voluntary deferrals of allowances by working with Ofgem and other network companies on:
 - refining the output definition for wider works so that it is more resilient to changes in the generation and demand background and the dynamic nature of boundaries
 - introducing new output categories for embedded generation, system operability and preconstruction work
 - better alignment of funding and expenditure for outputs delivered beyond the end of the period (e.g. T2 period + 3 years).
- Innovations in how we deliver projects and in new technologies have reduced costs for consumers in the T1 period. These efficiencies are included in both the costs of our baseline plan and in the unit cost allowance calculations of our proposed uncertainty mechanisms described in Section 7 of this chapter and highlights the consumer benefits of setting unit cost allowances in advance to continue to incentivise innovation.
- Despite risks, innovation delivers benefits for consumers. However, when investments are delivered late, consumer benefits are also delayed. We propose to address this by ensuring **we do not benefit from these delays** through the regulatory framework and that the proceeds of any contractual compensation events are passed back to consumers, as set out in Section 5.2.i later in this chapter.
- With hindsight, we could have put forward a more compelling whole system solution to emerging voltage issues in the T1 period. As the system continues to decentralise, managing voltage and inertia on the transmission network is more challenging. We are addressing this by working closely with DNOs and the ESO. The expansion of



the NOA process to cover voltage investments and development of a system operability unit cost allowance uncertainty mechanism, as described in Section 7 of this chapter, will also ensure that the optimal consumer outcome is delivered.

- vi) We have developed 10 projects under the current planning act with an average duration of 5-8 years to obtain consent. We are looking to use our experience from these projects to deliver the required pre-application consultation and engagement more effectively, better targeting resources at key aspects, considering the timing of high resource commitment activities in the process, and being more proportionate in the information we produce. By taking this approach we think we can reduce the time to achieve consents, the duration and extent of uncertainty for communities, and improve the cost profile of the process for the benefit of consumers.

3. What our stakeholders are telling us

The proposals put forward for how we enable the ongoing transition towards the energy system of the future are a combination of:

- i. licence obligations, annual processes and ongoing stakeholder engagement, and
- ii. bespoke engagements undertaken in building our T2 business plan.

i. Licence obligations, annual processes and ongoing stakeholder engagement

Most of our proposals are either heavily or exclusively influenced by our licence obligations, evolving annual processes run by the ESO and together with DNOs, as

well as ongoing stakeholder engagement, as detailed in figure 7.3.

Our licence obligations and the industry code framework set out how we must plan the network and interface with other parties. We must design the network to maintain compliance with the *Security and Quality of Supply Standards*, adhere to the procedures and requirements across the ESO/TO interface in the *SO-TO Code* and work with the DNOs as set out in the *Grid Code*.

We gather considerable insights through ongoing domestic and international engagement with customers about their future plans, other transmission owners, our leadership role in groups like the ENA, CIGRE, the Institute of Asset Management, the IET, and the Women's Engineering Society, amongst others. We also rely on publications by others operating in this field and the work we commission with expert consultants.

ii. Bespoke engagements undertaken in building our T2 business plan

We have logged the detailed information on our engagement for this priority and how we have responded to the challenges of the Independent Stakeholder Group which can be found in annexes NGET_A7-8.01 Engagement Log (Whole system – DNO&ESO), NGET_A7-8.02 Engagement Log (Future of Transmission & Managing Uncertainty) and NGET_A7.01 Engagement Log (Whole system – non-network company). A summary of our approach, key trade-offs and how this bespoke engagement has influenced our proposals is provided in table 7.4 below. This is split into three strands: (a) future role of transmission and managing uncertainty, (b) whole system engagement with network companies and (c) whole system engagement with non-network companies.

Figure 7.3 Key obligations, processes and ongoing engagement influencing our proposals for this priority





Table 7.4 Summary of our engagement

	a) Engagement on the role of electricity transmission in the long term and managing uncertainty in the short to medium term	
	<i>Future role of transmission</i>	<i>Managing uncertainty in the T2 period</i>
Purpose and approach	We published a discussion document in July 2018 supported by an online survey, social media, a webinar and bespoke sessions to cover all relevant stakeholders to: <ol style="list-style-type: none"> inform in an area with limited analysis and debate in the public domain gather views on priorities and the future role of transmission to shape our engagement consult on the need for the transmission network in the long-term to allow for more effective development of the RIIO-T2 price control framework and our business plans. 	We published a consultation document in February 2019 supported by a webinar to: <ol style="list-style-type: none"> playback the outcomes of our engagement on the future of transmission inform about our current approach to business planning and uncertainty consult stakeholders on how scenarios should be used for the T2 period involve stakeholders in where we should propose a baseline allowance shape our input into the Common Energy Scenario work.
What stakeholders told us	Stakeholders told us that: <ul style="list-style-type: none"> decentralisation and decarbonisation are trends most likely to impact transmission in the long term despite uncertainty, there is a need for electricity transmission in the long term decarbonisation, reliability and lower costs for consumers are top priorities; facilitating flexible energy services and enabling customer solutions are also important to certain segments we should play an active role in enabling the energy transition and ensure electricity transmission is not a blocker to EV uptake delivering whole system solutions is important we should undertake timely reinforcement where required. 	Stakeholders told us that: <ul style="list-style-type: none"> FES with additional regional insights are a suitable range for planning our business our approach to setting an England & Wales scenario is reasonable there is majority support for setting a baseline allowance that is least likely to change over the T2 period it is appropriate to review existing uncertainty mechanisms and consider the introduction of new ones, particularly where these facilitate potential whole system solutions there is merit in the development of an anticipatory investment mechanism.
What consumers told us	Quantitative acceptability testing showed strong support for investments needed to support future changes in electricity supply and demand (91% support for proposals). Planning the energy system of the future was ranked 3 rd after only reliability and protecting the network. This relative level of support remained when consumers were asked to also consider the impact on bills. Further qualitative testing, through focus groups, confirmed these results. Whilst results differed across domestic and non-domestic consumers, both showed a strong willingness to pay for investments to accommodate renewable energy. Combined, the results from our consumer engagement suggest that these types of investments should be near the top of our priorities.	
Examples of key trade-offs and how engagement influenced our plans	This strand of engagement confirmed stakeholders' priorities we had compiled from prior engagements (set out in our Listen Report). The insights we gained gave us confidence in the long-term role of electricity transmission and, therefore, in extending the current approach to managing medium-term uncertainty in the price control using 'unit cost allowances'. It also shaped our input to the Common Energy Scenario work and the England and Wales scenario upon which our plan is based, changing our assumptions on regional demand variations and solar PV capacity. <p>A key trade-off was whether we should play a passive role (responding to network issues), or a more proactive role (highlighting whole system issues and potential solutions) in enabling the energy transition. DNOs and, on some topics, the ESO, thought we should play a more passive role, whilst most other stakeholders wanted us to be proactive. This trade-off was debated twice in the Independent Stakeholder Group. Based on the views of most stakeholders, we decided that an active role is appropriate and are putting forward proposals for an anticipatory investment process, consideration of non-network solutions and our thinking on how to resolve some of the key challenges in this plan.</p>	
How we've responded to the Independent Stakeholder Group/ Challenge Group	The Independent Stakeholder Group challenged our approach to uncertainty mechanisms and whether we are doing enough to ensure the price control is sufficiently flexible to allow net-zero 2050 targets to be met. In response to this challenge, we have broadened our suite of mechanisms and have undertaken extensive statistical analysis and probabilistic modelling of uncertainty to develop the detail. <p>The RIIO-2 Challenge Group has influenced our plans by stipulating a requirement to work with other networks to create a Common Energy Scenario and to submit a baseline plan that is consistent with this scenario. They also challenged us to ensure our plan can flex to support the pathways to net zero. The broader suite of mechanisms we are proposing in response to the Independent Stakeholder Group, and set out in Section 7 of this chapter, address this.</p>	



	b) Engagement to build a whole system plan with electricity network companies	
	DNO engagement	ESO and other TO engagement
Purpose	<p>As a key stakeholder, we engaged extensively with all the DNOs through a series of all-day workshops and conversations. This working level interaction was supplemented with bilateral and senior level conversations as well as meetings through the ENA to:</p> <ol style="list-style-type: none"> share assumptions around future demand and generation growth understand DNOs future capacity requirements at grid supply points collaborate on proposed investment plans. collaborate on whole system options and processes collaborate on asset replacement plans. 	<p>As a key stakeholder, we engaged extensively with the ESO in an iterative process through bilateral discussions, with other TOs and through their System Operability and NOA processes to:</p> <ol style="list-style-type: none"> understand the network reinforcement that delivers boundary capability in the most economic way for consumers understand what services the ESO require to operate the network in the T2 period explore the potential of an incentive to minimise costs at the network owner/system operator interface. collaborate on potential new services that could help reduce the cost of system operation.
What stakeholders told us	<p>Through these various channels, the DNOs:</p> <ul style="list-style-type: none"> indicated there is an ongoing need for transmission infrastructure at the distribution interface agreed a national view of timing of electric vehicle growth and electrification of domestic heating indicated that DNO data submissions, rather than a national scenario, should be used for identifying specific investment requirements at the interface stated a preference for a strong ESO role in whole systems, particularly through NOA expansion, and agreed interim approach to building T2 plans supported the introduction of a reactive, unit cost allowance based, uncertainty mechanism 	<p>Through these various channels, the ESO have indicated that they:</p> <ul style="list-style-type: none"> support our intention to help facilitate the energy transition and further develop an approach to anticipatory investment that mitigates consumer risk are keen to ensure that any network options recommended through the expanded NOA process or other ESO needs are appropriately funded and they support progressing our proposed uncertainty mechanisms with Ofgem believe our proposals to develop an economic modelling capability to better inform our NOA submissions and explore options with flexibility providers may cause confusion with stakeholders on the role of the TO versus the ESO.
What consumers told us	<p>Delivering efficiency savings showed very strong consumer support in both the quantitative and qualitative acceptability testing (92% positive). Nevertheless, when asked to rank priorities, consumers positioned efficiency savings in 4th place after reliability, protecting the network and planning the energy system of the future. Delivering whole system solutions benefits all these areas and we have strongly pursued it as a result.</p>	
Key trade-offs and how engagement influenced our plans	<p>The ESO's requirements and recommendations have a huge influence on the proposals in this plan. Our investments in network reinforcements to increase boundary capability, innovation in new technologies and investment in system monitoring, together representing over 70% of costs in this priority, are all directly recommended by the ESO.</p> <p>A key trade-off for this strand of engagement was whether to include costs in our baseline to maintain compliance with security standards against the Common Energy Scenario where whole system alternatives could exist, or to exclude these costs from our baseline and develop an uncertainty mechanism that would provide funding where transmission investment is found to be the best solution for consumers. Based on the insights gathered through this engagement, we have decided not to put full reactor investment costs into our baseline to fully embrace the potential of whole system solutions to reduce costs for consumers, thereby reducing our baseline proposals by £184m (i.e. the cost difference between 5 and 35 reactors).</p> <p>Uncertainty on roles in the whole system planning process was highlighted by some DNOs and there were different views on the role of the TO. Some DNOs were keen to work exclusively with the ESO, whilst the ESO and other DNOs indicated a preference for full collaborative working. Most preferred the collaborative approach and, on balance, we think this is likely to lead to better consumer outcomes. As such, our proposals are based on this approach.</p>	
How we've responded to the Independent Stakeholder Group/ Challenge Group	<p>The Independent Stakeholder Group has challenged whether our plans are doing enough to support system operability into the future – this feedback was later echoed by both the RIIO-2 Challenge Group (“we are particularly interested in your plans to support the ESO in its goal of carbon-free operation by 2025...”) and in the ESO's direct feedback on our July draft plan (“keen to see you thinking more broadly around stability issues and what solutions you could provide there.”) – as a result we developed a system operability uncertainty mechanism as set out in Section 7 of this chapter and in annex NGET_ET.12 Uncertainty mechanisms.</p>	



	c) Engagement to build a whole system plan with non-network companies	
	Flexibility provider engagement	Customers and cross-sector engagement
Purpose	Through attending conferences, bilateral conversations and hosting workshops, we engaged flexibility providers and storage developers to: <ol style="list-style-type: none"> seek to understand their current and future capabilities inform them of the potential opportunities in providing network capacity services (as opposed to ancillary services) understand if we can play a role in helping them come to market. 	Through workshops, bilateral conversations, industry round tables and conferences we have been engaging customers, stakeholders across sectors, experts and policy makers on facilitating more renewable energy and the decarbonisation of transport to: <ol style="list-style-type: none"> listen to fully understand their challenges in decarbonising the economy at lowest cost to consumers ensure transmission is not a blocker involve stakeholders in the development of potential solutions. empower stakeholders to decide on a way forward.
What stakeholders told us	Flexibility providers and storage developers told us: <ul style="list-style-type: none"> the potential for flexibility is sometimes underestimated – especially for portfolios there are technical challenges for both flexibility and network companies to overcome to realise the potential greater visibility of network issues and their characteristics is needed greater acceptance of the services that can be provided is needed considerable uncertainty over future opportunities and revenue streams exists flexibility solutions can add consider consumer value by supplementing network solutions; opportunity to replace network capacity altogether limited in the short to medium term. 	Experts and customers told us that: <ul style="list-style-type: none"> an aggregated approach, where the regulated network owner invests in harmonic filtering equipment, could reduce the overall requirement for filters and lower costs for consumers a change in approach to the charging methodology may be required to accommodate this development a strategic/anticipatory approach to connecting large volumes of offshore wind on the east coast could accelerate their connection, lower costs for consumers and minimise disruption for those communities affected. Stakeholders in other sectors and policy makers have told us that: <ul style="list-style-type: none"> range anxiety is a challenge to the Government’s ambitions to decarbonise transport existing vehicle charging market structures at motorway services are complex and participants do not have enough certainty of affordable infrastructure or utilisation solutions must be robust to adapt to future uncertainty; a whole system approach is required that optimises between transmission and distribution.
What consumers told us	As set out in the strands of engagement, above, consumers showed strong support for investments that enabled decarbonisation. Through all strands of our consumer engagement, we also sought to test the appetite for investment ahead of clear need. Our proposed solution to overcome range anxiety had 85% support for the principle through our acceptability testing, with 51% also supportive of the potential bill impact. This result was discussed and corroborated through the focus groups. <p>Willingness to pay for investment ahead of need was the highest across all of our plan categories with domestic consumers at over £11 (per consumer per year) and was middle of the pack with non-domestic consumers at over £30. When asked what approach we should take to decarbonising energy, 58% of respondents using our slider tool indicated that we should invest now to meet potential demand or once the general direction is known.</p>	
Key trade-offs and how engagement influenced our plans	As highlighted in engagement strand (a), we have opted to play a proactive role in enabling the energy transition as a result of our engagement. We have worked closely with non-network companies and undertaken our own detailed analysis to jointly develop solutions to decarbonisation challenges. <p>Flexibility providers thought it was worth continuing to explore a potential role for TOs in helping them come to market, whilst the ESO pointed out that they also had this role, and expressed some concerns about TOs doing so. Our proposal has evolved to commit to continue to seek opportunities to work with flexibility providers as well as working closer with the ESO should opportunities arise.</p> <p>Due to a lack of stakeholder support, we have removed the proposal to invest £2m to develop an economic modelling capability to better inform our NOA submissions.</p>	
How we’ve responded to the Independent Stakeholder Group/ Challenge Group	The Independent Stakeholder Group challenged the breadth of our thinking on decarbonisation challenges, initially focused on ensuring transmission is not a blocker to a rapid EV roll-out and providing solutions to overcome range anxiety. As a result, we have also considered the challenges of connecting increasing amounts of wind generation; putting forward proposals for harmonic filtering and a strategic approach to connecting offshore wind on the east coast. <p>The RIO-2 Challenge Group challenged us to consider non-network solutions and expand our whole system thinking beyond network companies. This strand of engagement and the proposals we are putting forward in this chapter and annex NGET_A7-8.03 Whole System address that challenge.</p>	



4. Our proposals for the T2 period

The table below outlines how what stakeholders are telling us links to our proposals, costs and consumer benefits.

Table 7.5 Proposals for the T2 period

Main proposals for enabling the ongoing transition to the energy system of the future					
Stakeholder feedback	Proposals	Output type	T2 baseline (£m)	Consumer benefit	
 	1) Provide a network that enables the transition to net zero by 2050 at lowest cost to consumers	Innovate and invest in the network reinforcement to facilitate a changing energy market and keep costs down	PCD	507.1	Decarbonised economy Lower system operation costs
		Invest in protection and control coordination studies, changes required to maintain security of supply and identify future requirements for zero-carbon operation by 2025	PCD	31.1	Decarbonised economy Reliable supply
		Invest to facilitate closure of conventional generation and secure easements to maintain access and minimise costs	PCD	134.7	Decarbonised economy Lower network costs
 	2) Facilitate competition and new business models to minimise costs	Facilitate competition by highlighting projects meeting contestability criteria, consenting contestable projects and protecting consumers in incumbent delivery	PCD	181.5	Lower network costs Lower system operation costs
		Innovate by facilitating non-network solutions	Commitment	0	
 	3) Deliver electricity whole system solutions across network companies	Optimise with the ESO through a new mechanism to reduce whole system costs and installation of system monitoring to allow for zero-carbon operation by 2025	LO	48.0	Decarbonised economy Lower network costs
		Optimise with DNOs by identifying whole system opportunities, establishing an ongoing process and investing in reactor units	ODI PCD	30.7	
Anticipatory/strategic investment for enabling the ongoing transition to the energy system of the future					
What stakeholders are telling us	Proposals	Output type	T2 baseline (£m)	Consumer benefit	
 	4) Enable all energy whole system solutions	Seek to implement a suitable anticipatory investment mechanism that allows solutions to unlock rapid decarbonisation to net zero 2050.	Commitment	0	Decarbonised economy Lower network costs and barriers to entry
		Provide strategic network options that have the potential to help overcome some of the challenges of decarbonising at lowest cost to consumers.	N/A	0	Clean air



5. The justification of our proposals

Delivery of this priority predominately relates to enhancing the capacity and operability of the wider network to reduce wholesale, system operation and network costs for consumers.

All investments in our baseline proposals are underpinned by an investment decision pack and have been assessed as being the most efficient way to deliver outputs. Over 70% of proposals have been tested by the ESO and shown to deliver net consumer benefit.

5.1 Our proposal to provide a network that enables the transition to net zero at lowest cost to consumers

i. Innovate and invest in network reinforcement to facilitate a changing market and keep costs down

Key driver – Investment of £507m provides increased capacity of 22.5 GW on the transmission network. This investment, made in response to the ESO’s NOA recommendations, is estimated to save consumers at least £250m/annum in avoided future constraint costs (based on analysis of the latest NOA outputs).

Options considered – When assessing future SQSS compliance, we may find that a *key system boundary* is at risk of insufficient capability. In response, we develop and assess a range of options for increasing capability by upgrading existing assets, innovative use of new technologies, whole system options, and construction of new transmission assets.

When preparing our submission to the NOA process, we identify and submit multiple reinforcement options for a given boundary. The ESO undertakes econometric modelling and recommends the best option for consumers. In the 2019/20 NOA process we have submitted 154 reinforcement options for 25 boundaries.

Whole system alternatives – The outcome of our engagement with flexibility providers is that they are well placed to add value by complementing transmission investments on boundaries, but their ability to provide an alternative is currently limited by size and duration.

We continue to seek opportunities with flexibility providers (detailed in Section 5.2.ii of this chapter), but note that the ESO is expanding the NOA in 2019 and that they are best placed to identify these alternatives.

We engaged DNOs on how we arrived at our proposals and whether they might offer better alternatives. Whilst all said they would participate in the expanded NOA, no alternatives were put forward. Similarly, no concerns were raised with how we arrived at our baseline plan.

Funding for preconstruction will need to cater for efficiently incurred abortive costs if requirements change through a whole system approach (e.g. through the ESO Connection Infrastructure Options Note).

Business as usual innovation – We continue our innovative work with suppliers to develop the world’s first transmission level power flow controller technology (Smartwires), ensuring this T1 innovation continues to reduce costs for consumers in the T2 period.

Discussions with the ESO are ongoing to agree how many devices can be safely and reliably integrated into the system. Further justification is provided in annex NGET_A7.02 Incremental Wider Works.

We also continue development of an innovative approach to circuit capacity that uses correlation between the cooling effect of wind with increased power flows from wind generation on a given circuit. Statistical analysis of historic weather data and testing are required for full implementation.

A summary of innovations included in our baseline plan is shown in table 7.6.

Table 7.6 BAU innovation (£m)

NOA code	Description	T2 cost	Project cost
CBEU	Establish enhanced thermal ratings on the Creyke Beck to Keadby 400kV route.	■	■
HSS2	Install Smartwire device along Fourstones to Harker to Stella West 275kV route.	■	■
MHPC	Install Smartwire device along Harker to Gretna & Harker to Moffat 400kV route.	■	■
Total (rounded):		22	34

Competition – Tables 7.6 and 7.7 are a list of our proposed baseline investments. Some of these projects meet Ofgem’s value threshold for early (>£50m) or late (>£100m) competition and have been highlighted. In Section 5.2.i of this chapter, we explain why we do not think these meet all the criteria for competition.

Construction costs for projects assessed as meeting competition criteria have not been included in our baseline plan.

Cost justification – We have embedded innovation developed through the T1 period into our T2 plans. We are also making stretching commitments to future efficiencies by moving our benchmarked capex unit costs to be at or below the TNEI industry mean equating to an **£11.4m reduction** in this stakeholder priority. We have also applied a **£5.6m productivity commitment** to improve the productivity of our people by 1.1% year on year. Further detail is provided in Chapter 14 – *Our total costs and how we provide value for money.*

Uncertainty approach – We propose incremental improvements to the T1 mechanism, to ensure adjustments to our allowances more closely reflect the cost of delivering an output and ensure consumers only pay for what our customers require. Further information is set out in Section 7 of this chapter and in annex NGET_ET.12 Uncertainty mechanisms.



Table 7.7 Proposed investments for additional boundary capability in the T2 period (£m)

NOA code	Description of investment	T2 cost	Project cost
Note: projects highlighted are above Ofgem's project value threshold for early (>£50m) or late (>£100m) competition, but have been assessed as not meeting all criteria (including re-packaging), as detailed in Section 5.2.i of this chapter			
BMM2	Two new 225MVAR switched capacitors (MSCs) at Burwell Main providing voltage support to the East Anglia area as future system flows increase.	■	■
BMM3	One new 225MVAR switched capacitor (MSC) at Burwell Main providing voltage support to the East Anglia area as future system flows increase.	■	■
BNRC	Additional dynamic reactive compensation equipment (STATCOMs) at Bolney and Ninfield substations to maintain voltages within acceptable operational limits.	■	■
BRRE	Replace conductors in parts of the existing Bramford to Braintree to Rayleigh overhead line that have not already been reconducted, with higher-rated conductors, to increase the circuit's thermal rating.	■	■
BTNO	Construct a new 400kV double circuit between Bramford substation and Twinstead tee point to create double circuits between Bramford to Pelham and Bramford to Braintree to Rayleigh Main. Increase power export capability from East Anglia into the rest of the transmission system.	■	■
CDRE	Replace conductors on the existing double circuit from Cellarhead to Drakelow with higher-rated conductors to increase their thermal rating.	■	■
FMHW	Upgrade of Feckenham to Minety single circuit to allow it to operate at higher temperatures, and therefore increase its thermal rating.	■	■
HAE2	Replace an existing transformer at Harker substation with one of higher rating to prevent overloading following transmission system faults.	■	■
HAEU	Replace an existing transformer at Harker substation with one of higher rating to prevent overloading following transmission system faults.	■	■
HSNO	Up-rating of Hinkley Point to Bridgwater 275kV circuits to 400kV*.	■	■
HWUP	Upgrade Hackney, Tottenham and Waltham Cross substations and interconnecting double circuits from 275kV to 400kV, strengthening power flow into London, via Rye House, down to Hackney.	■	■
IFHW	Upgrade of Feckenham to Ironbridge circuits to allow them to operate at higher temperatures, and increase their thermal rating.	■	■
KLRE	Reconductor 400kV circuits running from Kemsley via Longfield tee to Littlebrook with higher-rated conductors.	■	■
KWHW	Upgrade of Keadby to West Burton circuits to allow them to operate at higher temperatures, and increase their thermal rating.	■	■
MBRE	Replace conductors in the Bramley to Melksham circuits with higher-rated conductors to increase their thermal ratings.	■	■
NEMS	Three new 225MVAR switched capacitors (MSCs) at Norton, Osbaldwick and Stella West 400kV substations providing voltage support to the east side of the transmission network as future system flows increase.	■	■
NOR1	Replace some of the conductors in the Norton to Osbaldwick double circuit with higher-rated conductors to increase thermal ratings.	■	■
RTRE	Replace conductors on the remaining sections of the Rayleigh to Tilbury circuit not recently reconducted, with higher-rated conductors, increasing the thermal rating.	■	■
SEEU	Provide new communications system and other equipment to allow existing reactive equipment to be switched in or out of service very quickly following transmission system faults. Providing better control of system voltages following faults.	■	■
SER1	Replace the conductors from Elstree to Sundon circuit 1 with higher-rated conductors to increase their thermal rating.	■	■
THRE	Replace the conductors in the Hinkley Point to Taunton circuits with higher-rated conductors to increase thermal ratings.	■	■
THS1	Install series reactors at Thornton substation to connect parts of the site currently being operated disconnected from one another to limit fault levels. This allows flow sharing between the different parts of the site and reduces thermal overloads on connected circuits.	■	■
WHTI	Turn-in the West Boldon to Hartlepool circuit, to connect to the Hawthorn Pit site it currently passes. This creates new West Boldon to Hawthorn Pit and Hawthorn Pit to Hartlepool circuits and ensure better load flow sharing and increased connectivity in the north east 275kV ring.	■	■
WYQB	Install a pair of quad boosters on the double circuits running from Wymondley to Pelham at Wymondley 400kV substation, improving capability to control power flows across North London.	■	■
WYTI	Modify the existing circuit that runs from Pelham to Sundon with a turn-in at Wymondley to create two separate circuits that run from Pelham to Wymondley and from Wymondley to Sundon. This improves the balance of power flows.	■	■
Sub-total:		■	■
N/A	Early up-rating of small cable section of Melksham – Bramley circuit in advance of NOA proceed signal for MBRE whilst completing undergrounding for Visual Impact Provision work.	■	■
Total:		485	1007
*part of suite of works required to deliver Hinkley – Seabank circuit		Average PV of constraint savings across FES: 56,600	



Our plan proposes investment to up-rate a short section of cable as part of the North Wessex Downs Visual Impact Provision (VIP) scheme in anticipation of the future NOA requirement to deliver the MBRE project. The VIP project is currently scheduled for 2024 delivery, ahead of the need to upgrade the capability of the overall Melksham to Bramley route (currently 2027 in NOA). Simply installing a cable section that matches the existing rating would very likely mean a costly upgrade of a cable section that was installed only 3-4 years before, when NOA indicates proceed for MBRE. As well as a significant cost impact, this would also involve major construction works in an area specifically identified for its visual and environmental sensitivity.

Subject to proceeding with the North Wessex Downs VIP scheme, we propose to include the additional cost required to deliver VIP underground cable mitigation works that provide capability equal to that proposed in the MBRE upgrade project as part of our plan. As NOA indicates a requirement for MBRE in both net-zero FES scenarios, the risk of demand not materialising is low.

The cost of a like-for-like cable installation, funded through the VIP scheme, is [REDACTED] whilst the cost of the increased capability proposed in anticipation of the future NOA requirement is [REDACTED]. Our plan includes the difference of £15m, the consumer benefits of which are evidenced in annex NGET_A7.02 the Incremental Wider Works and accompanying CBA.

ii) Invest in protection and control coordination studies, changes required to maintain security of supply and identify future requirements for zero-carbon operation by 2025

Key driver – To enable the ESO’s goal of operating a zero-carbon network by 2025. The System Operability Framework indicates increasing amounts of renewable generation leading to declines in system inertia and short-circuit levels that could cause transmission protection not to operate as expected, posing a risk to network safety and reliability. Consumers face the risk of more frequent demand disconnection if this risk is not better understood and appropriately mitigated.

Options considered and cost certainty – Investment in modelling, software and analysis is required to undertake coordination studies and make setting changes to ensure our protection and control systems are robust enough to withstand changes on the network. This type of detailed analysis has not been required to date, but must be undertaken in the T2 period due to the levels of renewable generation in all scenarios; particularly those consistent with net zero by 2050. We appointed independent experts, Quanta Technology, to estimate the scale, potential issues, work required to model and mitigate them as well as cost. The cost of modelling and changes to settings in the T2 period is £31.1m. Quanta’s work also indicates the likely need to upgrade equipment across England & Wales to mitigate risks.

Further justification for these costs is provided in annex NGET_A7.03 Protect and Control Coordination.

Whole system alternatives – We collaborate internationally with other network owners on this issue and modelling will need to be done at a ‘whole system’ level to fully assess impacts.

Uncertainty approach – The volume of upgrades is subject to the outcome of the studies and effectiveness of setting changes. Given this uncertainty, investments have not been included in our baseline proposals to protect consumers, as shown in table 7.8. We propose a targeted within-period determination uncertainty mechanism (UM) to fund upgrades identified through the studies, as detailed in section 7 of this chapter.

Table 7.8 Proposed investments for changes to protection and control in the T2 period

Category	Cost (£m)
Application software and modelling of protection system	[REDACTED]
Coordination study, testing and implementation of setting changes	[REDACTED]
Upgrade of non-unit and overcurrent P&C equipment	Subject to UM
Total:	31.1

iii) Invest to facilitate closure of conventional generation and secure easements to maintain access and minimise costs

These activities ensure we can access our assets and continue to operate our sites. They are a continuation of programmes started prior to the T1 period.

Securing easements

Key driver – As part of our operations, we require access to privately owned land to access our assets. This has historically been managed purely through wayleaves, but these wayleaves come with risks of termination (e.g. when land owners sell or assets pass to an executor) and potential negative network reliability and legal cost implications for consumers.

Options considered – To avoid becoming a distressed buyer of access rights or subject to litigation that requires us to move our assets, we have been undertaking a programme of renegotiating wayleaves as permanent easements with land owners for several years. Other organisations with similar challenges also take this approach. To protect consumers from this risk, we plan to continue this programme into the T2 period.

Cost certainty – Whilst the numbers and timing of easement claims are impacted by the property market cycle and other factors, there is a clear trend over time. Forecast costs for this programme in the T2 period, at £18.7m per annum, are therefore based on historic spend and recent trends. Further justification for the total cost of £93.3m is in annex NGET_A7.05 Easements.



Site separation to facilitate the closure of conventional generation

Key driver – As the electricity system continues to decarbonise, many ageing conventional power stations are closing. In parallel, many of Britain’s fleet of nuclear power stations are coming to the end of their lives. This work ensures we can continue to operate our substations at sites where power stations are closing. Most of the power stations were established when the transmission network and power stations were jointly owned, and the symbiotic nature of essential site services from that period has persisted.

Options considered – Past experience, where site separation was undertaken in a reactive rather than proactive manner, the short notice of closure provided by power stations has shown not to be sufficient to negotiate the necessary wayleaves and secure LV supplies, often leading to an additional cost of temporary supplies. Where this occurs, the costs tend to be at least 35% (~£1.5m per site) higher than when a proactive approach is taken. As a result, we are proposing a proactive approach in the T2 period.

Cost certainty – The work required to ensure that we can continue to operate these sites can include ensuring each substation has an independent 415V electricity supply, water supply, sewage and drainage, water disposal, telephone line, security fencing and tunnel security, earthing, firefighting and removal of assets from power station land where relevant.

The forecast cost of £41.4m in the T2 period to continue with this programme of work is informed by a site-specific assessment of the components of work required and the cost of those components from work undertaken in T1 (which is forecast to be a total of £75m across the period). A breakdown is shown in table 7.9 and further detail provided in annex NGET_A7.04 Site Separation.

Table 7.9 Cost of site separation work in T2 period

Site	Cost £m	Site	Cost £m
Cowes		West Burton	
Hartlepool		Ratcliffe	
Grain		Uskmouth	
Hinkley B		Wylfa	
Fawley			
		Total:	41.4

5.2 Our proposal to facilitate competition and new business models to minimise cost

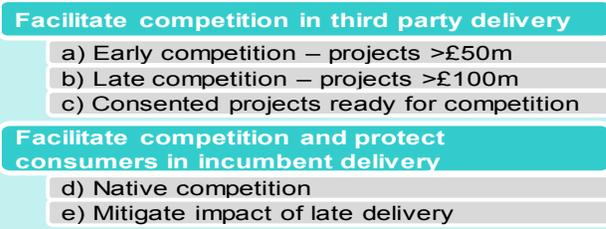
We are driven to further minimise the cost of the energy transition for consumers. We continue to engage Ofgem and stakeholders to progress key policy areas (i.e. approach to CATO and the replacement for Strategic Wider Works, referred to as SWW in the T1 period).

i) Facilitate competition by highlighting projects meeting contestability criteria, consenting contestable projects and protecting consumers in incumbent delivery

Incentives at the heart of the RIIO price control mimic competitive pressures and drive innovation and efficiency for consumers. For certain large capital projects, the introduction of a competitively appointed transmission owner (**CATO**) model in the T2 period has the potential to add further consumer value and we are strong advocates of this approach.

We continue to proactively engage to progress the CATO approach so that consumers can benefit from it as soon as possible. Where a CATO approach is not possible, we will ensure robust native competition to identify and reveal efficient costs. We also propose an approach to mitigate the consumer impact of late project delivery for large projects. These various components of our proposal are set out in figure 7.10 and explained in more detail, below.

Figure 7.10 Facilitate competition components



Key assumptions we have made

We have identified projects in our plan for the T2 period that are likely to be suitable for third party competition. In doing so, we have applied Ofgem’s “re-packaging” criteria, highlighted all projects meeting the £50m threshold for early and £100m for late competition and assessed these projects against contestability criteria. There are complex interactions between the process and funding arrangements for competition and the rest of our business plan. Some key policy decisions are also outstanding. We have made the following assumptions in putting together our final proposals:

- The ESO publishes future network capability needs in the Electricity Ten Year Statement (ETYS) and the NOA – *these sources are best for less defined “system needs” that could be competed; our early competition assessment is focused on the specific projects in our plan.*
- Ofgem has proposed a Large Onshore Transmission Investment (LOTI) mechanism for projects >£100m, replacing SWW, that works on similar principles and would be central to the CATO process. The detail of how such a mechanism would work has not yet been decided – *we have assumed the mechanism applies to all contestable and uncertain projects >£100m. Projects >£100m that do not meet these criteria have been included in our baseline plan.*



a) Early competition – projects >£50m

The early competition model, whereby Ofgem runs a tender before planning consent is sought, has the greatest potential for consumer benefit through innovation. We recognise there are challenges to implementation, but have put considerable thought into helping overcome these for consumers, including in our response to Ofgem’s Sector Specific Methodology consultation.

We have “flagged” all relevant projects >£50m across our entire business plan and assessed these primarily against the opportunity for innovation

as directed by Ofgem. As secondary considerations, we have also factored in time criticality and certainty of need in our assessment. Table 7.11 sets out how we have defined and applied these criteria and table 7.12 shows our assessment of projects within this priority. Similar assessments are shown for customer connection and asset health projects in chapter 8 *We will make it easier for you to connect to and use the network* and chapter 9 *We will provide a safe and reliable network*.

Table 7.11 Criteria for contestability assessment and how these have been applied to projects

Criteria	How we have applied to projects to assess suitability
Is the requirement new and separable?	We have assessed whether projects are new and could be separable to allow for clear ownership boundaries, safety requirements and segregation of obligations/liabilities. New = involving the implementation of completely new assets or the complete replacement of an existing asset; Separable = assets can be clearly delineated from other (existing) assets. <i>[note: only used in assessing suitability for late competition]</i>
How time critical is the requirement?	We have considered the current NOA recommendation (chapter 7), the customer’s contracted connection date (chapter 8) or asset health indicator (chapter 9) to assess whether time to run a competition could delay constraint cost savings, customer requirements or impact reliability.
Certainty of need	We have considered the number of FES scenarios in which a network requirement is deemed as beneficial for consumers, the estimated level of consumer benefit indicated by NOA (i.e. PV of future constraint savings), our project health score for customer connections and the NARMS risk output to assess certainty of need.
Opportunity for innovation	We have considered the level of opportunity for innovation in project design, delivery or operation for each project. Primarily, whether another solution to the requirement is likely/possible . <i>[note: only used in assessing suitability for early competition]</i>

Table 7.12 Competition suitability assessment for all projects >£50m within this priority

Project Name (NOA ref)	Project Cost (£m)	NOA Rec.	New and Sep.	Time criticality	Certainty of need	Scope to innovate	Suitability assessment	Suitability for competition against our criteria: Limited suitability ○ ○ ○ ○ ○ High suitability
HVDC: Peterhead to Drax (E4D3)	█	Proceed	●	○	●	○	Time criticality risks delay of benefits; scope to innovate reduced due to project maturity and multiple TO interface	○ ○ ○ ○ ○
HVDC: Torness to Hawthorn Pit (E2DC)	█	Proceed	●	○	●	○	Time criticality risks delay of consumer benefits; scope to innovate low due to project maturity	○ ○ ○ ○ ○
South London to South East Coast (SCN1)	█	Proceed	●	○	●	●	Considerable consenting challenges and challenging earliest in service date (EISD from NOA).	○ ○ ○ ○ ○
Bramford-Twinstead (BTNO)	█	Proceed	○	○	●	○	Maturity of project severely limits scope to innovate	○ ○ ○ ○ ○
Hackney-Tottenham-Waltham X (HWUP)	█	Hold	○	●	○	○	Upgrading of existing assets; scope to innovate limited by network requirement	○ ○ ○ ○ ○
Central Yorkshire (OENO)	█	Proceed	●	○	○	●	Time to run competition and considerable scope to innovate	○ ○ ○ ○ ○
Bramley – Melksham Reconductoring (MBRE)	█	Hold	○	○	○	○	Capability enhancement through reconductoring provides minimal scope to innovate + NOA already tests alternatives	○ ○ ○ ○ ○
Bolney and Ninfled Reactive comp. (BNRC)	█	Proceed	○	○	●	○	Time criticality risks delay of constraint cost benefits; scope to innovate low due to project maturity	○ ○ ○ ○ ○
Hinkley Point to Taunton Reconductoring (THRE)	█	Hold	○	○	○	○	Capability enhancement through reconductoring provides minimal scope to innovate + NOA already tests alternatives	○ ○ ○ ○ ○

b) Late competition – projects >£100m

To assist the ESO in identifying projects that meet Ofgem’s late competition criteria (high value >£100m, new and separable), we provide details of all network

reinforcement projects under development on an annual basis through the NOA process. All our projects were assessed by the ESO against Ofgem’s contestability criteria in the latest NOA iteration. The following projects



were highlighted by the ESO as meeting the criteria: OENO – Central Yorkshire reinforcement, SCN1 – New 400kV transmission line between south London and the south coast, E2DC – Eastern Scotland to England; Torness to Hawthorn Pit offshore HVDC, E4D3 Eastern Scotland to England; Peterhead to Drax offshore HVDC. We are highlighting all our projects >£100m in table 7.13, even if already assessed by the ESO as not

meeting the contestability criteria. Our suitability assessment for late competition uses the criteria set out in table 7.11, as with early competition, but the scope for innovation is replaced with Ofgem’s new and separable criteria. Our assessment shows that 4 projects meet Ofgem’s criteria, one of which (E2DC) may not be suitable due to the urgency of delivering the associated consumer benefits.

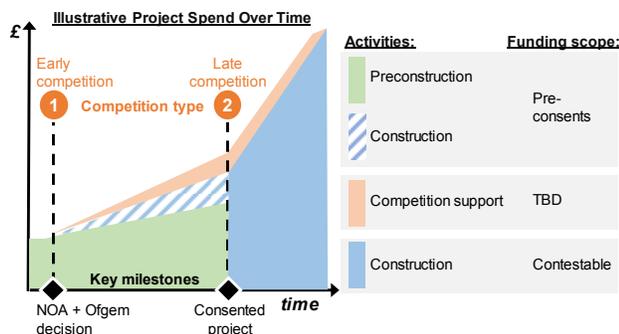
Table 7.13 Competition suitability assessment for all projects >£100m in our customer driven plan

Project Name (NOA ref)	Project Cost (£m)	NOA Rec.	ESO indicate contestable	New and Sep.	Time criticality	Certainty of need	Scope to innovate	Suitability assessment	Suitability for competition against our criteria	
									Limited suitability	High suitability
HVDC: Peterhead to Drax (E4D3)	█	Proceed	Y	●	●	●	●	More time to contest than E2DC and higher project value	○	○
HVDC: Torness to Hawthorn Pit (E2DC)	█	Proceed	Y	●	○	●	○	Time criticality risks unnecessary consumer exposure to additional constraint costs	○	○
South London to South East Coast (SCN1)	█	Proceed	Y	●	○	●	○	Considerable consenting challenges and challenging earliest in service date (EISD from NOA).	○	○
Bramford-Twinstead (BTNO)	█	Proceed	N	○	●	●	○	Does not meet Ofgem new and separable criteria	○	○
Hackney-Tottenham-Waltham X (HWUP)	█	Hold	N	○	●	○	○	Does not meet Ofgem new and separable criteria	○	○
Central Yorkshire (OENO)	█	Proceed	Y	●	○	○	○	Time to run competition and considerable scope to innovate	○	○

c) Consented projects ready for competition

To enable competition, we have not included any post-consenting costs for projects that meet the early or late competition criteria in our baseline plan. The total value of these projects is estimated at over £4bn, with over half this cost likely to be incurred within the T2 period. For those projects that have a NOA proceed signal and are contestable, we propose to define a new output of a **contested project**, which we would deliver, ready for a late CATO competition. To deliver this output, we propose a baseline allowance of £182m across all four projects to undertake the necessary activities to consent a project that is subsequently contestable and does not duplicate any costs, as shown in figure 7.14, below.

Figure 7.14 Scope of pre-consent activities



Funding for efficient activities to achieve consent includes normal pre-construction activities such as detailed project development, surveys and consenting, as well as costs traditionally considered to be construction, such as full surveys suitable for construction. We assume that any competition support costs would be covered by a separate mechanism.

A detailed breakdown of costs and benefits is included in annex NGET_A7.06 Facilitate Competition (pre-consents). Costs per project are shown in table 7.15.

Table 7.15 Estimated costs for potentially contestable projects (£m)

Project (NOA ref)	T1 cost	T2 cost to consent	Estimated total project cost [^]
SCN1	6.0	71	█
OENO	4.8	35	█
E4D3	1.5*	45*	█
E2DC	5.1*	31*	█
Totals:	17.4*	182*	5,067

*excludes costs to consent in Scotland

[^]total estimated project cost across Scotland and England

We have not included any pre-consenting costs for future projects that meet the criteria for late competition (i.e. those that do not yet feature in NOA or have not yet been given a *proceed* signal), but have instead developed an uncertainty mechanism that would automatically adjust funding for delivery of the output.

This mechanism, detailed in Section 7 of this chapter and annex NGET_ET.12 Uncertainty mechanisms, provides the funding certainty that allows us to respond promptly to NOA proceed signals and protect consumers from the potential late delivery of projects. It can be implemented in a manner that works with CATO and/or LOTI policy as this emerges and integrated into a milestone based approach to mitigating the impact of late delivery.

d) Native competition

We utilise competitive processes in all procurement, except where the potential benefits of doing so are outweighed by the costs. Our plan for native



competition is set out in Chapter 14 *Our total costs and how we provide value for money* and annex NGET_A14.06 Delivering competitive value through procurement.

e) Mitigate impact of late delivery

Innovation carries risk of failure, but consumers still benefit overall in the long term. As we set out to meet the challenge of net zero by 2050 it is important that networks continue to have incentives to innovate, but that they do not benefit when innovations fail. In considering how to minimise consumer detriment, we balanced benefits of additional protection against the cost of providing such protection.

Our proposal is that a mechanism is put in place for large capital projects to recover the time value of money over any delay period from network companies. In addition, any contractual payment for damages with suppliers would be used to offset consumer detriment. We propose that the delivery date is set at a milestone after consents have been obtained and a contract is put in place with suppliers. The detail of this approach should be finalised alongside LOTI and the approach to CATO.

ii) Innovate by facilitating non-network solutions

Key driver – The decentralisation and digitalisation of energy is leading to new opportunities to resolve network issues using storage technology (e.g. batteries) and demand side response (where electricity consumption is shifted as a service to the network operator). DNOs have started procuring flexibility to resolve issues on their networks and the ESO also procures flexibility services through ancillary services contracts and the balancing mechanism. To date, the focus has been on ancillary services and short-term balancing mechanism actions, rather than on providing a longer-term network capacity type service.

Options considered – At transmission level, it is primarily the role of the ESO to establish markets and procure services. The NOA process is expanding and evolving through the Network Development Roadmap to include the assessment of non-network solutions and the ESO is proposing to enhance its ability to enter into long-term contracts with flexibility providers in the T2 period.

As a Transmission Owner, we are keen to understand the role we can play in helping to bring these technologies to market for the benefit of consumers. The way we are funded through the RIIO framework may present opportunities in this area for developers of storage assets and demand side response portfolios to work with us to deliver combined solutions that lower costs for consumers. Our engagement in this area with the ESO, DNOs and flexibility providers continues as part of our ongoing engagement activities.

Whole system alternatives – Stakeholders have told us that the potential of storage and demand side response is often underestimated, there are technical

challenges to overcome and developers face uncertainty over future opportunities and revenue streams. We sought to better understand and align on the potential for flexibility against various network opportunities in the T2 period as part of our engagement.

Opportunities for flexibility will continue and likely grow to provide services within regional distribution networks and ancillary services for the ESO. In relation to our business plan, we understand that there are opportunities for flexibility to provide consumer value in delaying network investment at the interface between transmission and distribution. This has been part of our engagement with DNOs and is reflected in our plans at the transmission/distribution interface. In addition, there are opportunities to complement network investment on the wider electricity transmission network, particularly as flexibility solutions can often be deployed faster than most traditional network reinforcements.

From our engagement with stakeholders to date, we understand that the opportunity for flexibility solutions to provide an enduring alternative to network capacity is currently limited due to scale and duration. This is reflected in our conclusions in figure 7.16.

Figure 7.16 Flexibility network services potential

Consumer value:	Delay network investment at Tx / Dx interface	Reduce cost of secure system operation	Compliment network investment on wider network	Alternative to network investment on wider network
Type of flexibility suitable:	Small, short-duration storage and small to medium aggregated portfolios of domestic + I&C DSR	Medium, short-duration storage and large aggregated portfolios domestic + I&C DSR	Large, aggregated and diversified portfolios of storage and DSR assets or single large storage assets	Large, aggregated and diversified portfolios of storage and DSR assets or single large storage assets
Relative T2 opportunity (2021—2026):				

Detailed engagement with energy storage developers and Ofgem is ongoing to investigate the use of battery technology to supplement incremental transmission network upgrades and provide additional transmission boundary capacity within the T1 period. The potential for a long-term contract between the Transmission Owner and storage developer could allow for storage solutions to come online and deliver consumer benefits more quickly. Despite challenges, these engagements point to a potential role for network owners.

We commit to continue to work with the broader flexibility community and the ESO to enable flexibility solutions that address the ESO’s market requirements. This will be measured through regular updates to the Independent Stakeholder Group.

Cost certainty – We do not propose additional funding to work towards this commitment.

5.3 Our proposal to deliver electricity whole system solutions across network companies

As we rapidly transition towards a low carbon future, the consideration of whole system solutions across network companies is important to minimise costs for



consumers. Many emerging whole system options are not yet well defined and, whilst the ESO is expanding the NOA process and Regional Development Plans, no formal framework for carrying out whole system assessments currently exists. Many of the network issues that could most benefit from whole system solutions, such as system operability issues, are also difficult to define precisely ahead of time. We have taken an approach to building our plan that involves identifying known issues and working with the ESO, DNOs and other TOs to investigate whole system options.

i) Optimise with the ESO through a new mechanism to reduce whole system costs and installation of system monitoring to allow for zero-carbon operation by 2025

These proposals have been informed by the ESO's Operability Strategy document, requirements set out in the STC and engagements with the ESO and TOs.

a. Interface optimisation mechanism

Key driver – Decarbonisation has led to increased costs of operating the system (reported by the ESO as £449m in the 12 months to May 2019) and the ESO needs as many tools as possible to minimise the cost of operating a zero-carbon system by 2025.

Options considered – Whilst TOs can provide flexible services to the ESO, the existing Network Access Procedure (NAP – covered in Chapter 8 *We will make it easier for you to connect to and use the network*) delivers a fraction of the potential consumer benefit because it only allows for the recovery of costs incurred and therefore does not compensate for additional risk in providing services and the strong incentive to minimise network owner costs in the regulatory framework.

We propose that TOs will be able to offer the ESO a range of flexible services, including rescheduling or accelerating timescales for delivery, providing alternative contracting, maintenance and construction activities, and working practices which would otherwise not be available to deliver whole system solutions. The ESO would market test the suitability of these services against a range of alternative options and select the most economic one for solving the system's balancing and/or operability need.

The opportunity for TOs to earn a market rate for the extra cost and risk of delivering these services would provide a strong incentive to discover whole system solutions to reduce consumer costs, rather than minimise network owner costs in isolation.

This approach could be implemented in parallel with the existing NAP at no additional cost to consumers. Our proposal adds another tool into the ESO's toolkit for operating a zero-carbon system by 2025 and managing system constraint costs at no additional cost to consumers.

Competition – The introduction of this TO flexibility approach would lead to a larger market for services, increased competition and ultimately lower costs to consumers of operating the network. Depending on scope (i.e. how much of the network it covers), our analysis of published constraint costs estimates a reduction of up to £188m per annum. A more in-depth analysis of the potential on the top ten constraint causing outages in 2018, estimated at £156m, has shown that TO flexibility options had the potential to reduce this by a net £76m when the cost of delivery is considered.

Installation of system monitoring

Key driver – Our proposed investments in this category involve the installation of system monitoring equipment across the network to help deal with the system implications of the energy transition. A national roll-out of system monitoring is required through the SO-TO code procedure STC-P 27-1, which specifies the provision of synchronised data from all grid supply points to the ESO by 31 March 2026. These investments will enhance security of supply and reduce the cost of system operation.

Options considered – Provision of this data is a licence obligation and requires some investment in monitoring. Both a *full system* and more targeted *wide area* option were considered. The more targeted solution, providing wide area observability, delivers our obligation at lowest cost to the consumer and allows the ESO to operate a zero-carbon system by 2025. To deliver against this requirement we propose to invest in:

- system monitoring devices on all circuits at all grid supply points (approx. 1,200 services)
- data collection and archiving
- a system visualisation tool
- analytics to support modelling, validation and system dynamics.

Cost certainty – We propose to invest £48m to carry out this work. These costs are based on recent tender return costs from competent installers and schemes (VISOR, EFCC and SEWAMS schemes). Additional justification for these costs is available in the annex NGET_A7.07 System Monitoring.

b. Providing solutions to stability challenges

Key driver – The ESO's System Operability Framework highlights system stability as a key challenge in maintaining an operable system. Stability is the ability of the system to quickly return to acceptable operation following a disturbance. Conventional (synchronous) generation supports the stability of the system. Without intervention, the system will become less stable through the energy transition as less synchronous generation runs.

Options considered – The ESO is developing new approaches to maintaining a stable system through a variety of routes, including developing a better understanding of the issues and where and when they are likely to occur. The strategy sets out that new



technology requiring capital investment is likely to form a significant part of the solution and indicates that synchronous compensators are one option that could be in consumers' interests.

Uncertainty approach – We will ensure that we are ready to deliver these solutions when they are required and if they are deemed to be in consumers' interests. To allow for the ESO's whole system assessment, no costs are included in our baseline plan for this requirement and we have developed a system operability uncertainty mechanism to deal with potential funding requirements. This is described in Section 7 of this chapter and in annex NGET_ET.12 Uncertainty mechanisms.

ii) Optimise with DNOs by identifying whole system opportunities, establishing an ongoing process and investing in 5 reactor units

We worked closely with the DNOs in building our plans to ensure their needs are met and all whole system solutions were considered. As many of the network issues anticipated during planning are uncertain, an ongoing process for identifying and assessing whole system solutions was required. Work to develop a process is ongoing through the Energy Networks Association's (ENA) Open Networks Project but has not concluded in time for our T2 business plan. We have developed and agreed an approach to preparing our business plan with DNOs, as shown in figure 7.17.

Figure 7.17 Whole system approach to developing our business plan



The approach developed is iterative and comprises:

1. Engagement with the DNOs to understand their requirements and potential alternative solutions.
2. Assessing future requirements and building our business plan.
3. Development of a robust suite of uncertainty mechanisms that adjust allowances.
4. An ongoing process of whole system assessment throughout the T2 period; delivered through formal activities such as the expanded NOA or through region specific joint planning activities such as Regional Development Plans.

This is how we have developed our business plan.

Whole system assessment of network reinforcement

In line with the work of the ENA's Open Networks Project, the ESO is expanding their NOA process to allow DNOs and other third parties to provide solutions to network issues. This process has not yet been completely defined but is likely to be fully implemented in the early part of the T2 period.

To investigate whether DNOs could offer whole system alternatives to our plans, we discussed our boundary capability investment proposals (as set out in Section 5.1.i of this chapter) with them. Where additional capacity requirements are in the order of 1 GW, there was consensus that transmission investment is highly likely to be most cost effective as the distribution networks would require major upgrades to provide equivalent capacity, electrical losses would be higher and any flexibility services from regional distributed energy resources would be insufficient to resolve issues on that scale.

Where new capacity requirements are lower, in the order of 100s of MWs, some DNOs indicated they may

offer alternatives into the future NOA process, potentially in the form of parallel 132kV circuits. Other DNOs believed their networks did not have capacity to resolve these issues and that no alternative whole system options could be identified at this stage.

Whole system assessment of system operability (management of high volts)

Whole system options to managing high voltage issues were also discussed with DNOs.

Key driver – Reactive power is required for voltage control. As we transition to a decentralised and decarbonised electricity system, the ESO has indicated in its Operability Strategy document that it needs access to new sources of reactive power.

Options considered & whole system alternatives – Our analysis of SQSS requirements against the Common Energy Scenario indicates a potential need for 35 reactors across the network in England and Wales. The ESO will eventually test regulated network solutions for reactive power against other network and commercial options. The first of these is already underway through its high voltage pathfinding projects in the Mersey and Pennines regions.

We have agreed with the DNOs and the ESO that we will only include the costs of the most certain reactive investments in our baseline plan. We have used the [study on short-term need undertaken through the ENA pathfinder](#) to select these projects.

Cost certainty – The cost of our baseline proposal is £30.7m for the installation of reactors at [redacted], as shown in table 7.18, below. These costs are based on similar projects delivered in T1. annex NGET_A7.08 System Operability (Voltage) provides further detail.



Table 7.18 Reactor requirements

Scope and reactive requirement	Transmission solution and cost	Proposed T2 approach
Short-term need based on ENA study , DNO engagement and initial results of ESO pathfinder	██████████ ██████████ ██████████	Baseline funding
0.9GVar	£30.7m	
Remainder of Common Energy Scenario requirement across T2 period	██████████ ██████████	Unit cost allowance when transmission solution identified through whole system process
5.3 GVar	~£184m	

Uncertainty approach – We propose a new automatic uncertainty mechanism, which would provide a unit cost allowance when a transmission solution is identified through the whole system process. Further information is set out in Section 7 of this chapter and in annex NGET_ET.12 Uncertainty mechanisms.

Taking this approach to reactor requirements has allowed us to reduce our baseline proposals by £184m (i.e. a reduction from ██████████) so that optimal whole system solutions can be identified and delivered in the T2 period for the benefit of consumers.

5.4 Our proposal to enable all energy whole system solutions

i. Seek to implement a suitable anticipatory investment mechanism that allows solutions to unlock rapid decarbonisation to net zero 2050

Achieving net zero by 2050 requires the decarbonisation of our whole energy system at an accelerated rate. A different, more agile and coordinated approach is required to resolve the associated network challenges and minimise cost. Despite T1 improvements, building the necessary network infrastructure can often take longer than our customers need to deliver their projects. The resulting risk is that energy networks become a blocker to meeting societal decarbonisation ambitions. This more agile approach also needs to ensure it does not place too high a cost and risk on consumers.

We are proposing a mechanism, involving a cross sector group of key stakeholders, policy makers and regulators, that would consider the following factors for key strategic infrastructure solutions to net zero challenges:

- **Criteria:** define when anticipatory investment is in consumers’ interest.
- **Need case:** establish what circumstances trigger a pre-agreed investment approach.
- **Whole system outcomes:** stakeholder collaboration to ensure optimal, whole system outcomes are delivered.
- **Funding:** how companies can recover their efficient costs.

- **Risk sharing:** appropriate customer user commitment, consumer protection and reward for value created.
- **Monitoring:** provisions to provide regulatory and stakeholder oversight of projects.

We will continue to engage with stakeholders to further shape how an ongoing anticipatory investment process could work. Initial results from consumer and stakeholder engagement indicate support for acting early to enable decarbonisation, even if certain solutions are later not fully utilised.

ii. Provide strategic network options that have the potential to help overcome some of the challenges of decarbonising at lowest cost to consumers

Most stakeholders want us to take a proactive role in enabling the energy system of the future and have challenged us to provide whole system options to address the challenges of net zero. We’ve worked extensively with stakeholders to develop the following whole system options:

- East coast offshore wind coordination.
- Aggregated harmonic filtering infrastructure.
- Accelerating EV uptake through ultra-rapid vehicle charging at motorway service areas.

Some of these options could be well suited to an anticipatory investment mechanism whilst others, such as harmonic filtering, could be funded through an uncertainty mechanism in the core RII0 price control. Further detail on each is provided below.

a. East coast offshore wind coordination

To deliver net zero by 2050, we may need to safely integrate a further ~30GW of renewables by 2025. The cost reductions achieved in both onshore and offshore wind point to a significant role for these technologies in achieving this target. Strike prices as low as £39.65 £/MWh for offshore wind in the recent [Contract for Difference](#) round are a strong proof point.

The focus on wind development in the UK has resulted in 18 GW of installed capacity over the last 10 years, with an average annual rate of installation of 1.7 GW per annum. This rate is dwarfed by the Climate Change Committee’s (CCC) stated need for 6-8 GW of deployment per annum. Current offshore wind capacity of ~8 GW is connected via 32 connections. The same approach to deliver the CCC’s target of 75 GW by 2050 would require an additional 268 connections.

A coordinated approach to connecting offshore wind, supported by anticipatory investment, has the potential to accelerate connections, reduce costs and minimise disruption and visual impact. A [report](#) by Redpoint Energy for Ofgem in 2011 indicated that coordinated investment could reduce costs to consumers by 15%.

A coordinated approach

The Crown Estate has granted rights to extend existing offshore wind farms by 5.5 GW and has proposed



around 7 GW of Round 4 offshore wind leasing. Most Round 4 sites, approximately 5 GW, are likely to connect to the east coast.

There is potential for a further 37 GW of offshore wind and interconnectors to be developed off the east coast of England in the next 10 to 15 years. These connections imply a high number of cable route corridors, onshore substations, converter stations, and reinforcements to the existing onshore network. To address this challenge, the onshore transmission network could be built around the east coast, reducing the number of circuits required.

This approach, as shown in figure 7.19, would expand the existing transmission network on the east coast by building a loop of circuits to shore, providing connection sites for currently contracted offshore wind, interconnectors and anticipated (Round 4) projects.

Figure 7.19 Offshore wind topologies

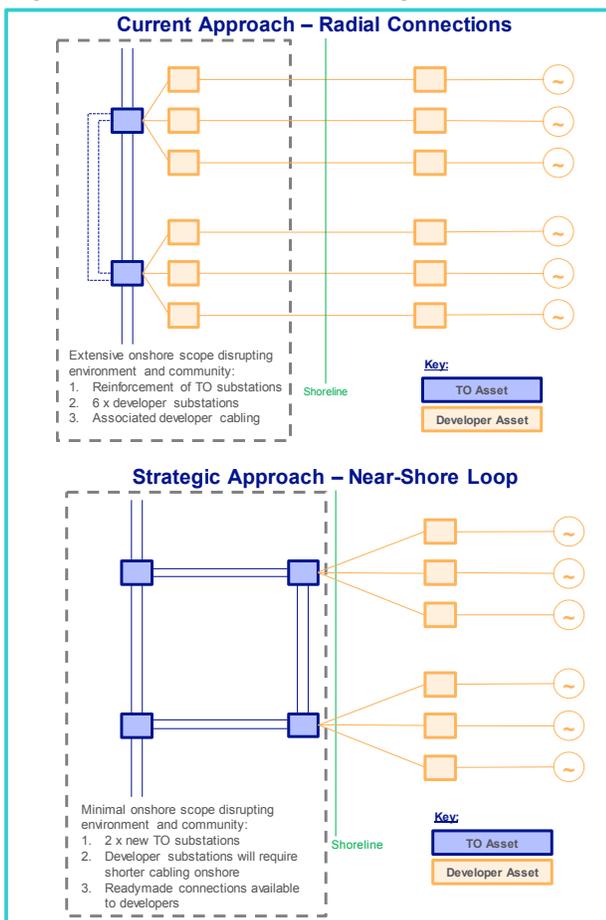


Figure 7.19 contrasts the current radial approach with a coordinated one that would require less onshore construction, minimising cost and disruption. In current costs, we anticipate that this solution would cost between £3bn and £5bn and deliver considerable net benefits for consumers.

Preconstruction work would be required over the T2 period to maximise the benefits of this approach and we

propose that any allowances would be allocated as part of the anticipatory process.

b. Aggregated harmonic filtering

All future energy scenarios show an increasing amount of wind, solar, storage and interconnectors. Connecting these technologies to the system introduces distortions that can be damaging to customer’s equipment at certain frequencies, known as harmonics. Limits on harmonic distortion levels are placed on developers of these technologies, often requiring them to invest in harmonic filtering equipment.

Together with experts, and alongside other network companies, we have been investigating the potential consumer benefits of aggregating filtering requirements to reduce the total number of filters required. This approach would involve the regulated network company responding to customer connection applications through the ESO and building any filtering requirements in lieu of developers alongside other reinforcements required to connect. The modular nature and relatively short delivery lead time would allow for aggregation without stranding risk.

We estimate that, if undertaken centrally, the total cost of harmonic filtering up to 2030, for the connection of 16 windfarms, could be up to £119m. Working with independent experts, Atkins, we found that an aggregated approach reduced the number of harmonic filtering units required from 56 to 37, reducing the cost by 20% compared to a disaggregated approach.

We have had positive views from stakeholders on the potential of this approach, which would lower the cost of decarbonisation for consumers, and believe that it could be implemented with minimal changes to the industry framework. We propose that this option would be suitable for funding through a within-period determination as set out in Section 7 of this chapter and annex NGET_ET.12 Uncertainty mechanisms.

c. Accelerating EV uptake through ultra-rapid vehicle charging at motorway services

The decarbonisation of transport is a huge opportunity for the UK to reduce emissions, as transport became the largest single contributor to the UK’s carbon emissions (27%) in 2016. The CCC, net-zero report recommended a phase out of fossil fuel powered vehicles by 2035 at the latest.

Electric vehicles (EVs) will play a large part in meeting these aims. They will be charged in many different locations: at home, at work or even when parked on the street. However, EV drivers will still require charging along the strategic road network to fuel during long journeys. A key barrier to EV purchasing is consumers’ perception of ‘range anxiety’.

To enable EV uptake for mass market customers, a network of ultra-rapid EV charge points will need to be delivered by 2025 – the time at which vehicle cost parity is anticipated. This will ensure that a lack of charging



infrastructure is eliminated as a barrier to EV uptake. Infrastructure must allow EV drivers to make long-distance journeys, delivering charging times like those experienced for refuelling existing internal combustion engine vehicles. Today, drivers are used to being able to take any journey in the UK with the ability to quickly refuel en route in the time it takes to buy a cup of coffee.

While initially these chargers will be under-utilised due to the small number of EV users, the most economic infrastructure solution is to plan for a future where there is no liquid fuel. The alternative scenario is to deploy infrastructure after the number of EV users rises, creating an environment of disruptive and costly construction work to modify the network. An inadequate number of charge points may cause queues, leading to a stalled market – reinforcing consumers' perception of range anxiety. Ensuring that there is enough capacity to enable more ultra-rapid chargers to be added as and when necessary to meet the future demand, ahead of current need, avoids this future expense and disruption to customers.

While some investment has been made into UK charging infrastructure, and approximately 90% of existing motorway service areas (MSAs) have chargers on site, they are usually 50kW chargers which can take over an hour to charge a vehicle. To leverage private investment, the market needs certainty in both affordable cost of infrastructure and EV utilisation rates.

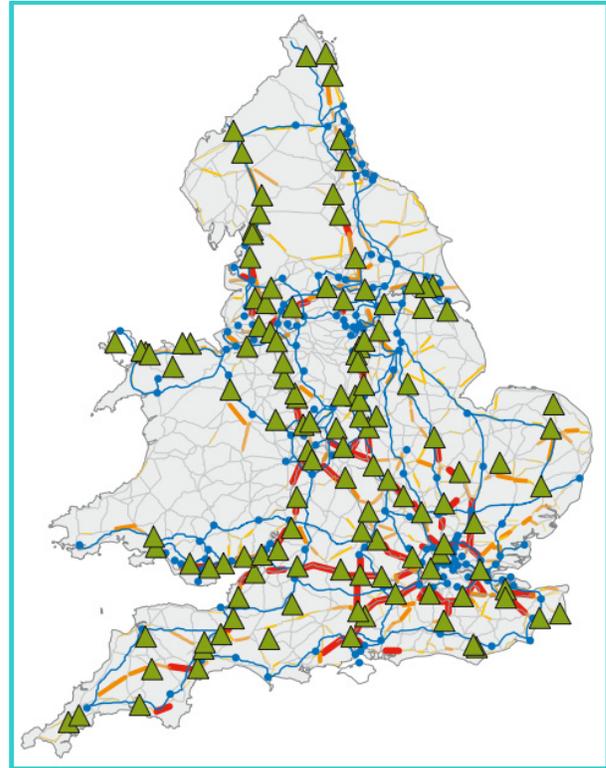
We know from talking to prospective market participants that they do not currently have certainty on either, with many struggling to make the case for the costs of the electricity network infrastructure, especially ahead of full utilisation. It is evident that under any likely scenario of EV uptake, due to existing power constraints, most MSAs will require a reinforced power connection before 2030 to meet demand for additional charging points.

Developing an electricity network solution

Transmission Owners and Distribution Network Operators, together, can enable a smooth and efficient consumer transition to EVs. We have examined the links between the strategic road network and the electricity transmission network in England and Wales to understand the minimal viable infrastructure requirement to overcome consumer range anxiety. We have studied the power capacity of the MSA sites, across the strategic road network, the journeys EV drivers are likely to take, and how close they would need to be to an ultra-rapid charger to overcome range anxiety. We also assessed the infrastructure required to support enough ultra-rapid charge points to provide EV drivers confidence and avoid peak-time queues.

As shown in figure 7.20, we have identified over 50 ultra-rapid EV charging sites along the strategic road network, where an upgraded electricity network connection would allow 95% of EV drivers in England and Wales to be within 50 miles of an ultra-rapid charging station. This would provide drivers with the ability to charge their vehicle in the time it takes to buy a cup of coffee.

Figure 7.20 Strategic motorway service areas



We have identified a cost-efficient solution for the sites, which could include a combination of distribution and direct transmission network connections. Of the MSA sites which prove most economical for a direct transmission connection, 90% could be supplied from existing substations, reducing reinforcement works and minimising the delivery cost.

Policy makers are still considering funding sources for this infrastructure. Anticipatory investment of between £500m and £1,000m in a network of charging infrastructure ahead of full market demand, as described in this section, can ensure networks help overcome range anxiety and decarbonise transport in a cost-effective manner.



6. Our proposed costs for the T2 period

Our proposed costs for delivering against our proposals for the T2 period on this priority are detailed within table 7.21.

We have embedded innovation developed through the T1 period into our T2 plans. We are also making

stretching commitments to future efficiencies by moving our benchmarked capex unit costs to be at or below the TNEI industry mean equating to an **£11.4m reduction** in this stakeholder priority. We have also applied a **£5.6m productivity commitment** to improve the productivity of our people by 1.1% year on year. Further detail is provided in Chapter 14 – *Our total costs and how we provide value for money.*

Table 7.21 Proposed baseline costs for the T2 period*

Baseline costs (£m 2018/19)	21/22	22/23	23/24	24/25	25/26	Total T2	Annual T1	Annual T2	Subject to native competition	Internal historic benchmarks	External benchmarks	Subject to UM
Innovate and invest in network reinforcement	94.1	138.9	65.6	71.3	137.2	507.1	77 [^]	101.4	✓	✓	✓	✓
Protection and control coordination studies	7	6	6	6	6	31.1	N/A	6.2	✓	✓	✓	✓
Generation closure and secure easements	34.7	34.8	27.6	18.9	18.7	134.7	26	26.9	✓	✓	✗	✗
Facilitate competition and new business models	106	72.4	3.1	0	0	181.5	12 ^{^^}	36.3	✓	✓	✗	✓
Optimise across the network owner and ESO	9.8	9.4	9.3	9.7	9.8	48.0	3	9.6	✓	✓	✗	✗
Optimise across transmission and DNO	4.9	24.7	1.1	0	0	30.7	16	6.1	✓	✓	✓	✓
Total:	256.6	286.2	112.7	105.9	171.7	933.1	134	186.6	Cost certainty status: High confidence			
	Pension allocation					3.1						

*Business Plan Data Table reference: Load related expenditure worksheets contained in section B (B0.7, B4.2a, B4.2c, B4.4b, B4.5, B4.5a, B4.6, B4.8, B4.9, B4.10) [^]excluding Western HVDC link ^{^^}only for pre-construction activities and only for projects >£500m

Figure 7.22 Expenditure profile across the T1 and T2 period (excluding SWW projects)

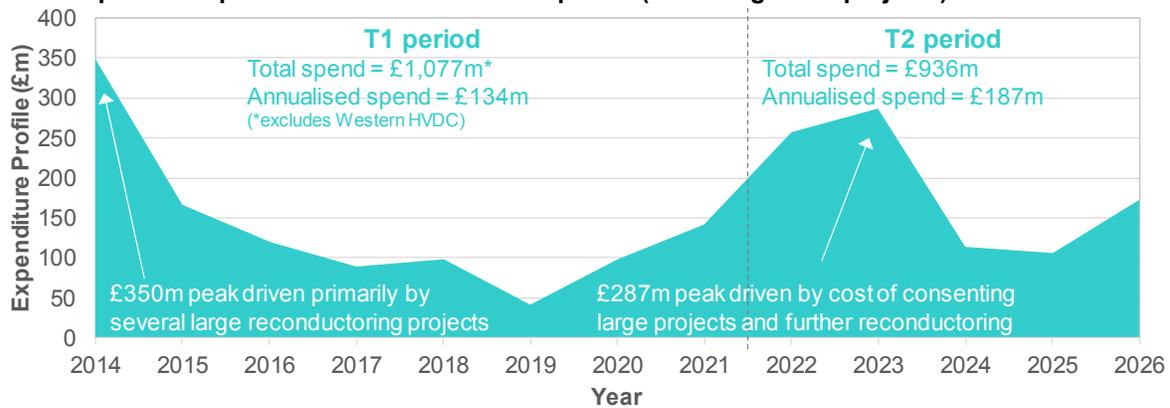


Figure 7.22 illustrates the expenditure profile for this priority over the T1 and T2 periods, excluding SWW Projects in the T1 period, but including the cost of taking similar projects to consent ready for competition in the T2 period. A simple comparison shows proposed annualised expenditure is 40% greater in the T2 period than in the T1 period (£187m vs. £134m). Comparing on a like-for-like basis, by excluding the cost of consenting 4 contestable projects, would bring annualised spend between the two to a difference of just over 10% (£151m vs. £134m). Peak to trough variability of T2 baseline expenditure is just 40% of that in the T1 period.

Table 7.23 Costs for projects that meet contestability criteria – not included in our baseline plan

Contestable projects not included in baseline plans to facilitate competition	Estimated cost (£m)
Construction and consenting costs in Scotland (where relevant) for Eastern HVDC link 1 and 2 (E2DC and E4D3), new South Coast route (SCN1) and central Yorkshire circuit (OENO)	4,885



7. How we will manage risk and uncertainty

We have built our plan with a focus on protecting consumers from risks in both the longer term (beyond the T2 period) and the medium term (within the T2 period).

Longer term risk: under-utilisation of assets

In the longer term, the main risk is potential under-utilisation of assets on our network. We have mitigated this through extensive [analysis](#) and [stakeholder engagement](#), confirming the ongoing need for electricity transmission in the most highly decentralised futures.

We also minimise the risk of under-utilisation of assets by ensuring each investment is accompanied by a strong need case. The signals we receive from our customers about their future requirements through the commercial arrangements (i.e. the Connection and Use of System Code) and the ESO's economic assessment of future constraint cost savings across all Future Energy Scenarios underline that need. The consumer payback period for many investments, in reduced system operation costs, will often be a period much shorter than the life of the asset (e.g. 5 – 10 years).

Medium term risk: cost and volume uncertainty in an ex-ante price control

In the medium term, one of the main risks is uncertainty over cost and volumes of work in an ex-ante price control. We mitigate this by only including the most certain costs in our baseline plan and proposing uncertainty mechanisms that allocate risk to whomever is best placed to manage it.

Our plan is consistent with the minimum values in the Energy Networks Association (ENA)'s [Common Energy Scenario](#) and therefore relies on uncertainty mechanisms to deliver for customers and enable net zero by 2050.

Consumers can best manage uncertainty about the route to Net Zero emissions because the route will reflect changes in their behaviour. We are best placed to manage uncertainty over the costs of achieving the outputs consumers want because we can efficiently control our costs.

With the market continuing to rapidly evolve, the ongoing development of whole system solutions, growing system operability requirements and network competition, a more complex uncertainty landscape exists in the T2 period, requiring an evolution of the T1 approach.

In developing our proposals, we have ensured mechanisms:

- i. change our allowances if consumers' needs change during the T2 period so that we can invest in the outputs they need,
- ii. allow whole system solutions to be identified and delivered during the T2 period,
- iii. retain the incentive for us to reduce our costs and share the cost savings with consumers.

We have worked with external experts to develop an enhanced suite of uncertainty mechanisms, building on the existing T1 approach of unit cost allowances and the experience of the operation of these mechanisms.

To manage uncertainty for this priority, we propose:

- A re-designed boundary capacity (IWW) mechanism to be more cost reflective and resilient to change
- A new volume driver for system operability investments required by the ESO
- A new volume driver for delivery of a consented project to facilitate competition
- A targeted within-period determination to fund protection and control upgrades indicated through planned coordination studies.
- A targeted within-period determination to fund investments in harmonic filtering

A rigorous and comprehensive econometric approach was used to develop our proposals, as shown in figure 7.24 below, which are a critical component of our overall business plan and are evidenced against Ofgem's business plan guidance criteria in table 7.25, below.

The detail of our analysis and proposals to manage energy supply and demand uncertainty is set out in annex NGET_ET.12 Uncertainty mechanisms and accompanying workbooks showing the detail of our development and statistical analysis.

Figure 7.24 Econometric approach used to develop proposals

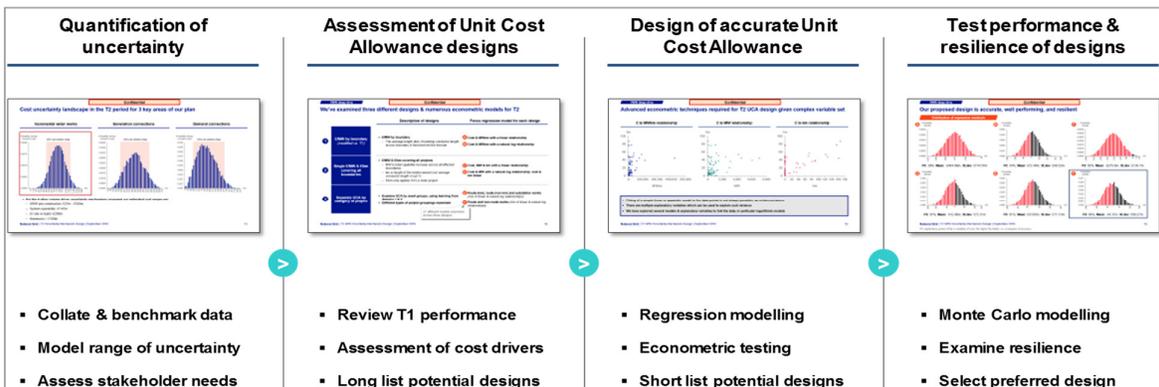




Table 7.25 Proposed uncertainty mechanisms and justification

Incremental Wider Works (Boundary Capacity) – Unit Cost Allowance (UCA)			Key stats:	
Uncertainty characteristics	T1 experience and learning	T2 proposals	Models considered	7
			Input data points (projects)	77
<p>i) Risk and ownership</p> <ul style="list-style-type: none"> System need and best whole system solution uncertain Requirements driven by annual ESO NOA process Network company manages cost risk, whilst consumer best to manage volume risk <p>ii) Materiality</p> <ul style="list-style-type: none"> Range of uncertainty is £541m (90% of Monte Carlo simulations have a total cost between £497m and £1,038m) <p>(output of Monte Carlo analysis)</p> <p>iii) Frequency and probability</p> <ul style="list-style-type: none"> Annually as part of the ESO NOA process Near 100% probability of some change in future requirements 	<p>i) T1 experience</p> <ul style="list-style-type: none"> Per boundary UCA reduced allowances by >£190m as system needs changed Output based UCA maintained ability to innovate (e.g. Smartwires); leading to considerable consumer benefit Mechanism not sufficiently cost-reflective / overly sensitive to energy scenario changes No ability to add new boundaries indicated by the ESO through NOA <p>ii) Learnings for T2</p> <ul style="list-style-type: none"> More rigorous, analytical approach to developing and testing UCAs, not limited to data on single boundary, required More cost-reflective, output based, UCA would better protect both consumers and companies Approach must work with annual NOA process and allow for new boundaries to be added Revenue calculation based on latest forecast of outputs can smooth customer charges 	<p>i) Proposed mechanism and benefits</p> <ul style="list-style-type: none"> Combined pre-construction and construction mechanism Separate UCAs for route and non-route projects, using average boundary length to enhance cost reflectivity Expansion factors applied to length in order to reflect increased cost of cabling to simplify mechanism Established regression techniques to design and Monte Carlo simulations to test for the most accurate and resilient UCA <ul style="list-style-type: none"> Roll-forward T1 efficiencies into T2 dataset for calculating UCAs Revenue calculated based on latest 5-year RRP forecast of outputs in order to minimise customer charging volatility <p>ii) Drawbacks and mitigations</p> <ul style="list-style-type: none"> Minor increase in complexity of mechanism outweighed by significant increase in cost-reflectivity and mitigated through simplifications in other areas, such as approach to cables 		

System Operability (Voltage) – Unit Cost Allowance (UCA)			Key stats:	
Uncertainty characteristics	T1 experience and learning	T2 proposals	Models considered	4
			Input data points (projects)	36
<p>i) Risk and ownership</p> <ul style="list-style-type: none"> System need and best whole system solution uncertain Requirements driven by expanded annual ESO NOA process and System Operability Framework Network company manages cost risk, whilst consumer best to manage volume risk <p>ii) Materiality</p> <ul style="list-style-type: none"> Volume uncertainty due to supply & demand changes is £92.9m (90% of Monte Carlo with total cost between £227m and £320m) <p>(output of Monte Carlo analysis)</p> <p>iii) Frequency and probability</p> <ul style="list-style-type: none"> Possibly annually, at least biennial 100% probability of some change in future requirements 	<p>i) T1 experience</p> <ul style="list-style-type: none"> Requirement to deliver both static & dynamic reactive compensation on the system increasing as more distributed and renewable generation connect - Increasing system voltage and negative reactive power demand - Reducing inertia and short circuit level T1 funding through a fixed ex-ante allowance not subject to UCA Significant uncertainty around volume and location of reactors and STATCOMS Approach to whole system assessment under development <p>ii) Learnings for T2</p> <ul style="list-style-type: none"> Need for reactive equipment will be determined by ESO expanded NOA or DNO whole system collaboration New UCA required to adjust allowances and allow work to commence when transmission solution chosen 	<p>i) Proposed mechanism and benefits</p> <ul style="list-style-type: none"> Need triggered either when ESO has provided delivery signal or whole system process with DNOs has completed Static - ordinary least squares regression and average unit costs modelled for (i) all schemes, (ii) by voltage and (iii) by size Dynamic - average unit costs modelled for all projects due to input data sample size Preferred model for static based on average unit cost by size & dynamic based on average unit cost for all projects <ul style="list-style-type: none"> Revenue calculated based on latest 5 year RRP forecast of outputs in order to minimise customer charging volatility <p>ii) Drawbacks and mitigations</p> <ul style="list-style-type: none"> UCA restricted to set unit sizes may restrict type of solution All system operability solutions are market tested by the ESO, or compared through the expanded NOA process, which mitigates any reduction in scope for innovation 		

Harmonic Filtering – within period determination		
Uncertainty characteristics	T1 experience and learning	T2 proposals
<p>i) Risk and ownership</p> <ul style="list-style-type: none"> Customer need and timing of implementation uncertain Requirements driven by volume of generation connected through power electronics (predominately renewables) Cost and volume risk too high to set ex-ante allowances in order to protect consumers <p>ii) Materiality</p> <ul style="list-style-type: none"> A total uncertainty of up to between £60m and £100m is estimated based on our work with Atkins <p>iii) Frequency and probability</p> <ul style="list-style-type: none"> Low frequency over T2 period (2 or 3 maximum anticipated) High probability of usage, subject to any necessary code changes being implemented 	<p>i) T1 experience</p> <ul style="list-style-type: none"> Uncontrolled harmonics on the system can have negative effects such as overheating of equipment and maloperation of protection Customers currently required to install harmonic filters to comply with levels set in the Grid Code Separate analysis undertaken by different TOs demonstrates that an aggregated approach could lower the overall cost of controlling harmonics for consumers <p>ii) Learnings for T2</p> <ul style="list-style-type: none"> There is an opportunity in the T2 period to implement an aggregated approach and reduce the cost of the energy transition Broad stakeholder support for this approach An ability to provide suitable allowances is needed in the regulatory framework for the T2 period 	<p>i) Proposed mechanism and benefits</p> <ul style="list-style-type: none"> No baseline allowance We propose the cost of aggregating harmonic filtering would be subject to a targeted in period determination upon a Bilateral Connection Agreement being in place between the customer(s) and the ESO <p>ii) Drawbacks and mitigations</p> <ul style="list-style-type: none"> Additional regulatory burden of in period determination outweighed by the consumer benefits Further mitigated by grouping of relevant customer projects informed by outcome of CfD rounds



Facilitate competition (pre-consents) – Unit Cost Allowance (UCA)			Key stats:		
Uncertainty characteristics		T1 experience and learning	T2 proposals	Models considered	3
				Input data points (projects)	9
i) Risk and ownership <ul style="list-style-type: none"> System need and approach to delivery of projects post-consents uncertain Requirement driven by ESO NOA process and approach to CATO competition/ Large Onshore Transmission Investment (LOTI) Network company manages cost risk, whilst consumer best to manage volume risk ii) Materiality <ul style="list-style-type: none"> Estimated range of uncertainty >£300m based on inspection of potential projects in NOA iii) Frequency and probability <ul style="list-style-type: none"> More than once in T2 period; linked to the ESO NOA process High probability of change in future requirements, given T1 experience 		i) T1 experience <ul style="list-style-type: none"> Project development costs split into pre-construction and construction activities Projects <£500m - fixed pre-construction allowance of 1%-4% total project cost Projects >£500m - fixed £46m (09/10) allowance for pre-construction of 2 projects with potential to substitute to other projects Significant churn in projects >£500m; mechanism not sufficiently flexible to reflect requirements, resulting in ~£33m overspend (18/19) ii) Learnings for T2 <ul style="list-style-type: none"> Desire to facilitate competition in transmission for projects >£100m that have a NOA proceed signal Completing pre-con. activities only would result in re-work and less effective competition; consents achieved milestone more appropriate Cost-reflective, automatic uncertainty mechanism would let allowances flex to meet requirements Approach must fit with NOA, any successor to Strategic Wider Works and Late CATO competition 	i) Proposed mechanism and benefits <ul style="list-style-type: none"> Propose new output of a consented project ready for Late CATO and/or LOTI mechanism Remove activities based differentiation between pre-construction and construction; include all efficient costs to achieve consents Baseline funding of £182m for projects that have a NOA proceed signal and meet criteria for late competition Separate unit cost allowances for onshore and offshore (sub-sea) projects so allowances can flex to meet future NOA signals 		
			ii) Drawbacks and mitigations <ul style="list-style-type: none"> Proposed approach flexible and robust to current understanding of approach to Late CATO and LOTI, but these have not yet been finalised leaving a minor risk of inconsistency This risk can be mitigated through continued engagement in CATO and LOTI design 		

Protection and Control – within period determination		
Uncertainty characteristics	T1 experience and learning	T2 proposals
i) Risk and ownership <ul style="list-style-type: none"> System need and the specific mitigating investment required uncertain Requirements driven by detailed study of system requirements, from modelling activity included in baseline plan Cost and volume risk too high to set ex-ante allowances in order to protect consumers ii) Materiality <ul style="list-style-type: none"> A total uncertainty of £90.2m is estimated based on independent review by Quanta Technology iii) Frequency and probability <ul style="list-style-type: none"> Low frequency – upon outcome of coordination study 100% probability of coordination studies identifying some additional future requirements 	i) T1 experience <ul style="list-style-type: none"> ESO & international studies consistently forecast a significant reduction of system inertia and short circuit level as capacity of synchronous generation reduces We employed an independent party (Quanta Technology) to estimate the scale and scope of the challenges and lay out a plan for further development to ensure effective operation and coordination of our protection and control systems We continue to engage extensively with experts and other network companies ii) Learnings for T2 <ul style="list-style-type: none"> To identify the details of protection and control issues and most efficient mitigating actions, it is necessary to develop comprehensive models and perform "wide area" protection coordination studies across the transmission network Changes to settings are also required and included in our plans, but subsequent investments will be required to enhance system operability and maintain security of supply 	i) Proposed mechanism and benefits <ul style="list-style-type: none"> Baseline allowance proposed in T2 period to deliver the coordination study and consequential changes to protection settings Subject to the outcome of the co-ordination study, further investment estimated at £90m for protection equipment replacement or other equipment installation may also be necessary to maintain protection performance within T2 period and beyond We propose the cost of protection upgrades would be subject to a targeted in period determination upon sufficient progress of the coordination studies ii) Drawbacks and mitigations <ul style="list-style-type: none"> A within period determination with a fixed date or window could delay funding to undertake the work required to operate a net-zero system by 2025 and mitigate the issues highlighted by the ESO in the System Operability Framework We propose that the determination could take place at any point during the T2 period when coordination studies have provided sufficient clarity on scope

System Operability (other ESO requirements) – within period determination		
Uncertainty characteristics	T1 experience and learning	T2 proposals
i) Risk and ownership <ul style="list-style-type: none"> Volume of TO solutions to future operability challenges unclear prior to ESO whole system assessment Risk too high to set ex-ante allowances ii) Materiality <ul style="list-style-type: none"> Robust estimate of materiality challenging; likely range of between £10m to £50m iii) Frequency and probability <ul style="list-style-type: none"> High frequency for small requirements (e.g. intertrips) Low frequency for large requirements (e.g. synch. comp.) Very high probability of usage (based on System Operability Framework) 	i) T1 experience <ul style="list-style-type: none"> Experience indicates that the ESO can sometimes benefit from equipment beyond the minimum cost TO design to reduce overall costs (e.g. inter-trips, additional circuit breakers, etc.) The ESO's System Operability Framework points to a need to address falling inertia and a NOA stability 'pathfinder' project has been launched to find solutions, but no funding mechanism is in place to allow TOs to deliver solutions ii) Learnings for T2 <ul style="list-style-type: none"> Once the ESO has undertaken a whole system assessment of solutions that meet their operability requirements, a mechanism is required to provide funding where a TO is deemed the most economic solution 	i) Proposed mechanism and benefits <ul style="list-style-type: none"> No baseline funding proposed For small ESO requirements we propose a logging up mechanism is used to fund these with a cap of £20m across the T2 period For larger ESO requirements, or once the £20m cap is reached, we propose that funding would be subject to a targeted in period determination upon completion of an ESO whole system assessment A mechanism that provides funding for TO solutions when they are deemed most economic is crucial for minimising the cost of energy transition ii) Drawbacks and mitigations <ul style="list-style-type: none"> Depending on how ESO requirements evolve over the T2 period, the frequency of usage for this mechanism could be quite high We propose to mitigate this through the introduction of a logging up mechanism for smaller requirements that the ESO has tested as economic



8. We will make it easier for you to connect to and use the network

What this stakeholder priority is about

We have many customers who want to connect to and use our electricity transmission network. We provide them with network connections, services related to the connection, and ongoing services once they're connected. We aim to achieve this by becoming a more customer-centric business. This stakeholder priority is about making it easier for customers to connect to and use the network.

What you have told us so far

You want our business to:

- provide a simple, flexible, affordable and co-ordinated approach to connections; to reduce lead times and share developer risk
- provide more support upfront before you make an investment decision
- make our charges more stable and improve the transparency of them
- improve information about planned outages on the network and minimise changes to them.

What we will deliver

We will ensure we are ready to **deliver whatever our customers require** of us. We have built the detail of our baseline plans for this priority on the [Common Energy Scenario](#).

We will invest to **connect new customers enabling 15.3GW of connections**. 69% is from renewable sources, technologies that optimise the use of renewable energy and from interconnectors that allow renewable energy to be imported from other countries.

We will be **installing 100 super grid transformers (SGTs)** to support our demand customers. We will manage the uncertainty over how many, and what type, of connections we will need to

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification of our proposals
6. Our proposed costs for the T2 period
7. How we will manage risk and uncertainty

make in the 2020s through improved uncertainty mechanisms. These make sure consumers only pay for the work we must carry out as the energy system develops in the future.

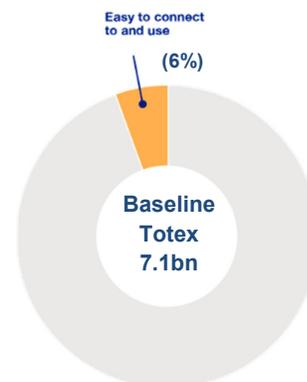
We will **deliver better customer service**, enabling more choice and a more tailored service.

We will develop **output delivery incentives** for service areas that **our customers value**, such as connections and outages and have included them in our business plan.

We are working with others to make improvements to the regulatory framework to make our charges more stable.

The cost of delivering these baseline proposals is £417m. This represents 6% of the overall business plan as reflected in figure 8.1. The baseline is approximately £105m lower through taking a whole system approach to addressing fault level issues at the distribution interface.

Figure 8.1- Proportion of expenditure





1. What this stakeholder priority is about

With the decarbonisation, decentralisation and digitisation of the energy industry, the way networks operate and how electricity is consumed will change.

In order to meet the net-zero carbon emission target, we will need to connect more renewable generation and more demand. This priority will support and enable this journey by focusing on the following areas:

- 1 Expenditure that is required to facilitate:
 - the connection of new electricity generators and storage operators to the network
 - the works associated on the transmission network for Distribution Network Operators (DNO) and other customers that consume power, such as rail companies, data centres etc
- 2 Expenditure and activities that will improve the customer experience for all of our customers connecting to or using the network. This means investing and improving our systems, our people capability and the processes we follow.

Consumer Value Proposition (CVP)

The CVP looks at the value we are providing above Ofgem’s minimum requirements that we can robustly monetise. This chapter contains the following CVP items:

CVP3 - Whole system approach to low-voltage substation re-builds (value of £9.48m)

For more detail, please see chapter 5.4 and the CVP annexes ET.07 to ET.07C.

Energy scenarios

The customer driven investments set out in this chapter are dependent on the changing needs of our customers. We have built our business plan using an England and Wales energy scenario built from our own market intelligence and the [stakeholder engagement](#) we have undertaken. Our scenario is consistent with the minimum values in the Energy Networks Association (ENA)’s [Common Energy Scenario](#), as required by Ofgem. As the Common Energy Scenario (CES) is not consistent with delivering Net-Zero by 2050, our proposed uncertainty mechanisms are a critical enabler of the transition to legislated targets at least cost to consumers, alongside our baseline totex plan. These mechanisms are set out and evidenced in section 7 of this chapter with more detail in annex NGET_ET.12 Uncertainty mechanisms.

2. Track record and implications for T2

2.1 Costs and outputs in the T1 period

In terms of what we delivered in the T1 period and the targets associated with this, Electricity System Operator (ESO) and Electricity Transmission (ET) collectively met the offer delivery target of within 90 days, 100% of the time up to the point of legal separation on 1 April 2019.

2.2 Customer connection offers in the T1 period

RiIO target	13/14	14/15	15/16	16/17	17/18	18/19
100%						

To date, we have also delivered our outputs required for connecting generation and demand customers in the T1 period. Initial forecasts are shown alongside current forecasts for the 8-year period in table 8.3, below.

Table 8.3 Costs and outputs in the T1 period*

Category	Initial T1 forecast		Current T1 forecast	
	Outputs	Cost	Outputs	Cost
Generation	26.3 GW	£1,388m	12.6 GW	£670m
Demand	SGTs	£355m	SGTs	£265m

*allowances automatically adjusted by uncertainty mechanisms, as described below (2018/19 prices)

Generation – Our 8-year forecast is that we will connect 12.6GW of transmission-connected generation, of which 47% is clean generation. The overall reduction in baseline outputs has reduced allowances by £972m from £1.45bn. We are forecasting to spend £670m with forecast allowances of £416m, an overspend of £254m. For further information please refer to section 2 in annex NGET_A8.02 Generation IDP.

Demand – The amount of SGTs required has reduced from units in final proposals to . The overall reduction in baseline outputs has reduced allowances by £188m from £355m. We are now forecasting to spend £265m against allowances of £167m. For further information please refer to section 2 of NGET_A8.03 Demand IDP.

Volume changes due to changing customer needs

Across the eight years of the T1 period, the major influence on the difference between expenditure and allowances has been the changing requirements of our customers in terms of the contracted generation and demand connections. The changes that we have faced have been in both volume and timing of customers connecting to the system.

Automatic adjustment of allowances

We expected that there would be a change in customer requirements and had uncertainty mechanisms that adjusted our allowances. These worked well overall and made sure consumers only paid for the work our customers required. A mechanism was put in place



providing a unit cost allowance for each additional MW or SGT installed. Considering the level of change experienced, the suite of mechanisms has worked reasonably well to adjust our allowances to reflect changing customer requirements whilst maintaining a strong incentive on us to drive efficiencies.

T1 benefits are embedded in our T2 plans

We have delivered all customer connections to date at lower cost. For generation, we have estimated at least £264m efficiency improvements against project costs that we might have expected to incur given prevailing investment and procurement approaches, as well as the industry codes, at the start of the T1 period. We reduced costs by identifying innovative solutions, applying lean asset design principles, reusing assets and finding improved commercial arrangements. For demand, we have estimated at least £141m has been delivered through commercial solutions for active network management and technical solutions like optimised scope, and the introduction of lean design techniques. These efficiencies have all been fully embedded into the T2 plan.

Innovation in the T1 period

We have been using tertiary windings on transformers for reactive power supporting equipment. Through innovating, we realised we could increase competition through an alternative use of tertiary winding of the transformer. We were able to engineer the use of tertiary winding to connect our smaller generation customers. This connection on average is **£3.2m** cheaper. This has reduced cost for consumers and facilitated quicker connections.

We also innovated by offering our land around substations which is not currently operational. As our land is near the substation, it allows developers to reduce project cost and lower risk, through shorter cable lengths, and provides cheaper connections that benefit both our customers and the end consumer.

Whole systems approach

Creating consumer benefit through a whole system approach is something we are doing in the T1 period – we worked with DNOs to install 9 Automatic Network Management (ANM) schemes for distributed generator connections as an alternative to spend on SGTs. In total, we estimate that these schemes will reduce costs by between **£90m-£108m** by avoiding the need for additional SGTs within the T1 period and saving consumers money. See annex NGET_A7-8.03 Whole Systems which details our approach.

Transmission reinforcements to resolve distribution network issues – across the T1 period, there have been instances where the DNO network required significant upgrades to accommodate increasing power flows. By working collaboratively, we and the DNOs were able to assess if a transmission investment could alleviate the issue at a lower cost to consumers. In

some cases, this analysis showed that the transmission reinforcement provided better value for the consumer.

Price control effects

Costs and allowances can also vary due to mechanisms in the price control, such as those required to deliver outputs beyond the second year of the T2 period.

Our costs differ from allowances set at the start of the T1 period due to changing customer needs, cost efficiencies, innovating and price control effects. This is illustrated in figures 8.4 and 8.5, below. Given considerable changes in the projects delivered versus those that were expected to be delivered, it is not possible to define a baseline against which to specifically measure efficiency

Figure 8.4 Costs and allowances for generation investment

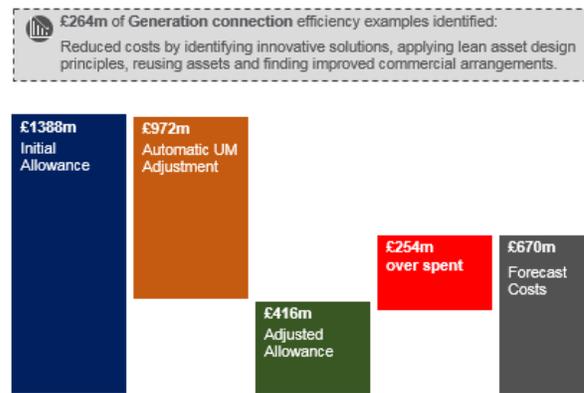
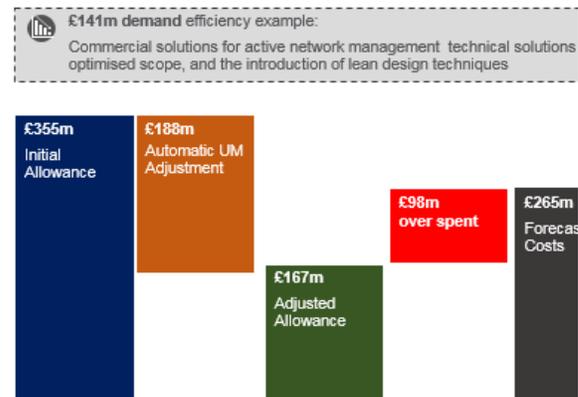


Figure 8.5 Costs and allowances for demand investment



*Excludes connection costs

2.2 Improving our customer experience

Our customer satisfaction tracker informed us of how our customers, both those in the connection pipeline and those already connected, felt about the quality of the Customer Experience (CX) we provided. Year-on-year, it has been tracking this in 10 core service areas across the ESO and ET operations; 3 shared by or



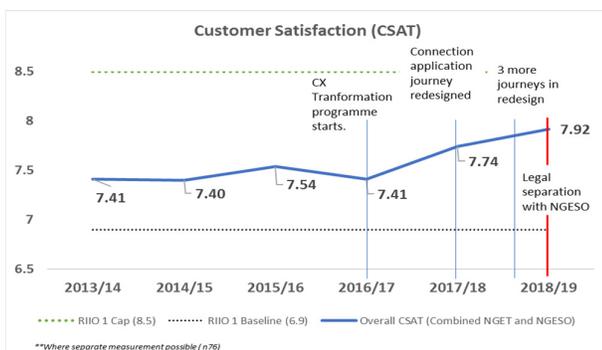
wholly operated by ET and the remaining 7 wholly within the ESO.

Although we consistently delivered connection offers within the 90 day obligation, we observed that customer satisfaction had in fact plateaued – we were delivering on time, but the quality of experience was not meeting the customers’ needs. This led to the launch of our customer experience transformation programme in 2017 and the redesign of our connection journey and other core customer journeys across ESO and ET. The insight we had through the voice of the customer (VOC), an in-depth process of capturing customers’ expectations, preference and aversions, led us to produce our five core principles (to **care**, be **agile**, be **transparent**, earn **trust**, deliver **value**) which were fundamental to improving the experience felt.

We recognised that the changes that we needed to adopt were not merely process adjustments but primary behaviour changes running right across the business from leadership to frontline – our culture. Embedding the changes that customers were needing to experience started and ended with our people; from how we communicate and take ownership to how we listen and collaborate with one another. These were all essential steps to providing the service our customers have told us they need. We now fully understand that employee engagement, alignment with a common purpose, clarity of direction, prioritisation and enablement through systems, tools and empowerment pave the way to the local sustainable changes that need to be made at each and every customer touchpoint. We also recognise that our moving from silo working within a decentralised model to a federated model, that enables the required CX governance for CX data management and processes, is essential to achieve our customer ambition overall.

By challenging how we operate against our five principles, our customer satisfaction (CSAT) started to increase, starting with the connections applications process and activities undertaken by the Transmission Network Control Centre (TNCC).

Figure 8.6 Customer satisfaction scores so far in the T1 period



The early deliverables of our customer experience transformation programme have laid the foundation for what we need to develop and deliver by the end of the T1 period and across the T2 period – all shaped by the voice of the customer.

- **A fully endorsed customer experience ambition** with customers and National Grid Group
- Our **customer experience set of principles and standards**, to roll out consistent best practice across our business.
- A **customer experience governance board and net promoter score programme** to drive cultural changes at all levels of our organisation.
- The early development of a **customer relationship management system** that enables us to provide a consistent and efficient customer experience and supports our goal of delivering a personalised customer experience.
- Our **customer journey mapping** work has been crucial in delivering better outcomes for customers, and implemented them. We will continue to have dialogue with our customers to ensure that the changes we implement are making a difference to their experience.
- An **improved website** that now includes information that our customers wanted e.g. network capacity map.

Connecting to the transmission network

Through the journey redesign work and our focus on improvement initiatives focusing on the application stage, we have improved our connections score from 7.5 to 8.0 between 2016 to 2019. We continue to innovate to make further step changes to this particular service experience. We are committed to continue to identify the evolving drivers of customer satisfaction and use the voice of the customer to shape what we need to do to improve their experience.

Learning for the T2 period

Taking time to reflect on learnings from the T1 period has been an integral part of shaping the T2 business plan.

The number of connections we had to provide in the last eight years was very different to what we and the industry anticipated at the beginning of the period. As our baseline plan was based on the central view of the energy scenario envelope (i.e. Gone Green), it is likely to lead to significant revenue adjustments through uncertainty mechanisms. We have engaged stakeholders and other networks to agree a common energy scenario in between the extremes, reducing this risk in the T2 period.

We have learned about the importance of uncertainty mechanisms to ensure our allowances reflect the connections our customers want us to carry out and ensure consumers only pay for what our customers want.



Investment driven by embedded generation has not been dealt with by the T1 price control framework, this has potentially impacted whole system solutions; moving into the T2 period, we are proposing an uncertainty mechanism that deals with investment that is driven by embedded generation.

We have learned that our uncertainty mechanisms could be more accurate so that the adjustment to our allowances more accurately reflects our costs. Further details on how the learnings from uncertainty mechanisms (UM) in the T1 period has shaped our latest thinking on UM development for the T2 period can be found in section 7 of this chapter or a detailed explanation can be found in annex NGET_ET.12 Uncertainty Mechanisms.

We have also learned that improving customer service is a cultural journey. We should have done more in changing the culture around customer and should have done this sooner, hence our CX strategy to drive customer centricity into the DNA of our business.

Our customers want more than a timely connection. The quality of our customer service also matters to them. Working with more new and smaller customers recently and learning about their specific needs, we have realised that different types of customer want different services. These learnings include new customers being less familiar with our processes and procedures, requiring more support, and application fees being a barrier for them. In response to this, we created web tools to facilitate feasibility assessment and will be looking into bespoke services in the T2 period.

In respect to project delivery, we need to be more agile and innovative in connecting customers quicker. We know that consenting is a factor in connection lead-time. We are looking to use our experience from these projects to deliver the required pre-application consultation and engagement more effectively, better targeting resources at key aspects, considering the timing of high resource commitment activities in the process, and being more proportionate in the information we produce. By taking this approach, we think we can reduce the time to achieve consents, reduce the duration, and improve the cost profile, of the process for the benefit of consumers.

3. What our stakeholders are telling us

Our plans must be shaped by our licence obligations – the rules that we must follow to connect customers to the network. We have engaged based on this framework and these have been described in table 8.7 below.



Table 8.7 Our obligations when connecting customers

CUSC	The Connections and Use of System Code (CUSC) is the contractual framework for connection to, and use of, the National Electricity Transmission System.
SQSS	The Security and Quality of Supply Standards (SQSS) provide a set of criteria and methodologies that transmission licensees must use when planning and operating the network. It is our licence obligation that we connect new and existing customers to the network in compliance with the SQSS. This ensures the safe and effective use of the network.
STC	The System Operator-Transmission Owner Code (STC) defines the relationship between the transmission owners and the system operator. The STC clearly sets out the roles, responsibilities, obligations and rights of each party in detail.

A summary of our engagement activities and outcomes is provided in table 8.8 below, alongside what trade-offs have been made and how stakeholders have influenced the plan. The engagement log contains detailed information on our engagement approach and outcomes. This can be found in annex NGET_A8.01 Engagement log (Connections and use of Network).



Table 8.8 Summary of our engagement

	Engagement on improving connections
Purpose and approach	The purpose of this engagement was to understand our customers' views on how we can make their connection to the network as easy as possible by using data from customer satisfaction feedback, bilateral meetings, bespoke research and interviews, our 'Future of Electricity Transmission' webinar and our 'connection journey' workshop and accessibility testing with consumers.
What stakeholders told us	<p>Stakeholders told us that they want a simplified, flexible, affordable and coordinated approach to connections. They also want us to provide options for a wider range of services such as increased digital services or support through the consent process. Providing more information and support upfront before they make an investment decision was also really important to them.</p> <p>Some of the specific feedback was that some customers thought we were unable to deliver their connection because of their small size, so they connected at the distribution level instead.</p> <p>Customers also fed back that it can sometimes be difficult for new entrants to the sector to work with us:</p> <p>"There are a lot of new entrants into the market and trying to unpick how to engage and how to work with National Grid can be a real problem, unless you've got people who have years of experience in the industry. If you're coming in fresh, then it's quite complicated." Customers would like more online platforms to help speed up the connections process. (Source: Bespoke Research, further details are in NGET_A8.01 Engagement log – Connections and use of Network)</p>
What consumers told us	Quantitative acceptability testing showed strong support for our proposed investments, 92% of respondent's agreed with the proposed investment of connecting new power generators and 71% agreed with the proposed investment and impact on bill is acceptable.
Key trade-offs and how engagement influenced our plans	<p>A key trade-off was whether to include costs in our baseline to manage additional thermal capacity and fault level capacity to address the impact of embedded generation on the transmission network, where whole system alternatives could exist, or whether to exclude these costs from our baseline and develop an uncertainty mechanism that would provide funding where transmission investment is the best solution for consumers. Based on the insights gathered through this engagement, we have decided to fully embrace the potential of whole system solutions to reduce costs for consumers, thereby reducing our baseline proposals by £105m.</p> <p>Uncertainty on roles in the whole system planning process was highlighted by some DNOs and there were different views on the role of the TO. Some DNOs were keen to work exclusively with the ESO, whilst the ESO and other DNOs indicated a preference for full collaborative working. Most preferred the collaborative approach and, on balance, we think this is likely to lead to better consumer outcomes. As such, our proposals are based on this approach.</p> <p>Another trade-off was between increasing the number of employees dealing with the connections process versus the development of digital platforms for self-service. Through our engagement, many of our customers and potential customers wanted an increase in the self-serve online capability (i.e. customers will be able to use the functionality to design their own connection). We took the decision to invest in the IT capability supporting what customers wanted.</p> <p>As described in chapter 6 <i>Giving stakeholders and consumers a stronger voice</i>, Frontier carried out an assessment on our engagement and highlighted that there was limited evidence customers wanted to directly contract with the TO, we have responded by removing the commitment for this.</p>
How we've responded to the Independent Stakeholder Group and Challenge Group	<p>The Independent Stakeholder Group challenged us on how we could provide more certainty on connection dates for customers and take on more risk. Our stakeholders also want us to take ambitious action on climate change by reducing greenhouse gas emissions. In addition, the UK government has put into law the target of net-zero greenhouse gas emissions by 2050.</p> <p>Based on this stakeholder feedback we have developed an ODI to encourage us to deliver earlier connection dates to benefit our customers and to bring forward the reduction in greenhouse gas emissions from low-carbon generators connecting to our network.</p> <p>Another challenge raised by the Independent Stakeholder Group around how we will ensure that our approach to connecting small vs. large customers is proportionate. To ensure that we are setting ourselves up to deal with these challenges in the most effective manner, and as part of our focus on the customer connections journey in the T1 period, we have an ongoing piece of work in this area that has highlighted the potential benefits of standardisation for smaller projects. This is something we will continue to investigate and ensure we incorporate learnings into our approach in the T2 period. We are also investing in our online capability to allow some customers to customise their connections.</p>



Engagement on better coordination of planned outages	
Purpose and approach	The purpose of this engagement was to understand our customers' views on how we can carry out vital repair work on the network with least disruption to our customers. Feedback was obtained via the following channels; customer satisfaction feedback, bilateral meetings, interviews with network companies and workshops.
What stakeholders told us	Customers have told us that we do not sufficiently communicate or explain the changes we make to outages and that we do not fully appreciate the impact our decisions can have on their business. Some emerging themes were: <ul style="list-style-type: none"> • in some cases, we do not sufficiently explain the reasons for our changes • in some cases, we do not sufficiently assess the impact of our planned outages which subsequently get cancelled • there are delays to works which create more changes in planned outages.
Key trade-offs and how engagement influenced our plans	Our engagement has influenced our plans as we are creating higher detail long term plans in collaboration with stakeholders and we are trying to be more transparent with our plans to get earlier feedback and understanding of the impact of our work on our stakeholders. We have put a greater focus on "systems" as part of our deliverability reviews ahead of plan submission to test that plans are credible and deliverable considering wider system limitations to ensure that customers are not impacted or we are able to manage the risk without negative consequence.
How we've responded to the Independent Stakeholder Group and Challenge Group	In defining the ODI for outage experience, the Independent Stakeholder Group highlighted the opportunity to work with Ofgem and incorporate this ODI into the common ODI for quality of connections. As a result of this feedback, we will work with Ofgem to establish if this would be feasible.

Engagement on improving the stability of our charges	
Purpose and approach	The purpose of this engagement was to understand our customers' views on our charges via customer satisfaction feedback, bi-laterals meetings, customer seminar, 'connection journey' workshop.
What stakeholders told us	Customers told us that year on year Transmission Network Use of System (TNUoS) volatility is a concern because this has an impact on their business. The ESO has also informed us that the polling that took place during customer seminars gave the same message. Customers would like us to be more transparent and communicate more effectively with them when there are changes to connection cost volatility during the build phase. For example, from a Customer Connection Journey meeting, we heard that we "give no pre-warning of cost increases in the project, no options to query at the time", this causes a problem as our customers are presented with a bill at the end.
Key trade-offs and how engagement influenced our plans	The ESO and stakeholder feedback has resulted in us looking to include actions that we could take to help address this concern.
How we've responded to the Independent Stakeholder Group and Challenge Group	The Independent Stakeholder Group wanted to see detailed proposals for the load related driver – we have included much more information on uncertainty mechanisms in the plan, including the T1 period experience and learning, and our proposal for the T2 period, and how this will help with charging volatility.



4. Our proposals for the T2 period

The table below outlines how what stakeholders are telling us links to the proposals we are making and the consumer benefits.

Table 8.9 Our proposals for the T2 period

Stakeholder Feedback	Our proposals	Output type	T2 Baseline (£m)	Consumer benefit
You want us to make it easier to connect to the network	We will invest in the network to connect 15.3GW of new generation, storage and interconnector for customers under the common energy scenario.	LO to connect MW of new generation Bespoke ODI- Accelerating low carbon connections	245.0	Help lower wholesale electricity costs and reduce carbon emissions.
	We will invest in the network to connect demand customers when they request connections by installing super grid transformers (SGTs) under the common energy scenario.	LO to install SGTs	141.7	To connect large consumers quickly and efficiently.
	We will invest in our systems, people and products to delivery our CX strategy.	Common ODI – Quality of connections survey	29.9	Improving our customers' experience, and meeting their needs, will benefit the consumer.
You want us to make it easier to use the network	We will make step changes to improve the system access experience for our customers so that they have more warning of network outages and changes to them.	Bespoke ODI- Outage management	N/A	Improving our customers' experience and meeting their needs, will benefit the consumer.
You want our charges to be stable and predictable	We will contribute to improving the stability and predictability of our charges.	Commitment to work to improve the regulatory framework to improve the stability and predictability of our charges.	N/A	

5. The justification of our proposals

5.1 Our proposal to make it easier to connect you to the network

Our proposals will be delivered by the investments and commitments outlined in this section. These are driven by our legal/licence obligations, ensuring that the options considered meet standards and the needs of our current and future customers.

The Common Energy Scenario did not provide a project-specific view of connections. Therefore, to develop a detailed business plan, we have utilised project-level intelligence - 'project health status'- to assess the projects within each technology type that are most likely to proceed. Details of this assessment can be found in annex NGET_A8.02 Generation IDP.

Projects that have achieved planning consents, are financially committed, and have obtained a Contract

for Difference or Capacity Market agreement are more likely to proceed than those that have yet to secure these. Those projects which are most likely to proceed, have been included in the business plan. Despite this, we do not have perfect foresight of connections and the actual mix of generation is likely to be different from that assumed.

The progression of connection investments is governed by our Network Development Process, which ensures that the most cost-effective solution to customer requirements is delivered. Using our own analysis and dependent on the location, size and type of plant, we have assessed all investments proposed in this chapter to be the most economic and efficient way to deliver the



outputs. These are evidenced in the investment decision packs, which include an engineering justification paper and cost benefit analysis (CBA). Our costs to develop this part of the business plan are **based on externally verified benchmarks**, as detailed in chapter 14 *‘Our total costs and how we provide value for money’*.

i) Invest in the network to connect generation, storage and interconnector customers

Key driver – Our business plan proposes a baseline allowance of £245m to connect 15.3GW of generation, storage, and interconnector projects during the T2 period. 69% is from renewable sources and technologies that optimise the use of renewable energy (e.g. wind and storage); and from interconnectors that allow renewable energy to be imported from other countries. This will support the UK achieving its net-zero emission goal.

The need for new connections, and the associated network investment, arises from customer applications to connect to the transmission system via NGENSO. Upon receipt of an application, we assess the customer’s request and identify the most economic and efficient solution to facilitate their connection.

We have robust processes in place to ensure that appropriate investment development is undertaken at the right time; that scope and cost estimates are robust; and that lessons learnt are captured and incorporated in future projects. It is inappropriate to make unit cost comparisons (£/MW) between projects expected to be delivered in the T1 period and the proposed baseline for the T2 period. This is because the proposed mix of projects anticipated to connect in the T2 period is very different (and consistent with the Common Energy Scenario).

Options – Using our engineering expertise, we develop a range of options and then assess these using a cost-benefit analysis to determine the most economic and efficient option. For example, the options considered to connect a project <50MW are:

Option Selection Summary
Options considered (Selected option in bold)
Option 1: Do nothing would not be consistent with our licence obligation to make an offer to connect.
Option 2: Innovative connection using tertiary windings
Option 3: Conventional connection by installing a new SGT
Option 4: DNO provided connection

We have justified our proposed baseline allowance, through 5 detailed case studies of the investment

¹ <https://www.nationalgrideso.com/document/45791/download>

decisions we have made and 20 individual cost-benefit assessments, these are described in annex NGET_A8.02 Generation IDP.

Well designed and calibrated uncertainty mechanisms will ensure allowances adjust appropriately, should the mix of customer projects change from that assumed, and provide an incentive to minimise investment costs.



Whole system alternative – In the case of connection for offshore wind farms and interconnectors, there are two stages of option selection. First, a process to determine the optimum onshore connection point, then a process to optimise the design of the agreed onshore connection. The first phase of this delivers a Connection and Infrastructure Options Note (CION)¹ and involves extensive close working between the customer, other transmission owners, and the ESO. The purpose of the CION is to ensure that the best whole system solution is selected and progressed.

Cost justification – Figure 8.10 summarises the maturity of the development activities of investments in our business plan. It shows 62% of investment during the T2 period is associated with projects in the early stages of development that have estimates based on the Cost Book, derived from internal historical benchmarks. The unit cost key assets in the Cost Book have been recently benchmarked by external consultants and provided independent assurance on our cost estimate process; further details of the study and methodology can be found in chapter 14 *Our total costs and how we provide value for money*. 19% of investments have had detailed design work completed and a bottom-up cost estimate made but are not yet in delivery; and 19% are already in delivery.

Figure 8.10 – % of total T2 spend by development stage

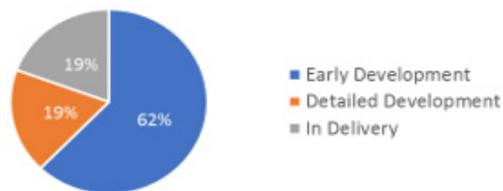




Table 8.11 Baseline: Proposed baseline expenditure for generation, storage and interconnector connections for the T2 period

Description	T2 infrastructure costs (£m)	T2 sole user connection costs (£m) *	T2 Output MW
Works for six combined-cycle gas turbine CCGT developments in the T2 period.	39.3	0.0	1827
Works for off-shore wind projects in the T2 period.	87.6	0.0	5460
We expect five interconnectors to drive investment costs in the T2 period.	40.5	0.0	4700
We have included three further generation developments in the plan: two open-cycle gas turbines (OCGTs); and a biomass plant in North Wales.	13.2	0.0	1109
Works associated with 13 battery connections .	9.2	27.4	499
Works for one nuclear power station, Hinkley C, in the T2 period. These works include construction of a new connection substation at Shurton.	26.1	1.8	1670
Total	215.9	29.2	15265

*costs relate to generation assets installed solely for and only capable of use by an individual user. These costs are recovered through connection charges which are treated as an excluded service within the regulatory framework

In our business plan, the wind projects connecting to the network during the T2 period are all offshore. This aligns with evidence of reducing cost for this technology, the UK's Third Contracts for Difference (CfD) auction has cleared at the record low price of £39.650/MWh for Delivery Year 2023/24 and £41.611/MWh in 2024/25 and existing government policy that is more supportive of offshore wind than large scale onshore wind within England and Wales.

Further to this, the Committee on Climate Change recommended target for the UK to become net-zero of carbon emissions by 2050 suggests potential further growth in this area (up to 75GW by 2050). Offshore wind tends to be located at the extremity of the network, often away from where traditional generation has been located, meaning that notable investment is required to facilitate these connections. The recent CfD results open up the possibility for offshore wind to play a greater role in delivering net zero by 2050.

We understand that there may be dependencies such as changes to government policy in nuclear or contract for difference, the levelised cost of energy and the anticipatory investment approach taken to combine network solution may impact our forecast. Any changes that occur will be dealt with through the uncertainty mechanism.

ii) Invest in the network to connect demand customers

Key driver – our business plan proposes a baseline allowance of £141.7m to deliver ■ new SGTs (including 2 new GSPs) to connect new demand customers and to provide additional capacity at existing DNO connection sites during the T2 period. Drivers of these investments are our demand customers, that fall into two categories:

direct connections (e.g. large, individual industrial, commercial connections or transport) and distribution networks.

Options – we identified a full set of options that satisfy the driver, including working with the DNOs to investigate non-build options and to select a preferred option by identifying with more certainty the scope, programme, costs and issues associated each of the potential options. This stage identifies a variety of different ways the driver could be met, including: no-build and less-build solutions (if they are available); use of innovative or emerging technologies (e.g. use of new conductor types); choices such as on-line versus off-line build and air-insulated versus gas-insulated solutions; the application of any lessons learnt from similar previous projects; and the current ratings different assets and technologies provide. For example, the options considered for demand driven new GSP are:

Option Selection Summary
Options considered (Selected option in bold)
Option 1: Do nothing would not be consistent with our licence obligation to make an offer to connect.
Option 2: DNO cable to existing site
Option 3: NGET construct a new Grid Supply Point

We have justified our proposed baseline allowance, through four detailed case studies of the investment decisions we have made and ten individual cost benefit assessments and a detailed description of the business as usual, and the T2 period specific, collaborative working with distribution networks, these are described in annex NGET_A8.03 Demand IDP.



We will continue to work with all stakeholders to develop and assess the whole system alternatives to new investment in this area during the T2 period. We will put in place appropriate uncertainty mechanisms to ensure we can take forward SGT investments should they be required when alternatives are not available.



Cost justification – Figure 8.12 summarises the maturity of the development activities for the investments in our business plan and shows 86% of investment during the T2 period is associated with projects in the early stages of development that have estimates based on the Cost Book that have been derived from internal historical benchmarks. For further details on the Cost Book see chapter 14 *Our total costs and how we provide value for money*; 12% of investments have had detailed design work completed and a bottom-up cost estimate made but are not yet in delivery; and 2% are already in delivery.

Figure 8.12 – % of total T2 spend by development stage

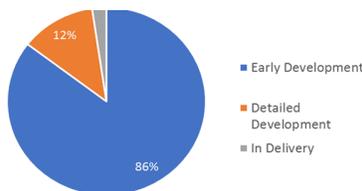


Table 8.13 Baseline: Proposed baseline expenditure for demand connections in the T2 period

Investment type	T2 infrastructure costs (£m)	T2 sole user connection costs (£m) *	Output – No. of SGT
DNO demand	88.1	51.7	■
Connecting non-DNO customers	1.0	0.9**	■
Total	89.1	52.6	■

*costs relate to demand assets installed solely for and only capable of use by an individual user. These costs are recovered through connection charges which are treated as an excluded service within the regulatory framework.

** We anticipate £1.3m of capital contribution that is paid directly by customers which has been netted off the connection costs.

iii) Driving efficiency and better outcomes through better collaboration, whole system solutions, competition and innovation in the T2 period

Proposal for a combined Network Access Policy (NAP) framework through better collaboration

The Network Access Policy will supplement the STC procedures already in place for outage planning and data sharing. It is valuable to have a policy in place to promote flexibility in both the TO and ESO with the joint focus of delivering greater overall consumer value.

We have been working with the other TOs, the ESO and customers in creating a single NAP that will promote all parties to retain focus on consumer value via the NAP forum, we propose the following:

- Performance of the Network Access Policy to be governed by a joint forum across TOs, NGESO and Ofgem (annual circulation of Chair between TOs).
- Same forum to be used for sharing of best practice and lessons learned.
- The Network Access Policy should be reviewed at least every 2 years based on lessons learned and improvements.
- Agree the content of the roles and responsibilities of a joint NAP with the other TOs and ESO before the start of T2 period.
- Creating metrics that have been advocated by our customers to ensure transparency and our impact on end consumers.
- A transformational proposal to complement the Network Access Policy which can be found in annex NGET_A7-8.03 whole system (SO-TO Optimisation mechanism).

Annex NGET_A8.04 Network Access Policy (NAP) provides further details on how we will approach delivering greater value for end consumers that go beyond our current licence obligation. This annex includes a set of metrics which we have created in collaboration with the ESO and the other TOs to feed in our customers' needs. In the foreword of this annex we have included details of the customer and stakeholder engagement we've completed in the T1 period to enhance the Network Access Policy, how we are going to continue to develop and enhance the proposed Network Access Policy through further stakeholder engagement and the development timeline.

Greater collaboration and co-ordination is driving better whole system outcomes

The growing trend for decentralised generation can present fault level challenges at Grid Supply Points (GSPs) where we retain ownership of lower voltage assets (e.g. 132kV) and this is another key driver of our investment plan.



Fault levels exceeding the rating of substation assets present a physical safety risk as well as a risk to security of supply. The default investment solution to resolve this would be to replace the equipment that has reached its maximum capability with higher rated equipment. In some cases, this continues to be the most effective, and the only potential solution. However, we have increasingly been looking to find a better way by working with DNOs, evident in the A7-8_Engagement Log (Whole system – DNO&ESO) and the ESO to determine if any non-build options can resolve fault level issues. These could include, for example, changes to running arrangements in either the transmission or distribution system.

Our analysis identified a potential requirement to invest £105m through the T2 period on low voltage substation re-builds due to higher fault levels associated with distributed generation. This requirement was included in the first draft of our business plan, which we discussed with DNOs. Through our collaboration and coordination with the DNOs, we have removed these costs from our baseline proposals and will develop a new uncertainty mechanism to cover substation re-build costs we might incur if a transmission investment is later confirmed to

be the best solution for consumers Further detail is available in annex NGET_ET.12 Uncertainty mechanisms.

Removing these investments from our baseline allows us to work with relevant DNOs and the ESO, as more information becomes available, to determine what is needed and who is best to deliver to the overall benefit of consumers. An uncertainty mechanism facilitates this flexibility.

Whilst alternative running arrangements can be effective, they normally represent a move towards a more complex network operating condition and can restrict capacity for further connections and increase future network access costs. If more distributed generation customers connect, the fault levels limits could be exceeded, and investment may be triggered.

Projects meeting OFGEM’s competition criteria

There are no projects that meet the >£100m threshold for late competition. Based on the criteria for early competition (high value >£50m, are the network requirements new and separable, how time critical are the requirements, the certainty of need and opportunity for innovation), we have undertaken an assessment to determine whether any connection projects would be subject to competition, and have identified two projects that would initially meet the >£50m criteria; King’s Lynn B and East Anglia (1N-2). However, upon further review we have determined that neither of these projects would be suitable for early competition as outlined in table 8.14 below, further information can be found on the competition criteria in chapter 7 *We will enable the ongoing transition to the energy system of the future.*

Table 8.14 – Competition assessment against Ofgem’s competition criteria

Project Name	Project Cost (£m)	Finish Date	New and Sep.	Time criticality	Certainty of need	Scope to innovate	Comments	Suitability for competition against our criteria					
								Limited suitability	○	◐	◑	●	High suitability
Kings Lynn	█	2023	○	○	◐	◑	The project development for King’s Lynn B, including gaining a Development Consent Order (DCO) for the new overhead line is complete. There is therefore little scope for innovation or in delivering an alternative solution which may lead to cost savings. Furthermore, King’s Lynn is currently contracted for a 2023 connection (dependant on gaining market capacity) and in order to achieve this date, National Grid would be seeking to approach the market for substation and overhead line proposals by February 2020. Running a competition to first appoint a TO would impact on these dates.						
East Anglia (1N-2)	█	2027	○	◐	◑	◑	The East Anglia (1N-2) project is required to accommodate several new connectees, including offshore wind and interconnectors, and the design and layout is linked to the capacity and timing of each of the connections. Should any projects change their required capacity or terminate, the design would feasibly need to change to account for this. Due to the design complexities and potential variability, and the number of customers and stakeholders involved, we do not believe that this project would be suitable for competition.						

Innovation and efficiency

We have embedded innovation developed in the T1 period into our T2 plans and will continue to connect smaller customers using the tertiary connection approach in the T2 period, whilst innovating to meet the needs of our current and future customers, this will on average will **save £3.2m per connection** compared to the previous transmission solution, passing on **£42m of cost saving** to consumers in our T2 plan for this

priority. In chapter 14 *Our total costs and how we provide value for money* we outline how over the last 6 years our current cost base has been market tested via competitive tender, and benchmarked internally and externally. We are also making stretching commitments to future efficiencies by moving our benchmarked capex unit costs to be at or below the TNEI industry mean equating to an **£14.9m reduction** in this stakeholder priority. We have also applied a **£3.4m productivity**



commitment to improve the productivity of our people by 1.1% year on year.

iv) Delivering the right systems and products to deliver the CX strategy

Our customer experience ambition

Our customers have told us that to achieve our vision of exceeding their expectations, we must listen, understand and consistently anticipate and deliver against their needs. When we do this well they will feel as though they are ‘treated like a partner’ – this is our UK customer ambition and forms the basis of our UK Customer Strategy to become a customer centric organisation.

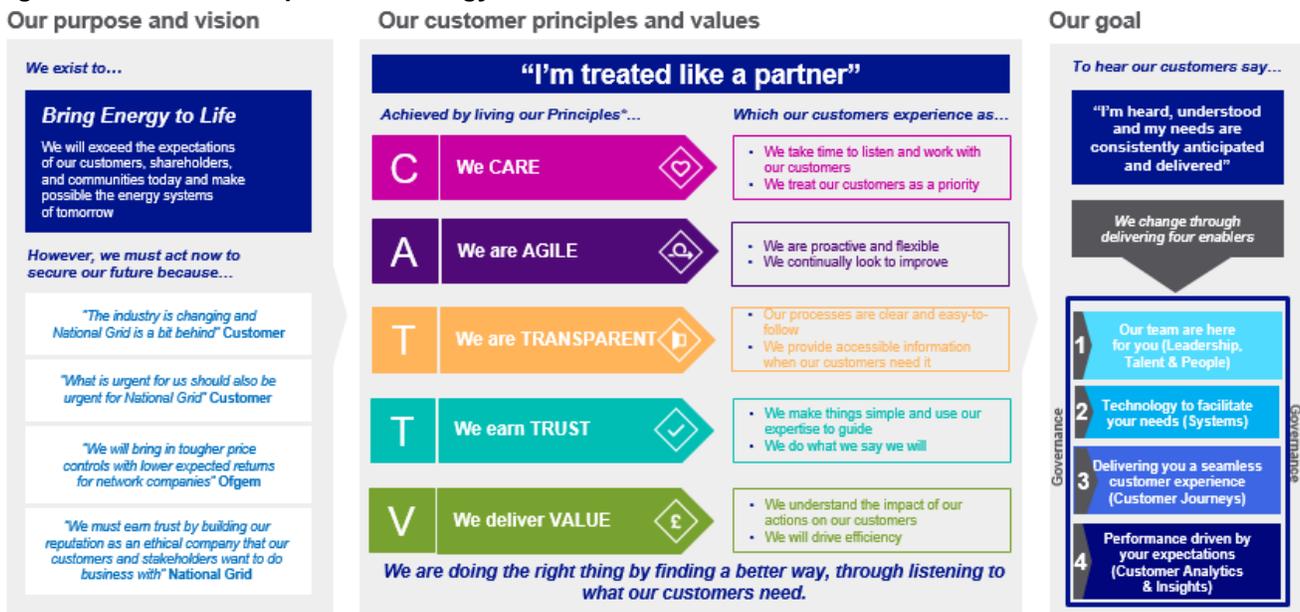
Our principle: The how

The behaviour and experience our customers see defining this partnership are outlined within our principles: that we **care**, we are **agile**, we are **transparent**, we earn **trust** and deliver **value**. These

customer principles were derived by exploring the drivers behind low satisfaction and net promoter scores. This customer commentary and insight show five key pain points from the customer’s perspective (a lack of trust, transparency, listening, agility and understanding the impact our actions had on their business). Our customer principles directly address their pain points and form the bedrock by which we create and test our customer experience.

The Customer Experience Strategy, including our ambition, our principles, a multiyear roadmap that extends into the T2 period and an agile delivery approach, provides a clear and measurable way to ensure we focus on those activities that deliver the most value to our customers. By living by our customer principles and working in partnerships, we want to ultimately hear our customers say... “I’m heard, understood and my needs are consistently anticipated and delivered”. Our CX Strategy is summarised in figure 8.15.

Figure 8.15 Customer experience strategy



IT investment

In order to deliver an increased workload in an efficient way, we need to invest in our systems, not just our people.

Our systems need to enable a tailored approach for different customers, and our IT investments detailed in the table below will help us facilitate this. We want to give customers the choice to either communicate with us using the self-service portal or have the ability to speak to a dedicated account management team. We will be flexible in ensuring that the right number of skilled resources are available dependent on the needs of the customer to ensure effective ongoing dialogue.

The Customer Relation Management (CRM) system will allow us to manage complex, multi-touch point relationships with a vast array of customers. The need, optioneering and justification of the enhancement of the CRM system and customer portal can be found in annex NGET_A14.12 IT System Heath Replacement and annex NGET_A14.07 ET IT Investment. We summarise this in the table 8.16 below.

Our IT costs have been benchmarked by Gartner Inc, who are a global research and advisory firm providing insights, advice, and tools for businesses. This report



demonstrates our investments are in line with the expected range.

Table 8.16 Baseline: Proposed IT investment in the T2 period

Investment area	Description	T2 costs (£m)
CRM system for connecting customers:	In the T2 period, our CRM system will underpin how we manage our entire customer connection process . We will need to invest to include more parts of the journey within the CRM system, we will use the customer insights and data to make sure we can offer a more tailored, bespoke and flexible end-to-end service to different types of our customers. Our research and recent feedback has found the CRM system to be the most efficient and effective way to manage customer data and processes. The CRM system will also underpin our website and proposed customer portal investments.	5.0
CRM system for non-connection customers	There are areas of our business that interact with customers outside of the connection process, such as asset protection, the transmission network control centre (TNCC), outages and land management. Each type of customer expects a different service and experience from us. This investment is to bring these interactions into the CRM system so that we can provide a more complete customer experience, this is as a result of direct feedback from our customers.	2.5
Customer Portal - Self-service website for connecting customers	This investment will improve our customer experience with a self-service website. The portal will provide customers with a digital channel to apply/manage and interact with National Grid – streamlining interactions with National Grid, allowing customers to self-serve for elements of the connections process and customers will be able to use the functionality to design their own connection. This is in direct response to customers identifying multiple frictions with the existing connections process e.g. customers find the process of managing connections too manual and applying for a connection is inefficient and hard to understand.	2.4

v) Delivering connections quicker in the T2 period and tailoring to deliver the needs of our customers

To ensure that we provide different approaches to different customer segments, we have already restructured the organisation to achieve a multi-**disciplinary sector-based** connections team, so our colleagues can expertly support different types of customers with different needs.

For our smaller and new connection customers in the T2 period, we will **expertly support our customers** by providing additional services to help them connect quicker, these services will be:

- creating a pre-application support framework so that we can provide early guidance for potential customers, ensuring we have the right balance of resources/specialists that supports the need of the customer
- working closely with our customers to identify suitable locations for their projects where capacity is available, such that their connection can be accommodated
- providing customers with choices and options for the design, timescales and costs of their projects by collaborating with the DNOs
- use our expertise and learning from the T1 period to make improvements to the lead time to achieve consent.

We recognise that different approaches are required to deal with these different types of customers. To ensure that we are setting ourselves up to deliver for these customers in the most effective manner, and as part of our focus on the customer connections journey in the T1 period, we have an ongoing piece of work in this area that has highlighted the potential benefits of standardisation for smaller projects. This is something we will continue to investigate and we will ensure we incorporate any learnings into our approach in the T2 period. The ability to connect smaller low carbon generators will help the nation as we head towards a net-zero carbon emissions target.

We will also deliver a seamless customer experience by different customer type by using customer insights and analytics via the CRM system and our continuation of work through the customer journey to evolve and adapt our products and services to meet the needs of different types of customers.

vi) Our commitment and targets for the T2 period

The following ODIs have been developed to improve on aspects that are important to our customers, different connection customers want different things from us: lower connection costs, quicker connection dates or connection dates closer to their preferences in response to this we have created. These ODIs have been tested and shaped with stakeholders’ feedback, further details on how these ODIs will work can be found in annex NGET_ET.06 Output Delivery Incentives.



Table 8.17 Output Delivery Incentives

LO/ODI commitment	Descriptor	T2 target
Timely connection offers	Ensure connection offers are made to the customer within the agreed timescales set out in the industry codes.	100%
Quality of connections survey	Common ODI to measure 'moments that matter' via a survey through the customer connection journey and 'post energisation' journey.	Target will be agreed once the pilot survey is completed.
Outage management	To improve customers' experience of outages saving them time and cost. This would allow our customers to lower costs and provide better services for end consumers. Note: If Ofgem covers all our customers affected by outages in its common ODI, we would expect to withdraw this proposal.	We propose a target, for all our customers and stakeholders affected by outages, that starts at 7.7 in 2021-22 increasing to 7.9 in 2025-25. The target starts at a score 0.1 above our average performance in the three most recent years. The target ends at a score that is the highest score we have ever achieved. Customer expectations tend to increase over time so the same score becomes harder to achieve each year.
Accelerating low carbon connections	The purpose of this ODI is to encourage us to deliver connection earlier to get new generation onto our network clearly bringing forward the benefits of low-carbon generation and more competition in the wholesale electricity market. This ODI help supports the drive towards achieving the UK's target of net-zero greenhouse gas emissions by 2050.	We are proposing two different ways of setting the target for new and existing customers: <ul style="list-style-type: none"> • <u>Existing customers</u>: we propose that for customers with existing contracts the baseline for this ODI is the date in the contract. • <u>New customers</u>: we propose that the target is based on the common energy scenario average delivery time for generation connections of approximately 64 months, which might need adjusting for the particular type of customer.

Our commitment to reducing sole use connection costs

For our customers that would like certainty in their connection costs, they can choose the fixed option that currently exists. For those customers who would like reduced connection cost, we would like to be incentivised to reduce the connection costs and share the risk. In order to facilitate this proposal, we will need to make some changes to the existing frameworks and work with Ofgem to create a unit cost allowance for the sole enabling elements because this will ensure the incentives uses a fair baseline is set. The incentive will be to deliver the sole enabling works lower than the UCA. We will align the sharing factor based on Ofgem's TIM as we believe this would be adequate for the risk that we will bear.

We would like to move the connection cost element, which are currently part of the excluded services into the main price control and extend the totex incentive mechanism to accommodate this.

5.2 Our proposal to make a step change in improving the system access experience

We have to take parts of the network out of service from time to time to maintain, improve and replace ageing assets. These 'outages' allow us to provide a good-quality service to all our customers in the long term through ensuring the reliability and health of the transmission system. Whilst this may cause short-term disruption it is essential to allow works to be carried out safely.



We are already acting on our customers' feedback. We are currently producing detailed outage and resource plans for the remainder of the T1 period. We are bundling work where possible to optimise system access and reduce disruption for our customers. We have identified Customer Ambassadors to be responsible for maintaining a good working relationship with our customers, listening to and acting on feedback and being a single point of contact for our customers. The Customer Ambassador initiative is focussed on driving quick improvements where needed and will measure how we are doing.

For the T2 period, we have undertaken a build of our outage plan. We are identifying the opportunities and risks to actively manage some of the future uncertainties for our projects and how we can minimise disruption for our customers. Our approach to planning outages is that we produce long-term plans that develop into more detailed plans at the year ahead of delivery, when there is greater



certainty about the work we will need to carry out. We then manage changes with stakeholders as we build the year ahead plan and through the within-year change control processes. Our ambition is to design and implement an improved outage experience for our customers linked to our processes and system requirements. We are already developing a set of customer metrics that we will use to provide greater transparency for our customers about outages and that will enable us to improve how we manage outages.

We are looking at ways to provide greater visibility of outages and reduce the changes that occur to minimise the implications that changes to outages have for customers. Using the insight from our Customer Ambassadors' engagement, we will ensure we build a shared view of which works matter most to our customers. We are aiming to make sure we carry out our annual outage plan with minimal customer impact and that we communicate our plan and any changes to it in line with our customers' expectations.

Our approach to managing system access is directly linked to our work on whole system thinking. This is because we will be coordinating our work more closely with DNOs, generators, directly-connected customers and other parties connected to the transmission system to minimise the cost to consumers. In chapter 7 *We will enable the ongoing transition to the energy system of the future* section 5.3, we talk about our proposal to optimise across the network owner/system operator interface.

We are working with Ofgem and others to extend the connection quality survey ODI to include the satisfaction of our customers with their outage experiences. Further details on this ODI can be seen in annex NGET_ET.06 Output Delivery Incentives.

5.3 Our proposal to improve the stability and predictability of our charges

There are two elements to charges for customers:

1. Connection charges – these charges relate to assets installed solely for, and only capable of use by an individual user and are treated as excluded services within the regulatory framework.
2. Transmission Network Use of System (TNUoS) charges – these charges recover the costs of installing and maintaining the electricity transmission system that serves all network users.

We recognise that changes to our charges can have an impact on customers. There are several reasons why charges can change, but most of the volatility in network charges arises from the methodology used to calculate them, as set out in the Connection and Use of System Code (CUSC). As with other Transmission Owners, NGET is not a party to this code and therefore is unable to propose changes. We have

proposals to improve stability (and therefore certainty) of charges, and the transparency of these, for the elements that we are able to influence. However, we do have ideas on how the price control framework can be improved to reduce the volatility of our revenue and therefore charges.

i) Improving how our charges reflect our costs

To improve the cost reflectivity of our charges, we are looking to improve the design of the existing uncertainty mechanisms, in particular the unit cost allowances that adjust the amount of money we can recover from or must return to our customers to reflect the work we must carry out. We want to make these more reflective of our costs. To achieve this, we are carrying out a detailed review of the triggers of infrastructure costs and are using the results to inform alternative designs for both the generation and demand connection volume drivers. Our commitment to reducing cost for sole enabling connection costs will also support this.

ii) Improving the stability of our charges

To improve the stability of our charges, we are looking at the scope for enhancing the general design and operation of uncertainty mechanisms. Some features of the current design have meant our allowance has been unnecessarily volatile, which has created volatility in our charges. We are currently considering whether the changes uncertainty mechanisms make to our allowances should reflect changes in our best forecast of output delivery, as opposed to when output is delivered. This should help smooth the effects of the uncertainty mechanism on our charges to customers. We will work with Ofgem to take forward this approach. For further details refer to annex NGET_ET.12 Uncertainty Mechanisms.

iii) Improving the transparency of our connection charges

We will also be clearer about our connection charges in advance. If our charges are likely to change, we will discuss this with customers in advance and explain the reasons behind this. We will enable customers to view the latest information on your charges using the new customer portal. This will allow them to see and understand information about their charges, this aligned with what customers have told us as detailed in chapter 13 *We will be transparent about our performance*.

6. Our proposed costs for the T2 period

In summary, our proposed costs for delivering against our proposals for the T2 period are detailed within table 8.18, below. Further justification on how these costs have been benchmarked, and how our operational expenditure has been assessed as efficient is detailed within the chapter 14 *Our total costs and how we provide value for money*



Table 8.18 Proposed baseline costs for the T2 period***

Baseline cost	21/22	22/23	23/24	24/25	25/26	Total T2	Annual T1	Annual T2	Subject to native competition	Internal historical benchmarks	External historical benchmarks	Subject to UM
Generation connections*	30.5	29.9	34.6	82.2	67.8	245.0	86.6	49.0	✓	✓	✓	✓
Demand connections*	31.6	53.9	25.9	12.6	17.7	141.7**	81.8	28.3	✓	✓	✓	✓
IT Investment	1.7	2.4	2.4	1.7	1.7	9.9	1.3	2.0	✓	✓	✓	N/A
Opex	4.0	4.0	4.0	3.9	4.1	20.0	5.6	4.0	N/A	✓	✓	N/A
Sub total	67.8	90.2	66.9	100.4	91.3	416.6	175.3	83.3	Cost certainty: High confidence			
Pension allocation						0.7						
Total						417.3						

* includes connection costs that are treated as excluded service within the regulatory framework.

** We anticipate £1.3m of capital contribution that is paid directly by customers which has been netted off the connection costs.

***Business Plan Data Table Reference: Load related expenditure worksheets contained in section B -B0.7, B4.2a, B4.2c, B4.4b, B4.5, B4.5a, B4.6, B4.7, B4.8
IT Investment 4.3a – Non- ops capex Opex D4.5 - closely associated indirects

Figure 8.19 Expenditure profile across the T1 and T2 period

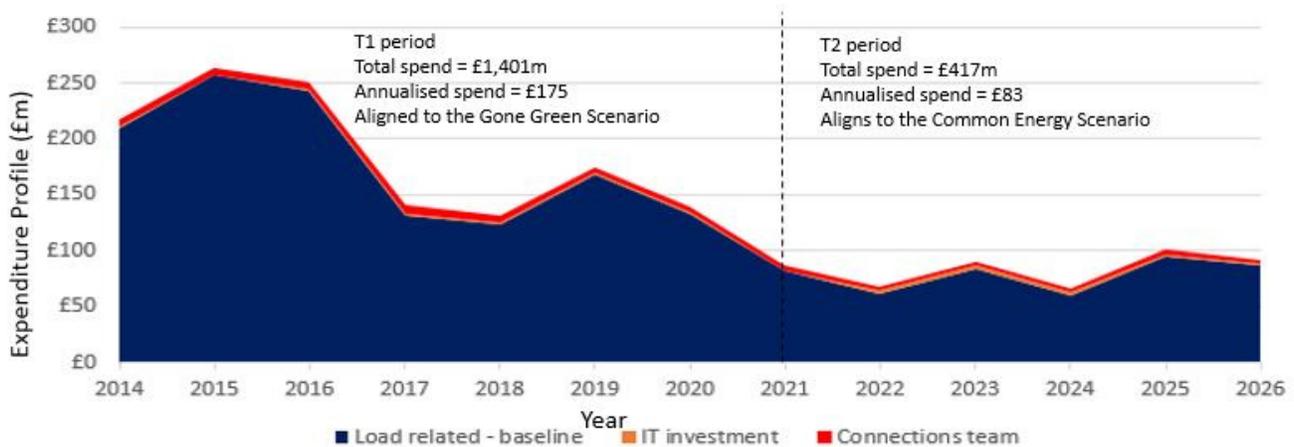


Figure 8.19 illustrates the expenditure profile for this priority over the T1 and T2 periods. Proposed annualised expenditure is 53% less in T2 than T1 (£83m vs. £175m).

7. How we will manage risk and uncertainty

We have built our plan with a focus on protecting consumers from risks in both the longer term (beyond the T2 period) and the medium term (within the T2 period).

Longer term risk: under-utilisation of assets

In the longer term, the main risk is potential under-utilisation of assets on our network. We have mitigated this through extensive analysis and stakeholder engagement, confirming the ongoing need for electricity transmission in the most highly decentralised futures. We also minimise the risk of under-utilisation of assets by ensuring each investment is accompanied by a strong need case. The signals we receive from our customers about their future requirements through the

commercial arrangements (i.e. the Connection and Use of System Code).

We protect consumers for the risk of under-utilisation of assets by holding securities for customers that intend to connect. For generation projects customers commit to paying TNUoS for a number of years, for demand connections the cost of assets are mostly collected directly from the customer through excluded services.

Medium term risk: cost and volume uncertainty in an ex-ante price control

In the medium term, one of the main risks is uncertainty over cost and volumes of work in an ex-ante price control. We mitigate this by only including the most certain costs in our baseline plan and proposing uncertainty mechanisms that allocate risk to whomever is best placed to manage it.



Our plan is consistent with the minimum values in the Energy Networks Association (ENA)'s Common Energy Scenario and therefore relies on uncertainty mechanisms to deliver for customers and enable net zero by 2050.

Consumers can best manage uncertainty about the route to net-zero emissions because the route will reflect changes in their behaviour. We are best placed to manage uncertainty over the costs of achieving the outputs consumers want because we can efficiently control our costs.

We are protecting consumers by only including the most certain costs in our baseline plan and proposing an uncertainty mechanisms that allocate risk to whomever is best placed to manage it.

Our plan is consistent with the minimum values in the Energy Networks Association (ENA)'s Common Energy Scenario and therefore relies on uncertainty mechanisms to deliver for customers and enable net-zero by 2050.

With the market continuing to rapidly evolve, the ongoing development of whole system solutions, growing system operability requirements and network competition, a more complex uncertainty landscape exists in the T2 period, requiring an evolution of the T1 approach.

In developing our proposals, we have ensured mechanisms:

- i. change our allowances if customers' needs change during the T2 period so that we can invest in the outputs they need,
- ii. allow whole system solutions to be identified and delivered during the T2 period,

- iii. retain the incentive for us to reduce our costs and share the cost savings with consumers.

We have worked with external experts to develop an enhanced suite of uncertainty mechanisms, building on the existing T1 approach of unit cost allowances and the experience of the operation of these mechanisms.

To manage uncertainty for this priority, we propose:

- re-design of the generation and demand volume driver to ensure they are in line with the observed changes in our customer base and make the unit cost allowances more cost-reflective;
- develop a new volume driver for network investment driven by embedded generation; and
- work with Ofgem to improve the uncertainty mechanisms so that they lead to smoother adjustments in our allowances and more stability in our charges to customers.

A rigorous and comprehensive econometric approach was used to develop our proposals, as shown in figure 8.20 below, which are a critical component of our overall business plan and are evidenced against Ofgem's business plan guidance criteria in table 8.21.

The detail of our analysis and proposals to manage energy supply and demand uncertainty is set out in annex NGET_ET.12 Uncertainty mechanisms, NGET_ET.12A UM Snapshot table, BPDT D.18 Bespoke Uncertainty and accompanying workbooks showing the detail of our development and statistical analysis.

Figure 8.20 Econometric approach used to develop proposals

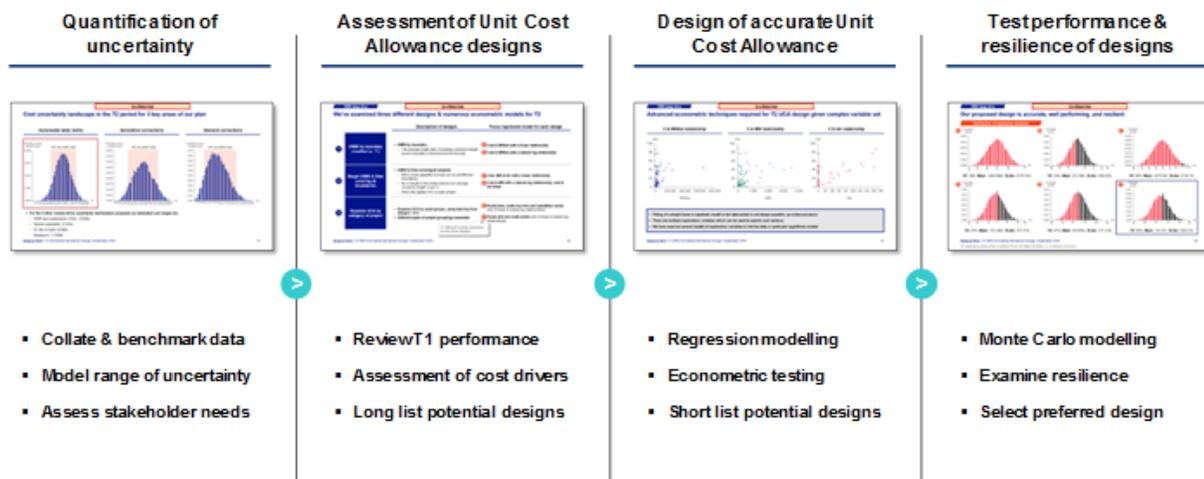
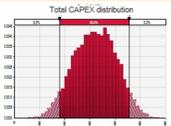
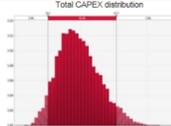
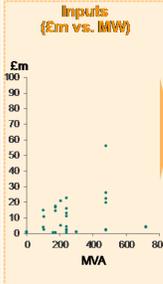




Table 8.21 Proposed uncertainty mechanisms and justification

Generation Connections – Unit Cost Allowance (UCA) – Volume Driver			Key stats:	No.
Uncertainty characteristics			Models considered	8
T1 experience and learning			Input data points (projects)	57
T2 proposals				
<p>i) Risk and ownership</p> <ul style="list-style-type: none"> Customer need and associated type of connection and extent of works are uncertain Requirement driven by changing customer activity Network company manages cost risk, whilst consumer best to manage volume risk <p>ii) Materiality</p> <ul style="list-style-type: none"> Estimated range of uncertainty is £277m (90% of the Monte Carlo simulations guided by the Future Energy Scenarios have a total cost between £178m and £455m)  <p>T2 CAPEX probability distribution (output of Monte Carlo analysis)</p> <p>iii) Frequency and probability</p> <ul style="list-style-type: none"> A minimum frequency of annually Near 100% probability of some change in future requirements 	<p>i) T1 experience</p> <ul style="list-style-type: none"> Per kW, per circuit-km UCAs – Reducing allowances by >£970m as system needs changed Substation cost volume driver UCA is not cost reflective of applications for connections capacity shift towards <100MW The overall mechanism has also not been reflective of network upgrades required beyond the connecting substation <p>ii) Learnings for T2</p> <ul style="list-style-type: none"> Mechanism should reflect evolving customer base by accommodating for: <ul style="list-style-type: none"> - smaller connection sizes - cost of beyond substation enabling - alternative connection solutions, such as tertiary winding connections A more cost-reflective UCA designed by rigorous statistical analysis would better protect consumers Revenue calculation based on latest forecast of outputs can smooth customer charges 	<p>i) Proposed approach and benefits</p> <ul style="list-style-type: none"> Separate UCA for AIS vs. GIS sites, and then further split by new and existing sites and whether the connection is above or below 100MW New UCAs are designed using established statistical techniques and stress-tested using Monte Carlo simulations to ensure accuracy and resilient UCA  <p>Proposed Design</p> <p>Substation (sub) Costs – MW connected at:</p> <ul style="list-style-type: none"> new AIS sub: £m/MW existing AIS sub <100MW: £m/MW existing AIS sub >100MW: £m/MW new GIS sub: £m/MW existing GIS sub <100MW: £m/MW existing GIS sub >100MW: £m/MW <p>Beyond Sub. Circuit Upgrade Costs - £m/circuit km</p> <ul style="list-style-type: none"> New Overhead Line Circuits - £m/circuit km New Underground Cable Circuits - £m/circuit km  <p>Mean: -£0.78m Std. Dev.: £22.98m</p> <p>ii) Drawbacks and mitigations</p> <ul style="list-style-type: none"> Additions to the mechanism outweighed by significant increase in cost-reflectivity and mitigated through providing greater clarity on which assets the UCA is covering 		

Demand Connections – Unit Cost Allowance (UCA) – Volume Driver			Key stats:	No.
Uncertainty characteristics			Models considered	9
T1 experience and learning			Input data points (projects)	33
T2 proposals				
<p>i) Risk and ownership</p> <ul style="list-style-type: none"> Customer need, associated type of connection and potential whole system alternatives are uncertain Requirement driven by changing customer activity Network company manages cost risk, whilst consumer best to manage volume risk <p>ii) Materiality</p> <ul style="list-style-type: none"> Estimated range of uncertainty is £147m (90% of the Monte Carlo simulations guided by the Future Energy Scenarios have a total cost between £54m and 201m)  <p>T2 CAPEX probability distribution (output of Monte Carlo analysis)</p> <p>iii) Frequency and probability</p> <ul style="list-style-type: none"> A minimum frequency of annually Near 100% probability of some change in future requirements 	<p>i) T1 experience</p> <ul style="list-style-type: none"> UCA per SGT and per km of OHL – reducing allowances by >£185m as system needs changed Substation UCA could have been more cost reflective of the projects delivered. It was based on shared infrastructure sites for connection; but the volume of higher cost single customers connecting has increased We delivered several connections without the need for an SGT; not triggering allowance but incurring cost <p>ii) Learnings for T2</p> <ul style="list-style-type: none"> UCA should reflect evolving customer: <ul style="list-style-type: none"> - e.g. demand from industrial facilities decline, while demand from data centres rises - reflect lower cost, innovative connection solutions, such as tertiary winding connections A more cost-reflective UCA designed through rigorous statistical analysis would better protect consumers and companies Revenue calculation based on latest forecast of outputs can smooth customer charges 	<p>i) Proposed approach and benefits</p> <ul style="list-style-type: none"> Separate UCA for connection and infrastructure sites Connection sites UCA split by new vs existing and new <50MVA Infrastructure sites UCA split SGT vs. no SGT requirement The new UCAs are designed using established statistical techniques and stress-tested using Monte Carlo simulations to ensure accuracy and resilience Revenue calculated based on latest 5-year RRP forecast of outputs in order to minimise customer charging volatility  <p>Proposed Design</p> <p>Substation (sub) costs</p> <p>Connection Projects</p> <ul style="list-style-type: none"> Capacity delivered at new subs: £m/MVA Capacity delivered at existing subs: £m/MVA Capacity delivered at new sub <50MVA: £m/SGT <p>Infrastructure Projects</p> <ul style="list-style-type: none"> New SGT delivered: £m/SGT No SGT required: £m <p>New circuit details in Annex ET.12</p>  <p>Mean: -£4.27m Std. Dev.: £22.58m</p> <p>ii) Drawbacks and mitigations</p> <ul style="list-style-type: none"> Additions to the mechanism outweighed by significant increase in cost-reflectivity and mitigated through providing greater clarity on which assets the UCA is covering 		



Embedded Generation (Low Voltage Rebuild) – Unit Cost Allowance (UCA) – Volume Driver			Key stats:																							
			Models considered	No.																						
			Input data points (projects)	12																						
Uncertainty characteristics	T1 experience and learning	T2 proposals																								
<p>i) Risk and ownership</p> <ul style="list-style-type: none"> Both system need and the most economic solution (i.e. potential transmission alternatives) uncertain Requirements driven by working with ESO & DNOs taking a whole systems view of system requirements Network company manages cost risk, whilst consumer best to manage volume risk <p>ii) Materiality</p> <ul style="list-style-type: none"> A total range of uncertainty of >£105m is estimated in the Common energy Scenarios; baseline of zero <p>iii) Frequency and probability</p> <ul style="list-style-type: none"> A minimum frequency of annual aligned DNO demand data submission 100% probability of some change in future requirements 	<p>i) T1 experience</p> <ul style="list-style-type: none"> Allowance of 9 sites for circuit breaker replacement, during the mid-point review this was updated to replace 1 circuit breaker. Taken a whole system approach with the DNOs to determine investments <p>ii) Learnings for T2</p> <ul style="list-style-type: none"> Continue to take a whole system approach when determining investment requirements UM required to give allowances when transmission has been identified as the best solution for consumers A more cost-reflective, output based UM would better protect consumers and companies 	<p>i) Proposed approach and benefits</p> <ul style="list-style-type: none"> Unit cost allowance would trigger upon completion of a whole system assessment with the DNO and identification of a transmission solution as most economic for consumers █ £m/substation for each new substation required Existing substation – █ £m/substation fixed cost allowance (bay refurbishment, database changes and substation control system) <table border="1"> <thead> <tr> <th>Bay type</th> <th>£k/circuit breaker</th> </tr> </thead> <tbody> <tr><td>LV 132kV (AIS)</td><td>█</td></tr> <tr><td>LV 132kV (GIS)</td><td>█</td></tr> <tr><td>LV 275kV (AIS)</td><td>█</td></tr> <tr><td>LV 275kV (GIS)</td><td>█</td></tr> <tr><td>HV 132kV (AIS)</td><td>█</td></tr> <tr><td>HV 132kV (GIS)</td><td>█</td></tr> <tr><td>HV 275kV (AIS)</td><td>█</td></tr> <tr><td>HV 275kV (GIS)</td><td>█</td></tr> <tr><td>HV 400kV (AIS)</td><td>█</td></tr> <tr><td>HV 400kV (GIS)</td><td>█</td></tr> </tbody> </table> <p>ii) Drawbacks and mitigations</p> <ul style="list-style-type: none"> Additional complexity mitigated by opportunity provided by automatic allowance adjustments to discover whole system solutions through the price control period, reducing costs 	Bay type	£k/circuit breaker	LV 132kV (AIS)	█	LV 132kV (GIS)	█	LV 275kV (AIS)	█	LV 275kV (GIS)	█	HV 132kV (AIS)	█	HV 132kV (GIS)	█	HV 275kV (AIS)	█	HV 275kV (GIS)	█	HV 400kV (AIS)	█	HV 400kV (GIS)	█		
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9. We will provide a safe and reliable network

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification for our proposals
6. Our proposed costs for the T2 period
7. How we will manage risk and uncertainty

What this stakeholder priority is about

Our main responsibility as a transmission owner is to ensure a safe and reliable electricity transmission network. Our network needs to be available to our customers, when they need it, to provide secure power supplies for consumers. To fulfil this role, we need to maintain high safety standards that protect our employees, contractors, stakeholders and the public. To achieve the level of reliability expected by our stakeholders, we need to keep our assets in a healthy condition. This means monitoring their condition, and intervening at the right time to maintain, refurbish or replace them.

What you have told us so far

We understand that a safe and reliable electricity transmission network is the top priority for you.

Whilst there are uncertainties in how the system may operate over the long term, even in a more decentralised world, you want us to maintain a reliable transmission network to enable future opportunities.

You have told us that, for the T2 period, you want us to maintain reliability similar to the level we currently provide. And you want it at a fair cost. You have also told us that our plans should support the future demands on the network. So the decisions we take in the short term do not limit future opportunities.

What we will deliver

We will deliver world class levels of reliability and standards of safety. **In the T2 period we will need to replace and refurbish more assets** than in the T1 period **to maintain the current level of reliability** that our stakeholders are asking for. We

will invest £4.29bn to replenish and modernise the ageing network to keep it healthy and reliable for future generations.

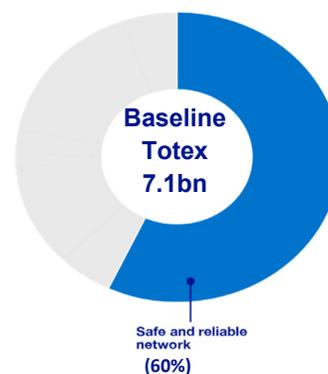
To reduce the bill impact of this increased investment, we will embed innovation

developed through the T1 period into our T2 plans, and continue to innovate utilising our advanced asset management capability. Our plan is 14% lower as a result, passing on £707m cost savings to consumers through our T2 plan, by utilising the innovation we have developed.

We will invest in operational and asset management IT systems to help us continue to make the lowest overall cost decisions into the future.

The total cost of delivering these baseline proposals is £4.29bn. This represents 60% of the overall business plan as reflected in figure 9.1.

Figure 9.1 Proportion of expenditure





1. What this stakeholder priority is about

As the electricity transmission owner in England and Wales, we are responsible for the safe and reliable operation of an extensive network of assets. Our role is to protect the public and those who work on our network, from the inherent dangers associated with providing a high voltage electricity transmission supply. We have over 14,000 circuit kilometres of overhead line, 3,000 circuit kilometres of underground cables and over 300 substations, providing the electricity stakeholders and end consumers rely on.

We ensure a safe and reliable network by:



Developing our people, to provide **advanced asset management capability**



Creating **advanced asset condition monitoring** techniques, to understand what needs to be done and when



Maintenance, repair & refurbishment of assets to ensure they operate safely



Replacement of our assets at the optimum time, to prevent network outages associated with end-of-life failures



Making sure our **central control and data support systems** are robust

Consumer value proposition (CVP)

The CVP looks at the value we are providing above Ofgem's minimum requirements that we can robustly monetise. This chapter contains the following CVP items:

- CVP4 - Tougher energy not supplied (ENS) target (value of £2.68m)

For more detail, please see chapter 5.4 and the CVP annexes ET.07 to ET.07C.

2. Track record and implications for T2

Safety is our number one priority and we are committed to the wellbeing of our staff, contractors and the public. There are inherent dangers associated with our activities, an incident on our high voltage electricity network could pose a threat to life. Our obligation is to comply with relevant health and safety legislation, monitored and enforced by the Health and Safety Executive (HSE).

We are proud of our safety track record, which is among the best in the industry (ENA Annual Safety Report 2017-

2018). Our safety record is measured by our Injury Frequency Rate (IFR). The following figure shows our performance is consistently within the 'UK Energy Industry Safety Leaders' group range of 0.04 to 0.25.

Public safety trends are also continuously improving as a result of the programmes, campaigns, risk management and control measures we have put in place.

Figure 9.2 Injury frequency rate

Year	Injury frequency rate (IFR*)
2013/14	0.16
2014/15	0.16
2015/16	0.10
2016/17	0.13
2017/18	0.12

*Injury frequency rate (IFR), counts the number of injuries sustained for every 100,000 hours worked

Costs and outputs in T1

Reliability of our network is critical to our stakeholders and end consumers, and we have delivered to a world class level in the T1 period. A measure of reliability in the **short term** is the amount of energy not supplied (ENS) in a year.

With only a few exceptions, our performance in figure 9.3 shows electricity is available whenever people need it.

Figure 9.3 Availability of network

Year	Volume of un-supplied energy (MWh)	Availability (or Reliability) of network (%)
	T1 Target = less than 316 per year	
2013/14	136	99.999950
2014/15	10	99.999996
2015/16	5	99.999998
2016/17	89	99.999964
2017/18	40	99.999984
2018/19	37	99.999984

1 megawatt hour (MWh) is roughly equivalent to the amount of energy used by 200 UK homes in a year

Delivering this level of reliability requires maintenance of our assets, to ensure they continue to operate safely and reliably, as designed. In the T1 period, we had allowances of approximately £109m per year to carry out this work. We have undertaken more work than planned, but at a cost approximately £17m per year lower than expected, reflecting significantly improved efficiency in our operating costs.

A **longer-term** measure of reliability are the levels of asset risk on our network. By 'risk' we mean how likely the asset is to fail and the potential impact of its failure. We can influence the level of risk on the network, by investing



in condition monitoring, maintenance, refurbishment and replacement of assets. Investing in this way reduces the risk to our installed assets, ensuring we can maintain a reliable supply of electricity over the long term.

Innovation in the T1 period

Our innovative culture and drive to be efficient has meant we are on track to outperform our network risk targets, whilst **saving £1.4bn compared to our allowances** (£748m saving is the consumer portion (53%) derived from the Totex Incentive Mechanism).

This has been achieved by utilising our expert asset management teams who invested in advanced condition monitoring and modelling techniques to understand end-of-life failure modes of our assets. This investment, in the early T1 period, has enabled us to reduce network risk at a reduced cost through:



New interventions: targeted asset replacement of components driving the asset risk



Life extension of assets: reducing the volume of work needed in T1 and future periods

We have also optimised how we deliver our work; for example working with our operational teams and supply chains to:



Reduce the unit cost of work required in replacing or refurbishing our assets

This provides additional reliability at a lower cost to consumers and is backed by cost benefit analysis (CBA) to show it is in the interest of consumers over the long term.

In the T1 period, over **£500m of this saving is used to avoid any impact on consumer bills.**

T1 benefits are embedded into our T2 plans

In section 5 of this chapter, we show in more detail for each asset category what innovation we have done, and how we have used this **innovation, to reduce costs** in our business plan for the T2 period. Please also refer to annex NGET_A9.04 'T1-T2 interactions for detail on deferral and advancement of work in the T1 period to manage network risk. This includes a description of life extension, implemented through these innovations, impacting a portfolio of assets. This has a significant impact on performance in the T1 period, and also reduces the volume of work required in subsequent periods. The following table shows this saving in the T1 period, split by asset category. These cost savings are 100% reflected into our baseline T2 plan.

Table 9.4 Savings in the T1 period

Category	T1 residual risk target	Target on track	Cost vs allowances (£m)
Transformers	153	✓	-277
Reactors	82	✓	
Switchgear	336	✓	-331
Cables	191	✓	-347
Conductor	4428	✓	-238
Fittings	3919	✓	

Our strategic approach is to keep network risk level over the longer term. This allows us to manage risk over the portfolio of all our assets, optimising across asset categories to lower costs. We build on this in the T2 period through the monetised risk approach (described in more detail in section 5 of this chapter).

Whole system approach

As part of our BAU approach to asset management, we are in constant contact with the Electricity System Operator (ESO) and Distribution Network Operators (DNOs) to check that our plans are aligned and deliver the best whole system solution for consumers. Examples of this relate to the ESO, where we change our construction methods, at additional cost in order to save ESO constraint costs, resulting in an overall cheaper cost for the consumer. We also carry out Joint Technical Planning Meetings (JTPMs) with each DNO at least twice a year, in order to align our work and identify efficiencies.

Learning for the T2 period

The T1 period was the first time the RIIO framework had been used, resulting in some large consumer benefits being realised, and also some areas that could be improved upon for the T2 period. Key learnings are:

- Although our safety record in the T1 period was good, we experienced a fatality in 2016. We have improved our lifting processes following our investigation into this incident.
- An output based RIIO framework incentivised networks to look for no build solutions.
- The longer 8-year T1 period enabled the development of innovations across asset portfolios, whilst delivering against output targets. These innovations have been built in to our T2 plan.
- The RIIO framework incentivised networks to optimise across operational and capital costs. Investment in asset management tools and systems supported innovations over the period.

3. What our stakeholders are telling us

We understand that a safe and reliable electricity transmission network is the top priority for you.

Whilst there are uncertainties in how the network may operate over the long term, even in a more decentralised



world, you have told us there is a role for electricity transmission.

You have told us that, for the T2 period, you want us to maintain reliability similar to the level we currently provide. And you want it at a fair cost. You have also told us that our plans should support the future demands on the network. So the decisions we take in the short term do not limit future opportunities.

Investment associated with a safe and reliable transmission network will have short and long-term impacts on the users of the network and consumer bills. In our engagement on this priority, we set out to understand what our stakeholders needed this service to be both in the T2 period and beyond.

Engagement on this topic covered the breadth of stakeholders associated with the electricity transmission system, along with business and domestic consumers. Whilst engagement questions covered were broad and have a material impact on how we build our business plans, some of the boundaries of engagement on this priority are set by our licence obligations to maintain compliance with the Security and Quality of Supply Standards (SQSS).

Through business as usual engagement, our stakeholders expect us to comply with these obligations, including safety legislation.

As the investments we make on this priority affect consumer bills in the long term, we have aligned our engagement activities with other priorities. Part of the engagement for Chapter 7 *We will enable the ongoing transition to the energy system of the future*, included the future of role of transmission. The outcomes of this engagement are relevant to this priority and stakeholders told us (see table 7.4 in chapter 7):

1. Despite uncertainty, there is a need for electricity transmission in the long term.
2. Decarbonisation, reliability and lower costs for consumers were key priorities.
3. Decisions made in the short term should not limit future opportunities.

In parallel to this engagement, we have conducted bespoke sessions with our stakeholders. We have also conducted broad engagement in conjunction with other priorities, so we can understand the ‘ranking’ of the safe and reliable priority with the others.

Based on feedback from the [Listen Report](#) and the Independent Stakeholder Group, we set out to deliver on a three-step approach when talking directly about reliability:

1. **Educate** – it is important stakeholders and consumers understand this priority; so that they can make the best-informed decision possible.
2. **Bring to Life** – helping stakeholders and consumers ‘visualise’ the topic using language they are familiar with.
3. **T2 options** – providing real options on different levels of network risk.

A summary of our engagement activities and outcomes is provided in table 9.5 below, alongside what trade-offs have been made and how stakeholders have influenced the plan. The engagement log contains detailed information on our engagement approach and outcomes. This can be found in annex NGET_A9.01 Engagement log.

Transition from NOMs to NARM

The Independent Stakeholder Group requested that we provide more information relating to the transition from NOMs to NARM, which are the changing methodologies between T1 and T2 for measuring network risk outputs.

In T1 the output for our lead assets (Transformers, switchgear, OHLs and Cables) was NOMs (Network Output Measures). This used an asset health and criticality approach to define a replacement priority for each asset (0-2 years, 2-5 years, 5-10 years and 10+ years). The NOM targets were set to maintain a volume of assets in each of these categories.

During the T1 period NARM (Network Asset Risk Metric) was developed by Ofgem in collaboration with the other network companies. NARM uses a monetised value of risk for each asset, which in simple terms is the probability of failure of that asset, multiplied by the consequence of the failure (PoF x CoF = Monetised Risk). In NARM the condition of the asset is the first step in determining the probability of failure (In T1 this was called asset health index) where the condition of our assets is updated annually.

There are a couple of terms used in this chapter:

- **R£m** = Current risk value (in millions of pounds)
- **LR£m** = Long-term risk benefit (term is the duration of the intervention)

Our T1 NOMs targets will be re-baselined as monetised risk NARM targets for the close-out of T1. Our T2 target will be the risk reduction (risk delta) we will deliver through the investments in lead assets in this chapter. Monetised Risk gives us a common currency for reliability to enable better engagement with stakeholders. Stakeholders have asked us to do more in this area, which we explain in section 3, and we propose more NARM outputs in section 4 of this chapter



Table 9.5 Summary of our engagement

Initial engagement	
Purpose and approach	<p>We carried out workshops, online consultations and surveys with academics, large customers, consumer bodies, network companies, regulatory, supply chain, consumers, governmental, small/new customers, other interest groups.</p> <p>Our aim was to understand what our stakeholders' priorities are across the breadth of the electricity transmission landscape.</p>
What stakeholders told us	<p>Two clear priorities emerged regarding what stakeholders need from us:</p> <ol style="list-style-type: none"> 1) a reliable network to provide security of supply 2) value for money. <p>Stakeholders told us reliability of the electricity transmission network, both now and in the future, is key to ensuring the required levels of security of supply. They told us we need to explore options with stakeholders in more detail, particularly regarding the cost-reliability trade-off. We are required by the HSE and other regulators to comply with all relevant safety legislation.</p>
Consumer engagement	
Purpose and approach	<p>We recognised the need to undertake more consumer research on this priority as result of:</p> <ul style="list-style-type: none"> • consumers facing cost pressures from multiple sources, not just energy bills • the priority consumers and stakeholders place on reliability, and its material size of the priority. • challenge from the Independent Stakeholder Group, promoting further consumer engagement. <p>Reliability has featured heavily in our consumer engagement, which is the most extensive consumer engagement we have carried out. We sought to:</p> <ul style="list-style-type: none"> • bring the priority to life and make it accessible through a variety of channels • offer real options for the T2 period, and understand consumers' willingness to pay or accept different levels of service. <p>We carried out workshops, online consultations, surveys, research (qualitative, cultural and attitudinal), acceptability testing, online interactive tools covering domestic consumers, business consumers, and members of the public (targeted).</p>
What consumers told us	<p>Across all gas and electricity priorities, consumers clearly stated:</p> <ul style="list-style-type: none"> • maintaining and developing a reliable network was their number one priority. • consumers were willing to pay (WTP) the most for this area of the plan. <p>In terms of WTP for specific levels of reliability:</p> <ul style="list-style-type: none"> • consumers showed a willingness to pay extra on their bill to reduce the risk of powercuts. <p>In our October acceptability testing, we asked if it is acceptable for bills to go up a small amount if it is efficient? The view across the groups was that it was not worth the risk of keeping bills flat. The general consensus was that keeping bills flat would be less acceptable than the proposed plan for electricity transmission.</p>
Stakeholder engagement	
Purpose and approach	<p>We carried out workshops, online consultations, surveys, bi-laterals, bespoke sessions, consultation document, and webinars. We covered a broad range of stakeholders, including Ofgem, academics, large customers, consumer bodies, network companies, DNOs, supply chain, governmental, small/new customers, and other interest groups (incl Energy UK).</p> <p>Based on feedback from the Independent Stakeholder Group, our engagement approach for the safe and reliable priority has been more in depth and far reaching than we have conducted before. We have moved engagement from a predominantly inform approach previously to a consult, involve and collaborate approach which will be used for ongoing engagement.</p> <p>Desired outcomes from this engagement were to:</p> <ul style="list-style-type: none"> • inform stakeholders on the interactions between our safety and asset management approach; and the impact on services they receive • gather stakeholder views on priorities and investment options we could take to manage reliability over the short and long term • conclude what price control framework targets and business plan investments we should deliver from the insights gained.



<p>What stakeholders told us</p>	<p>In terms of informing/educating, stakeholder polling stated:</p> <ul style="list-style-type: none"> • 76% agreed the decisions we make in the T2 period will impact the long-term network reliability. • 75% agreed that the measures provided a sufficiently broad representation of reliability. • They had improved understanding of transmission reliability and were interested in further topics. <p>In terms of how we should build our business plans, stakeholders stated:</p> <ul style="list-style-type: none"> • In all scenarios, there is a future need for a reliable electricity network. • We should take account of specific local forecasts, sensitivities and projects. • We should maintain the network risk position over the T2 period. • For non-lead assets we should consider extending our monetised risk approach to a wider range of asset types (i.e. non-lead assets), and agreed with our targeted approach as long as it did not limit future system requirements. • We should ensure that short term decisions do not limit future growth. • Investment decisions should be subject to a whole system assessment.
<p>Key trade-offs and how engagement influenced our plans</p>	<p>Reliability level feedback:</p> <ul style="list-style-type: none"> • While the majority of stakeholders agree that reliability levels should not deteriorate, there are mixed views on whether reliability levels should be maintained or improved. • Whilst stakeholders agreed on an increasing dependency on electricity and a need for electricity transmission, there were different views on the impact of a decentralised network. • The majority of consumers (54%) want to maintain transmission reliability, and 33% wanted to see reliability increase, 9% wanted to reduce costs even if it reduced reliability, 5% didn't know. <p>Investment proposal feedback:</p> <ul style="list-style-type: none"> • 90% of stakeholders polled through recent engagement supported the output of our July plan, to maintain network risk levels despite an increased cost. 10% wanted to see more granularity in how we had optimised the plan and embedded innovation. • The majority of consumers (57%) supported the proposed investments to maintain network risk. For those not supportive; 19% wanted more context, 13% said affordability of the bill was the issue, and 4% did not think the investment was needed. (7% didn't know). <p>Influence on our plans:</p> <ul style="list-style-type: none"> • The plan will aim to maintain network risk through investment in assets, to avoid costs associated with increasing reliability further. • This approach balances stakeholder views on levels of reliability, and delays investment to reduce network risk further than today's levels. By investing now to maintain risk, flexibility is enabled as we develop future networks, including decentralisation. • Used the feedback received to continuously challenge our investment options, resulting in a plan reduction (-2%) between July and October, through investment timing and scope changes. We have also challenged ourselves hard on costs, resulting in stretching efficiency commitments. • We will also monitor uncertainty during the T2 period, changing our approach to ensure our refurbishment strategies are flexible so they do not limit system development. • The T2 plan balances views on the future, to keep options open for a variety of possible futures. • For those stakeholders and consumers who wanted to see reliability increase, there was a trade-off between affordability and reliability to be made. The proposal to create a tougher target for ENS in the T2 period, whilst maintaining proposed spend, was deemed by our stakeholders to achieve the right balance.
<p>How we've responded to the Independent Stakeholder Group and Challenge Group</p>	<p>Independent Stakeholder Group influence:</p> <ul style="list-style-type: none"> • Who and how we engage. Moved from predominantly inform for this priority, to a consult, involve, collaborate approach which will be used for ongoing engagement. • Challenge and insight enabled broadening scope and reach of consumer and stakeholder engagement, resulting in a rich set of feedback from multiple engagement channels. • Simpler more accessible and transparent narrative now included in our business plan. <p>RIIO-2 Challenge Group influence:</p> <ul style="list-style-type: none"> • Requests for analysis of low totex scenarios, defining further outputs, and cost and volume interactions between periods has helped us improve the analysis and commitments in the business plan and supporting Investment Decision Packs. • Challenge on options (including timing), leading to the plan reduction post July (-2%).



4. Our proposals for the T2 period

The table below outlines how what our stakeholders are telling us links to the proposals we are making and the consumer benefits.

Table 9.6 Our proposals for the T2 period

Stakeholder Feedback	Our proposals	Output type	Target	T2 Baseline Cost (£m)	Consumer benefit
Comply with all relevant safety legislation	Maintain our safety standards, aiming for zero harm to our employees, contractors, stakeholders and the public	Commitment	Injury frequency rate reduced from 0.12 towards zero	n/a	Protected from potential harm relating to the work we carry out on our assets
<p>Safety is, and will continue to be, our top priority. We are committed to maintaining our safety standards, aiming for zero harm to our employees, contractors, stakeholders and the public. We want to further improve our safety record, to reduce the likelihood of anyone being injured by our activities. In our goal for zero harm we will:</p> <ul style="list-style-type: none"> • simplify and improve work procedures • create new processes to embed learning from near misses • ensure work is always resourced with the right qualified staff • improve our public safety metrics, assurance, transparency & sharing of best practice. <p>Our future safety performance is underpinned by the culture of our organisation and the behaviours of our people. We are committed to embedding a culture for the T2 period where:</p> <ul style="list-style-type: none"> • high standards are set and we strive to exceed them • failure is used to improve not to blame • management knows what is really going on because the workforce tells them • people are trying to be well informed because it prepares them for the unexpected. 					
Stakeholder Feedback	Our proposals	Output type	Target	T2 Baseline Cost (£m)	Consumer benefit
Maintain levels of reliability, at an affordable cost. Recent Energy Not Supplied (ENS) performance should be weighted more heavily than long-term performance	Create a tougher T2 target for ENS which more heavily weights recent performance Independent Stakeholder Group to provide independent challenge throughout the T2 period NGET_A9.10 ENS Incentive ⁷ includes detail on how stakeholders have proposed the T2 target	ODI	<i>T1 target was 316MWh</i> ENS target Weight performance 50% (0-5 yrs.) 30% (5-15 yrs.) 20% (15+ yrs.) ~175MWh p.a. based on recent performance Collar: 3% revenue Cap: Natural	n/a	World class levels of reliability Maintain access to critical energy supplies when needed.
Stakeholder Feedback	Our proposals	Output type	Target	T2 Baseline Cost (£m)	Consumer benefit
Maintain levels of network risk, at an affordable cost Ensure short-term decisions do not limit future system opportunities	We will maintain our network risk position through condition monitoring, maintenance, repair, refurbishment and replacement our assets. We will deliver this work at lowest cost (on average per unit) by embedding innovation.	PCD (NARM) <u>Lead assets</u> Conductor Fittings Transformers Reactors Switchgear Cables PCD (Other)* Non- lead *Commitment areas below	<i>No comparable target for T1 as NARM is a new methodology</i> Delta risk target 1,267 LR£m (Long-term risk benefit of T2 Interventions)	2,251	Long term reliability, at a lower cost, for current and future consumers Modernisation of the network to support decarbonisation, through the renewal of assets



Non-lead asset outputs				
<p>We are committing to deliver more outputs in the T2 period than in the T1 period, creating more certainty and transparency. For the T2 period, we are proposing more outputs for our non-lead areas. Along with NARM, this will provide coverage for over 80% of our plan for this priority. We are committing to develop NARM outputs for the following non-lead areas, to be set early in the T2 period, with an interim reporting volume also identified where appropriate. The costs below are for these outputs only, total costs are in table 9.10. *Please note definition of site is to be agreed.</p>				
Non-lead asset outputs		Price control deliverable (Output)	Cost (£m)	Interim reporting
Substation	Instrument transformers	NARM (We will develop for the T2 period)	327	151 sites*
	Through-wall bushings			24 sites
	Bays			161 sites
	Protection & control	NARM (We will develop for the T2 period)	489	█ units
Circuits	OHL steelwork replacement	Bespoke Equivalent Tonnes = █t	53	N/A
	OHL steelwork refurbishment	Bespoke Equivalent Area = █km ²	92	N/A
	Cable tunnel	*Ringfenced (NARM category A3)	407	N/A

5. The justification of our proposals

Our proposals will be delivered by the investments that have been outlined in this section. These are underpinned by investment decision packs which include engineering justification reports and cost benefit analysis. We have assessed these investments to be the most economic and efficient.

Key driver: Our stakeholders have told us that they want us to maintain current levels of reliability in the T2 period.

There are two main cost categories to deliver our proposals in this priority: (1) Operational costs and (2) Capital asset intervention costs. We have operational costs to maintain our assets, to ensure they remain operable and can reach their expected asset life. Our field-force of over 1,000 technicians and engineers monitor and maintain our network and respond to faults 365 days a year. Our asset base is growing, along with a rapid and complex transformation of technologies being utilised across the energy sector. This impacts the amount and type of maintenance we need to carry out.

In the T2 period, we **considered options** to reduce the cost impact of this requirement. We will deliver at a lower unit cost, through:

- standardisation and continuous improvement of repeatable maintenance tasks
- optimised work delivery for operational staff between operational maintenance work, and capital work in the replacement and refurbishment of assets
- implementing new ways of working, allowing staff to be more flexible and mobile
- enabling operational teams through our IT systems.

There are also other operational costs required to maintain a safe and reliable network. This includes training and resourcing our asset management teams who operate and maintain the network. Table 9.7 shows a summary of operational costs in the T2 period. These are reducing by 16% compared to the T1 period, despite the required increase in work required. Please see annex NGET_A14.17 Total Opex for a detailed T1 to T2 cost comparison

Table 9.7 Proposed operational costs for the T2 period

Maintenance category	Description	T2 Cost (£m)	T2 vs T1
Inspections	Asset and site inspections	█	-16%
Repairs & Maintenance	Maintain assets in line with policy & repair of components	█	
Vegetation Management	Control vegetation around our assets	█	
Civils & Safety	Maintain safe infrastructure on our sites	█	
Total		505	
Support category	Description	T2 Cost	
Health, Safety & Environment	The team that define and implement our policy	2	
Engineering support	Our asset management and engineering teams	141	
Operational training	Training for operational engineering teams	62	
Operational IT & telecoms	Service agreements and running costs	49	
Vehicles & transport	To operate and maintain the network	0	
Total		254	



To enable a clean and reliable network for future consumers over the **longer term**, a different approach to managing reliability is required. Large parts of the high voltage electricity network in England and Wales were built in the 1960s and 1970s. Whilst these assets will have been regularly maintained, inevitably some have reached their end of useful life on the network. Data collected from advanced condition monitoring of our assets throughout their operational lives, informs how their condition deteriorates over time.

To understand which assets should be prioritised for the T2 period, we have used an improved asset risk methodology. This new methodology has been developed over the last three years with our stakeholders and is approved by Ofgem. It ensures the right long-term decisions are made to manage overall network risk at the lowest cost.

The methodology calculates the **probability** of failure and **consequence** of failure of our 'lead' assets. Lead assets are the primary assets on our network. They are the assets that carry the current over long distances, transform the voltage between our network and customers and that break the current during faults or switching. Our approach for 'non-lead' assets follows the same asset management principles; understand the probability and consequence associated with failure of assets.

We have followed a process for optimisation of our plans which ensures the outputs from our stakeholder engagement flows through into the targets we are trying to meet, and hence the amount of work that we need to do.

Figure 9.8 explains the stages of creating a business plan using monetised risk. By following this process, we can align the plan to deliver what our stakeholders want, to **maintain our overall reliability** in the T2 period.

Figure 9.8 Creating a business plan using monetised risk



Options considered

We have built the plan not only to maintain overall network risk, but also to maintain risk within each of our asset categories. Accepting higher risk for asset categories may not result in lower reliability in the short-term; however, over the long term it can become unrecoverable.

The figure below provides an example of how we were able to optimise the plan to manage risk associated with our overhead lines. We can replace the fittings (or

'connections') of our overhead lines, without replacing the main conductor that carries the current. By reviewing the risk associated with each component, and using the new methodology to compare them, we can understand the effect a change in the volumes of fittings and conductor replacements has on overall risk and overall cost. Please see annex NGET_A9.20 NLR Plan Build' for further detail how we have built the plan including consideration of trade-offs between asset classes.

Figure 9.9 Creating a business plan using monetised risk

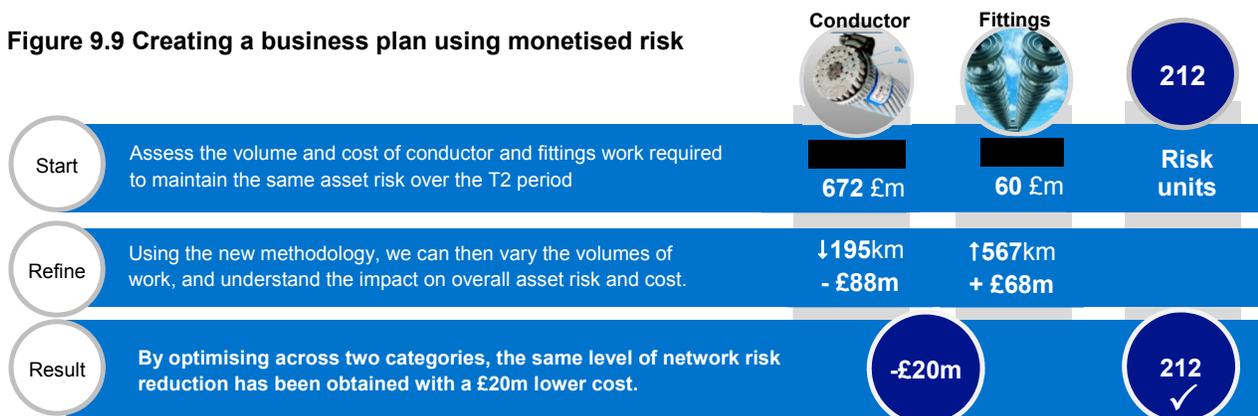
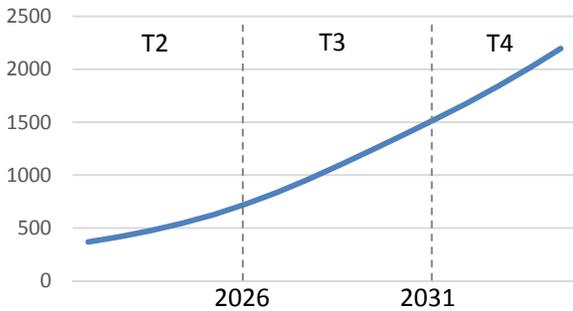




Figure 9.10 network risk (R£m) over time with no intervention



This figure demonstrates the importance of viewing asset risk over the long term, as decisions we take in the T2 period affect the reliability levels we are able to achieve in the future. For example, delaying intervention and increasing risk in the short term, requires even more work in the future if you wanted to recover network risk back to today's levels. How much work we are able to deliver in any given period is limited by resource, the supply chain and the availability of outages whilst managing the supply of energy.

In the T2 period, we will need to replace and refurbish more assets than in the T1 period to maintain the current level of reliability that our stakeholders are asking for.

Our OHL network was not installed gradually, but in peaks, over half of this in the 1960s. This creates the need for increases in intervention volumes for certain asset types depending on their original installation date and expected technical life.

Over the past 25 years, we have reduced the peak in this profile through better understanding of the deterioration of our assets, ensuring we manage them to end of life and through our asset management actions such as increasing our intervention options.

We have not been able to completely flatten the profile and some 'peaks' still exist.



In the T1 period, due to the condition of our circuit breaker population, we replaced and refurbished over 1,000 assets. In the T2 period, we therefore need to do over 50% fewer interventions on circuit breakers.



We need to do more overhead line conductor and fittings in the T2 period than in the T1 period, as more of the OHL network is reaching end of life.



For protection and control, we have different technologies both reaching their end of life. Electro-mechanical protection relays (installed primarily in

the 1960s with an expected technical life of 60 years) and the first generation of computer based digital numeric protection relays (installed in the 2000s with expected technical life of 15-20 years). This increase continues into the T3 period.

We've minimised the cost of the T2 plan through whole system thinking, innovation and efficiencies.

Whole system We engaged with each DNO, whilst building our T2 plans, to identify efficiencies where our plans could be aligned. In addition, we have shared our plans with the ESO, to identify where collaboration can deliver more efficiencies. For example, on the London Power Tunnels 2 (LPT2) project, we saved £25m through coordinating with UKPN to identify the optimal solution for network replacement work in London. For the Dinorwig-Pentir cable replacement, we co-ordinated with the ESO, stakeholders and customers to undertake a cost-benefit analysis to optimise replacement of cable circuits connecting Dinorwig power station. See chapter 7 *We will enable the ongoing transition to the energy system of the future*, for more detail.

Innovation We have embedded innovation developed in the T1 period into our T2 plans, and continue to innovate utilising our advanced asset management capability. Our total plan cost for this priority is 14% lower as a result, passing on **£707m cost savings** to consumers. We also have a **stretching additional £27m** forward looking efficiency on protection & control, rolling out smart ways of working into further assets types.

Efficiency In Chapter 14 *Our total costs and how we provide value for money*, we outline how these costs benchmark against external metrics. The TNEI report (A14.02) covered 65% of our capital costs. 50% of **costs were below the industry mean**. We are making stretching commitments to future efficiencies by moving our benchmarked capex unit costs to be at or below the TNEI industry mean equating to an **£16.8m reduction** in this stakeholder priority. We have also applied a **£23.6m productivity commitment** to improve the productivity of our people by 1.1% year on year.

Cost confidence: We have a long track record of delivery of the projects detailed for this priority. We have used this experience and historic data to inform our forecasts. Following a robust process, using independently assured costs (as outlined in chapter 14), ensures this is a **high cost confidence** area. 100% of new T2 investments are covered by Investment Decision Packs, showing investments proposed are economic and efficient.



In this next section we set out our proposed volumes, costs and risk reduction to provide a safe & reliable network. Table 9.11 describes:

- a summary of overall capital costs
- how those investments deliver against the proposed risk output to maintain overall network risk

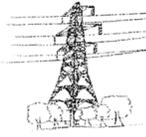
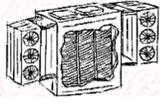
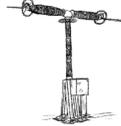
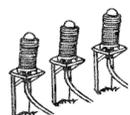
Table 9.13 compares:

- T2 average spend to T1 average spend, including justification summaries from Investment Decision Packs.

Tables 9.14 to 9.20 describe:

- a summary of the driver and options considered at an equipment category level
- whole system thinking and innovation embedded to maintain risk at optimal cost.

Table 9.11 Summary of asset category costs for the T2 period

Asset category spend (£m)						T2 cost £3.52bn
						
Overhead lines	Transformers & reactors	Switchgear	Protection & control	Underground cables & tunnels	Other equipment	IT
905	328	352	489	862	409	176
A category level breakdown of costs compared to T1 averages has been included in the next sections: Table 9.13 for overhead lines, transformers, reactors, switchgear. Table 9.17 for Protection & Control.				The nature of these projects requires granular analysis. An overview of the T2 scope is included later in this chapter, with detailed T1 comparison in the Investment Decision Packs		

Monetised Risk Target for T2 (Network Asset Risk Metric – NARM)

Our monetised risk target is informed by stakeholder engagement and cost-benefit analysis (CBA). Investment Decision Packs demonstrate how selected investment options efficiently both meet stakeholder-driven objectives and deliver sufficient net benefit for existing and future consumers. To deliver this, we will broadly maintain network risk in the T2 period at the same level as the end of the T1 period. The replacement or refurbishment of our assets is planned at the optimum time, to prevent network outages associated with end-of-life failures. Using end-of-life failure modes to build our plan provides the most efficient method of delivering consumer benefit over the long-term. The T2 NARM target will be based on the lifetime benefit of the interventions in T2 (which includes both non end-of-life and end-of-life failure modes). The non end-of-life failure modes have not yet been rigorously validated and tested across networks. We therefore propose the target will need further refinement once appropriate validation and testing has been carried out.

The risk delta for our T2 plan is £527m (EOL risk delta is £347m)
The long term benefit for our T2 plan is £1,267m (EOL long term benefit is £1,060m)

Figure 9.12 Forecast of total risk over the period without intervention, end of T2 risk and risk deltas

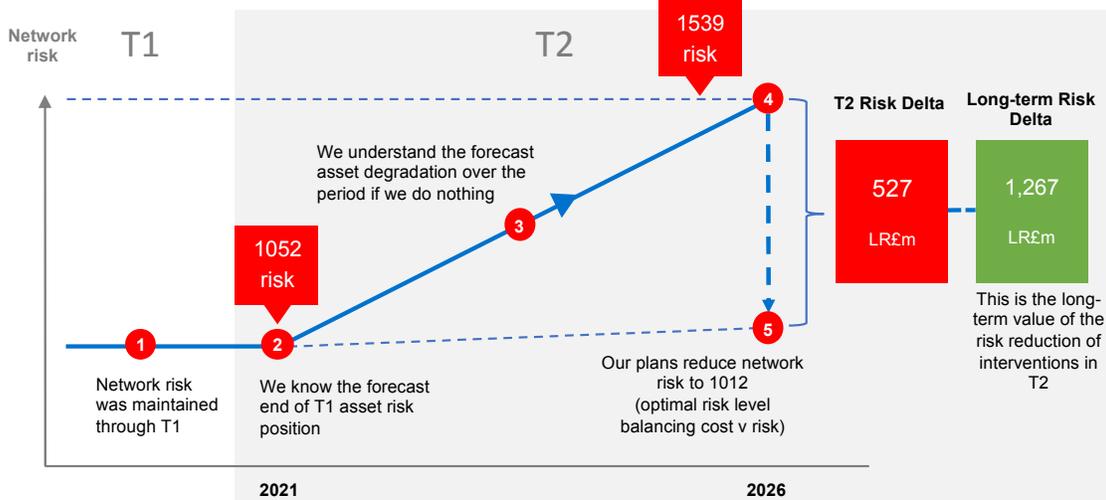


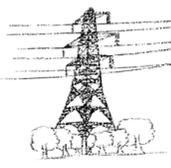
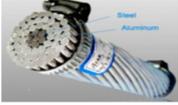


Table 9.13 Lead asset cost drivers T1 to T2

		Compared to T1 actual average (first 6 years)	
		volume	overall cost
Overhead line conductor (IDP A9.09)		↑ 48%	↑ 34%
<p>*excludes Port of Tyne</p>		<ul style="list-style-type: none"> Increased volume reflecting an ageing population and the need to do more to maintain risk. Volume impact reduced through life extension (reduced cost not shown here, see table 9.14). Unit costs are lower than the T1 period due to embedded innovations such as improved condition monitoring, delivery efficiencies & less complex urban routes. Unit costs are also lower than benchmark. We have considered 3 options – fix on fail, full replacement and partial replacement. Full replacement provides the best CBA. 	
Overhead line fittings (IDP A9.09)		↑102%	↑148%
		<ul style="list-style-type: none"> Increased volume reflecting an ageing population and the need to do more to maintain risk. Risk has been optimised across conductor & fittings saving £20m. Material decrease in cost per km of replacing fittings through T1 innovation. Unit costs are lower than benchmark. T2 costs are higher than the T1 period due to the scope of the intervention, and more urban routes (more complex access). Considered 3 options; fix on fail, full fittings and targeted fittings, with targeted offering the most economic intervention. 	
Switchgear replacement (IDP A9.03)		↓ 11%	↓ 33%
<p>*bulk schemes only</p>		<ul style="list-style-type: none"> Similar volume compared to the T1 period. Unit costs are lower than the T1 period due to the type of switchgear being replaced. Unit costs are lower than benchmark. Considered 3 options: The most efficient solution is dependent on the type of Circuit Breaker (CB) hence we have carried out 27 CBAs to cover all the different types of CB. This ensures the optimum mix of replacement and refurbishment in our plan. 	
Switchgear refurbishment (IDP A9.03)		↓ 91%	↓ 91%
<p>*bulk schemes only</p>		<ul style="list-style-type: none"> Lower volume compared to the T1 period as asset types requiring intervention are more cost efficient to replace. Unit costs are lower than T1 due to the type of switchgear being refurbished. Unit costs are lower than benchmark. Considered 3 options: The most efficient solution is dependent on CB type hence we have carried out 27 CBAs to cover all the different types of CB. This ensures the optimum mix of replacement & refurbishment in our plan. 	
Transformers & reactors (IDP A9.16 & A9.17)		↑ 20%	↑ 15%
		<ul style="list-style-type: none"> More transformers are planned towards the end of the T1 period (vs first 6 years in this analysis). Planned volumes overall are broadly consistent across T1 and T2 periods. Unit costs are lower than T1 period and lower than benchmark Considered 3 options: CBA preferred solution is replacement (e.g. over refurbishment which has a higher whole life cost) due to most efficient long-term benefit. 	



Table 9.14 Overhead line investment in the T2 period

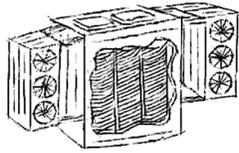
Category: Overhead Lines (OHLs)		EOL Risk delta: 212R£m Long term benefit: 531LR£m		
 <p>Key driver: We need to do more overhead line conductor and fittings in the T2 period than we did in T1, as more of the OHL network is reaching end-of-life. We have reduced the impact of this peak through innovation (see detail below). Replacement of OHLs has a better CBA than refurbishment. However, 99.6% of our fittings in T2 is refurbishment. The amount of overhead lines we can work on at any one time is mainly restricted by system access, but also by there being only a small number of external delivery companies who can safely carry out this type of work. The work will be delivered by internal and external resources.</p>				
Description	Options considered	Volume	% of asset base	Cost £m
Conductor Wires that transmit power and connect each tower	Complete replacement of sections of OHLs (refurbishment isn't technically viable)	██████	■	536
Fittings The connection pieces on each tower	Complete replacement of fittings on a section of overhead lines	■	■	83
	Refurbishment (targeted replacement) of only the poor condition fittings on a section of OHL	██████		
Port of Tyne Stakeholder driven project to support growth in wind-turbine manufacture	Multiple options considered: Modifying existing OHL, replacing OHL, subsea cable. (Ringfenced to protect consumers from uncertainty)	■	-	89
Towers (or pylons) that the conductor and fittings are attached to	Remove rust and paint steelwork with a protective coating to prevent steelwork from needing to be replaced.			92
	Recover rusted and damaged steelwork, foundation refurbishment, and replacement of towers, only where beyond recovery.			105
Innovation applied to T2 plan			Saving description	Saving £m
<p>Reduction in conductor volumes required through asset life extension</p> <p>In the T1 period, we have applied a 10-year life extension to 30% of the conductor asset population (█████ circuit km). This reduces the amount of assets we need to replace to maintain the same level of network risk. We delivered the volumes we set out to deliver in the T1 period, so the majority of consumer benefit will be realised in the T2 period, by reducing volume and cost required to maintain network risk. This was delivered through 'within span' conductor sampling, incorporated with third party development and expertise in advanced mathematical modelling and insight from accelerated ageing studies.</p>		  		Reduced volume of conductor ██████ -204
<p>Targeted fittings replacements and life extension through enhanced condition monitoring</p> <p>We have invested in visual assessment using a new process of helicopter & drone data capture, with dedicated technicians and reviews by subject matter experts. This drives consistency and availability of imagery in order to improve condition data.</p> <p>We have learnt about spacer, damper and suspension clamps through sampling of conductor during outages, and we're subjecting 40-50 year old glass insulation to rigorous mechanical and electrical testing. This allows us to hone in on the components and towers/ spans driving the likelihood of failure. This enables new options for smaller scale targeted investment and allowed for the extension of asset lives.</p>		 		Reduced fittings unit cost ██████ - 132
<p>Tower steelwork cost savings through recovery of corroded steelwork</p> <p>At the beginning of the T1 period, the outcome of an innovation project allowed us to change our policy around the treatment of corroded overhead line tower steelwork. This means that some corroded steelwork which would previously have had to be replaced can now be recovered using an enhanced coating system.</p>				Reduced cost -124

The Investment Decision Pack(s) related to this category can be found in annexes NGET_ A9.09, A9-09A, A9.12



Table 9.15 Transformer and reactor investment in the T2 period

Category: Transformers (SGTs) and reactors EOL Risk delta: 59R£m Long term benefit: 336LR£m



Key driver: End-of-life risk is broadly level in comparison to overall T1 volumes. A volume increase has been mitigated by life extension in the T1 period, which has reduced the overall volume required in the T2 period by four units per year.

Transformers are used to increase or decrease voltage in circuits. The reliability of our transformers is critical to customers because failures can immediately lead to supply interruptions and have a long lead time to replace.

Reactors are utilised to reduce the voltage on the transmission network. They help us to maintain voltage compliance within the required standards. They also help us to provide the capability to recover from full or partial network shut downs (a “Black Start”) by helping to manage the voltage on the network as more and more demand is being restored. Changes in voltage are due to changes in flows (driven by generation and demand) and the type of assets on the network.

This work will mainly be delivered by external contractors.

Description	Options considered	Volume	% of asset base	Cost £m
Transformers Increase or decrease voltage in circuits	Replacement and refurbishment have been considered. Optioneering informs us that replacement of SGTs delivers a greater long-term consumer benefit than refurbishment in every case. We commit to replacing transformers and not refurbishing in the T2 period. Optimum timing of intervention ahead of end-of-life failures is crucial, due to their criticality and the lead times associated with replacement. Includes 5 spare transformers.	■ units	■	273
Reactors Reduce voltage on circuits		■ units	■	55

Innovation applied to T2 plan	Saving description	Saving £m
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<p>Reduction in volumes required <i>through asset life extension</i></p> <p>In the T1 period, we have delivered on our continuous asset health monitoring plan. We have:</p> <ul style="list-style-type: none"> changed the way we carry out regeneration and prevent the oil becoming corrosive, reducing the risk of transformer failure and unreliability resulting from corrosive sulphur in oil (see our TOPICS innovation project) enhanced fire-resistant transformers using the synthetic ester based oil (Midel) developed RESNET methodology which allows us to combine thermal models for transformers with climate data to consider future impact on our assets. <p>These condition assessment results have identified slower deterioration rates than predicted.</p> <p>This understanding enables us to reduce the amount of assets we need to replace to maintain the same level of network risk.</p>	 <p style="text-align: center;"><i>Forensic analysis of a transformer</i></p>	<p>Reduced volume of transformers</p> <p>■ units</p>	<p>-97</p>
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The Investment Decision Pack(s) related to this category can be found in annexes NGET_A9.16 & A9.17



Table 9.16 Switchgear investment in the T2 period

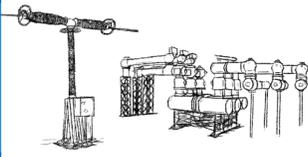
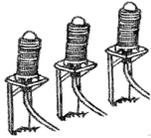
Category: Switchgear		EOL Risk delta: 65R£m Long term benefit: 127LR£m		
 <p>Key driver: In the T1 period, due to the condition of our circuit breaker population, we are replacing and refurbishing over 1000 assets. In the T2 period, we need to do over 50% fewer interventions on circuit breakers, as the peak was in the T1 period. 37% of our CB plan is refurbishment in the T2 period, delivering a greater consumer benefit than replacement.</p> <p>The equipment required to connect and disconnect electrical circuits within substations is collectively known as switchgear. The lead asset is the circuit breaker. Switchgear refers to the circuit breaker and its closely associated equipment (bays) such as disconnectors, earth switches and surge arresters (items of equipment that protect the network from over-voltage events such as lightning). There are more bay assets to refurbish and replace in the T2 period due to condition and age. This work will be delivered by both internal and external resources.</p>				
Description	Options considered	Volume	% of asset base	Cost £m
Circuit breaker only Used to connect and disconnect electrical circuits	Replacement – removal of the old circuit breaker and replacement with a brand-new circuit breaker.	■ units		352
	Refurbishment – a lower cost solution to replacement which extends the asset life but does not achieve the same new asset life as replacement.	■ units	■	
	Repair – one-off activity to address specific issues e.g. SF ₆ leakage	■ units		
Bay assets	Refurbishment and replacement	■ units	■	
Innovation applied to T2 plan				
<p>Reducing the unit cost of replacement – <i>reducing delivery times and install costs</i></p> <p>We have worked hard with our supply chain in the T1 period to reduce the cost of switchgear investments, developing quicker and more efficient ways to do our work. An example is the condition assessment (using core samples, civil inspections) of existing infrastructure to enable its reuse. This reduces the carbon impact, cost and outage time it takes to replace.</p>				
 <p><i>Old air-blast circuit breaker, mounted on existing elevated concrete plinth</i></p>		 <p><i>New circuit breaker installed on existing elevated plinth</i></p>		
<p>Reducing the global warming potential impact of our assets – <i>through different insulating materials</i></p> <p>In order to 'break' the electrical current, our circuit breakers use insulating materials like oil, air, and sulfur-hexafluoride (SF₆). SF₆ has a high global warming potential. In the T1 period at Sellindge 400kV substation we commissioned an insulating gas 'g3' as an alternative to SF₆, a world first. This has the potential to reduce the global warming ratio potential from 23,900 to 345 in our equipment (98% improvement). We will investigate further use of this type of technology to decarbonise as we implement our T2 plans.</p>				
<p>The Investment Decision Pack(s) related to this category can be found in annexes NGET_ A9.03</p>				



Table 9.17 Underground cable investment in the T2 period

Category: Underground cables

EOL Risk delta: 11R£m Long term benefit: 67LR£m

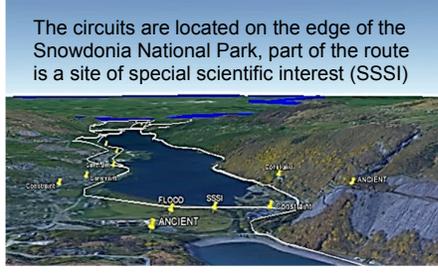


Key driver: In the T2 period, cost increases over T1 levels are mainly driven by investment in cables in London (LPT2). There are also critical and strategic cable projects located in Wales and Sheffield. Underground cables provide crucial ‘connections’ between our substations, generation and demand. Underground cables were traditionally used where urban development (London and Sheffield) or visual amenity (North Wales) required circuits to be placed underground. This work will mainly be delivered by external contractors.

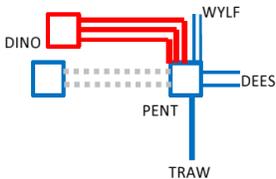
Dinorwig – Pentir (Ringfenced Project)

The Dinorwig–Pentir 1 & 2 cable circuits are critical circuits, they connect the Dinorwig pumped storage power station, which is heavily utilised to balance the national electricity system. The cables were commissioned in 1984, and the asset condition of the circuits is deteriorating. Data from circuit monitoring equipment has shown that due to the way the power station operates, the cables have been subjected to a cycle of thermo-mechanical forces which degrades the cables. This has accelerated the rate of cable degradation beyond that predicted.

The current configuration means that when one circuit is offline for maintenance or a fault, a fault on the second circuit (resulting in loss load of generation) could cause a breach to system frequency levels required under Security and Quality of Supply Standards (SQSS). Dinorwig often represents the single largest loss on the system, so it is necessary for the ESO to hold reserves to mitigate negative effects on the wider system. The cost of holding reserves can be up to £500k per day. Anticipated future changes in the GB Electricity Market are likely to mean that these costs will increase in the future.



The circuits are located on the edge of the Snowdonia National Park, part of the route is a site of special scientific interest (SSSI)



We have engaged with the ESO, our stakeholders and customers on an optimal **whole system** solution, to ensure we deliver the lowest overall cost to consumers. Utilising cost benefit analysis, a 3-circuit offline build provides the lowest overall cost, rather than replacement of the existing 2-circuit configuration. This new configuration (highlighted red in the diagram) minimises expensive system operator constraint costs that would be associated with construction outages in this region.

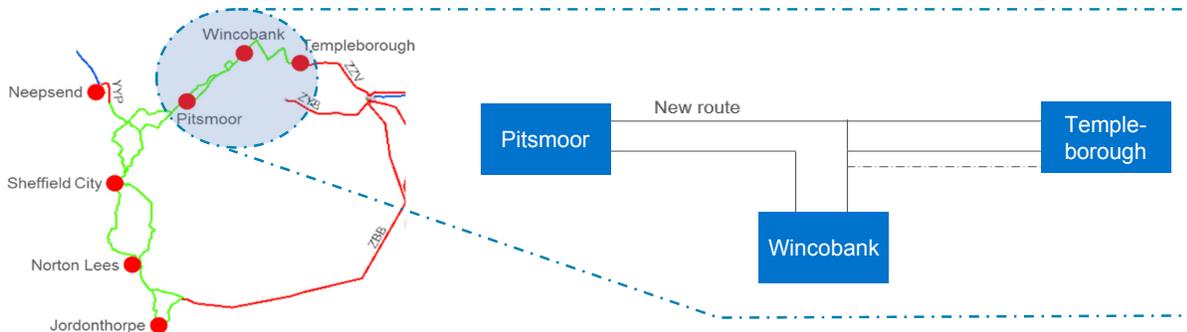
We are **ringfencing** this project to protect consumers from uncertainty. Ringfencing means that this project will not be available for ‘risk-trading’ in NARM, and so will only deliver a risk benefit if completed.

Sheffield Ring

The original strategy in the T1 period for the Sheffield area was based on a like-for-like replacement of the existing 275kV cables. However, as much of the heavy steel industry in the area has closed or has been consolidated, the existing network configuration has been reviewed. We are continuing to undertake system studies and are working with Northern Power Grid (Distribution Network Operator) to consider the most efficient **whole system** solution for the area.

To enable this, a targeted intervention approach has been considered to address the most urgent asset health risk on the existing Sheffield cables. The Pitsmoor–Wincobank–Templeborough cable is prone to oil leaks and sits within a bank of land subject to erosion and subsidence. This subsidence of land puts stresses on the cable outside of its design, accelerating the need to intervene to prevent faults on the network.

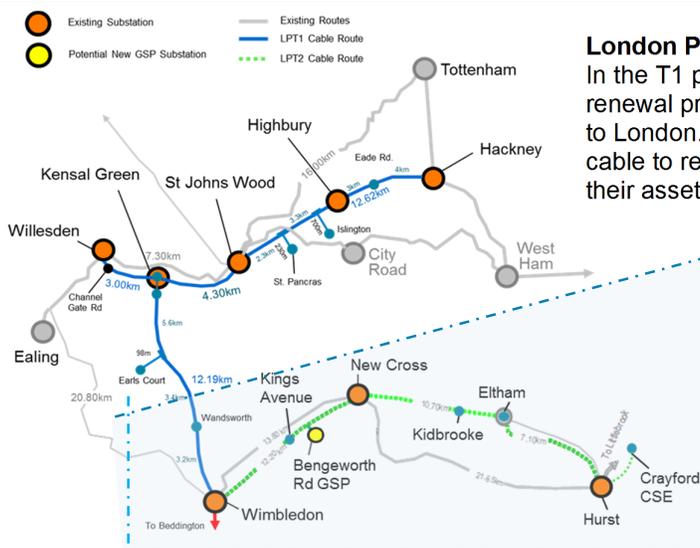
Whole system studies have shown that a new circuit configuration could be achieved, at a lower cost to replacement of the existing circuits (-£25m). We are continuing engagement with the DNO in this area to ensure system reconfigurations meet the long-term demand.





Category: Underground cables

London Power Tunnels 2 (Ringfenced Project)



London Power Tunnels 1

In the T1 period, we have completed a major cable infrastructure renewal project, critical to maintaining security of electricity supplies to London. The project built new tunnels and installed 192km of cable to replace the existing cables that have reached the end of their asset life.

London Power Tunnels 2

In the T2 period, the second phase of this cable renewal is planned. The aim of the project is to create a secure route for the replacement of high voltage cables connecting 3 substations:

- Circuit 1: Wimbledon to New Cross
- Circuit 2: New Cross to Hurst
- Circuit 3: Hurst to Crayford

The existing LPT2 cable routes form the sole transmission supply to the New Cross and Hurst grid supply points (GSP) and provide system interconnection between East and West London.

At New Cross, there are existing 132kV and 66kV substations, which supply the distribution network in addition to supplies for Network Rail. Hurst substation feeds Eltham 132kV and Bromley 33kV sites. In order to continue to supply consumers within central and south London, it is essential to maintain connections to these sites. There is insufficient capacity existing within the Distribution Network Owner (DNO) to achieve the connected demand at these sites, as UK Power Networks rely on transmission supplies to meet group demands.

Whole system discussions have taken place with the DNO, to understand future demand predictions on their network. The project team has also consulted on LPT2 with all relevant London and Royal Borough planning teams as well as other key stakeholders including; Greater London Authority (GLA), Environment Agency, Natural England (NE), Transport for London (TfL), Thames Water and landowners. During this engagement, stakeholders have expressed serious concerns about an in-situ replacement due to the level of disruption this would cause to the London road network.



Public consultation and information events took place at six venues in the vicinity of the above ground sites to provide information on LPT2 to members of the public in the local community, Members of Parliament (MPs), local councillors and stakeholders to receive feedback on our proposals.

Cost benefit analysis of all the options has been conducted and consulted on. The chosen option for the route is a new underground tunnel and a new grid supply point to the DNO. This option secures the electricity supply to central and south London through the renewal of the cable network, addressing demand capacity issues and providing diversity of supply at lowest cost. The LPT2 project needs case has been approved by Ofgem in the T1 period and has been through detailed development with delivery starting in the T1 period.

A milestone-based approach has been developed for delivery of this large capital project, using lessons learnt from the successful delivery of LPT1. Further detail of the programme can be found in Investment Delivery Pack annex NGET_A9.19 London Power Tunnels Phase 2.

We are **ringfencing** this project to protect consumers from uncertainty. Ringfencing means that this project will not be available for 'risk-trading' in NARM, and so will only deliver a risk benefit if completed.

The Investment Decision Pack(s) related to this category can be found in annexes NGET_A9.07, A9.08 & A9.19 This includes justification of a number of smaller projects and cross site cables that require replacements as they reach end-of-life, with a total cost of £50m



Table 9.18 Protection and control investment in the T2 period

Category: Protection & control



Key driver: The volume of protection and control replacements increase in the T2 period. This is due to different technologies reaching their end of life; electro-mechanical protection relays (installed primarily in the 1960s with an expected technical life of 60 years), and first generation computer based protection relays (installed in the 2000s with expected technical life of 15-20 years). This increase in volume requiring intervention continues into the T3 period. **76% of our interventions in T2 are based on refurbishment.** Protection and control devices are crucial to the safe and reliable operation of the transmission network. They allow for the safe removal of inherent dangers and costly damage associated with faults, including protection for the public and those who work on the network. They also provide safe control, monitoring and operation of equipment both locally and remotely. This work will be delivered by internal and external resources.

Description	Options considered	Volume	% of asset base	Cost £m
Protection Monitors the flows on the network, protecting the transmission system when there is a problem by switching out faulty equipment.	Replacement Complete replacement of all associated protection equipment in a cubicle.	■ units	■	263
	Refurbishment Replacement of only the life limiting protection components, in some instances using an interface between old and new.	■ units		
Control Enables the transmission system to be operated both locally and remotely by control rooms.	Replacement Complete replacement of the control asset or substation control equipment.	■ units	■	214
	Refurbishment Replacement of only the life limiting control components, in some instances using an interface between old and new.	■ units		
Metering Collect data from our assets, for control rooms and for billing purposes.	Replacement The nature and cost of this equipment means replacement provides the optimal solution.	■ units	■	12

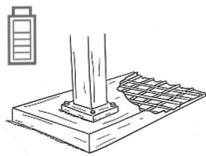
Justification summary (A9.14)	Volume	Overall cost
<ul style="list-style-type: none"> Increase in volume due to equipment obsolescence driven by modern technological changes to P&C equipment and more equipment coming to the end of their technical asset lives. A high percentage of refurbishment versus replacement, and alternative methods for replacement ensures these higher volumes are deliverable. Asset health & criticality has been used to determine volume. Lower unit costs due to rolling out proven T1 innovation (SPAR). Considered 5 options and 23 CBAs which cover all the different asset types, the result being a mix of strategies which provides the best long-term risk benefit. 	↑ 236%	↑ 218%

Innovation applied to T2 plan	Description	Saving £m
Reducing the cost of replacement – through smart interventions Our engineers have worked collaboratively with the supply chain, to develop innovative solutions to address the life limiting components of protection and control systems. This has enabled: <ul style="list-style-type: none"> replacement of “the brain”, retaining associated infrastructure including complex plant wiring warranty and support periods provided by suppliers, similar to that of replacement sites less time on site, less resource required, reducing cost outage times shortened with benefits of reduced system risk and increased system security and reliability. 	unit cost reduction < ■	-66
		Rolling out smart ways of working into further assets types

The Investment Decision Pack(s) related to this category can be found in annexes NGET_A9.15



Table 9.19 Other equipment investment in the T2 period

Category: Other equipment		
Description	Investment activity	Cost £m
	<p>Key driver: Overall, the volume of equipment requiring intervention to maintain risk in this category increases in the T2 period. The main areas for increased volumes are site supplies, instrument transformers, civils and condition monitoring. This category of equipment includes all the equipment not covered in the previous categories that are needed to ensure a reliable network. They provide crucial support for lead assets, and provide back-up to ensure security of supply and recovery. Work is forecast based on the age, condition information and historic volumes. The work will be delivered by internal and external resources.</p>	
<p>Condition monitoring Equipment used to assess the health of our assets</p>	<p>We are committed to continually improve our condition monitoring approach, a crucial component of our asset management expertise. Investment in the T2 period will be focused on continuing to grow our current capability and a targeted approach to acquiring new asset performance data by installing integrated condition sensors to our assets. Many of the innovations and costs savings developed in the T1 period, and embedded in our T2 plans, are as a result of investment in condition monitoring. Improving our condition monitoring capability, through a targeted approach in the T2 period, will enable further innovation and consumer savings.</p>	22
<p>Low voltage boards (LVAC), batteries & diesels Provide site supplies and back-up systems</p>	<p>There are two main drivers for investment in the T2 period. Firstly, there is a requirement to ensure compliance with policy on 'back-up' supplies. This includes ensuring sites have fully operational automatic starting/changeover standby generator systems, a fully-rated standby diesel, or an emergency diesel connection point. These assets support the operational resilience of the substation site, in the event the normal incoming supply fails. The second main driver is to replace substation auxiliary systems based on asset health. These assets require interventions during the T2 period to manage the risk to the system and to maintain network reliability.</p>	75
<p>Instrument transformers Measure current & voltage, feeding protection & control devices</p>	<p>Replacement of assets reaching the end of their asset life. In the T2 period, there are more assets reaching end-of-life than in the T1 period. Replacement of these assets are essential to maintain and operate a reliable transmission system. They measure crucial data that feeds and operates our lead assets and our protection and control devices.</p>	63
<p>Civils Supporting infrastructure</p>	<p>The infrastructure on our 346 substation sites is ageing and this is reflected in the condition reported. The health of our substation infrastructure is crucial to ensure our operational assets can perform as designed and protect our staff and the public from the inherent dangers associated with high voltage assets.</p>	84
<p>Plant Status & cable sealing ends</p>	<p>Substation repairs forecast over 150 repairs per annum for plant such as circuit breakers and transformers, plus for emergency repairs required to return assets to service. The activities will reduce the number and duration of reactive, short notice outages arising from deteriorated and unreliable equipment. Cables sealing ends provide a transition from overhead lines to underground cables. The main driver for replacement is asset health condition (individual assets with identified poor condition and asset family issues) where assets are at or beyond anticipated end-of-life.</p>	107
<p>Through wall bushings</p>	<p>Through wall/floor bushings provide a junction for the passage of electricity from internal substation floors and outside of substation buildings.</p>	14
<p>Productive work environment</p>	<p>Main substation sites receiving an appropriate level of refurbishment, in order to improve the working conditions of site staff whilst ensuring compliance with workplace regulations.</p>	15
<p>Spares</p>	<p>Strategic stock holdings; spares purchased and used during emergency replacement activity, usually associated with asset faults.</p>	26
<p>Other equipment</p>	<p>Including portable and free-standing earths and specialist equipment used by field engineers to carry out routines safely.</p>	5

The Investment Decision Pack(s) related to this category can be found in annexes NGET_ A9.05, A9.10, A9.13, A9.14, A9.18, A9.21



Table 9.20 IT Investment in the T2 period

Category: IT



Operational and asset management information systems are essential in enabling us to provide a safe and reliable network. They provide a registry of all of our assets and hold a record of all work undertaken and planned. They also store drawings and documentation and hold geographical information about our current and future planned assets. The transmission network is controlled and switched from the Transmission Network Control Centre (TNCC) using an integrated energy management system. To maintain a safe and reliable operation of the network, it is necessary to replace this aged and shared energy management system with a fit for purpose SCADA system (Supervisory Control and Data Acquisition).

In the T1 period, we have made significant progress in improving business performance through investments in technology. We have mobilised our field force through investment in work management applications and we have invested in technology platforms that capture and analyse asset performance and condition data, enabling decisions to be made about the health of our assets and overall network risk. **The key driver** for our IT investment in the T2 period is to upgrade and/or replace our core control, work and asset management systems as they reach end of life, whilst at the same time simplifying and rationalising our systems landscape. Our forecast investment on safety and reliability related IT is £177m, which is 85% of our total direct IT investment. This investment is required to ensure that we maintain the capability to deliver capital investment and maintenance activities for our customers in a safe and efficient way. We have commissioned Gartner (an IT consultant) to benchmark our IT costs. In the majority of areas, our costs were below benchmark. Where we were above benchmark, we have reduced our costs.

Description	Investment activity	T2 cost £m
Control centre and network management systems	The Integrated Energy Management System (IEMS) is a shared Critical National Infrastructure system with the ESO, which is used to manage and control the electricity transmission system. Investment is planned to separate the system into ESO and Electricity Transmission (ET) specific components. The ESO requires an energy management system, whereas ET requires a SCADA in line with the other Transmission Owners and DNOs. This will benefit customers and stakeholders by; assuring physical separation of ET and ESO data, reducing ET system costs, and creating process efficiencies in the management and control of network access and safety.	■
Asset registry and work management systems	End of life replacement of our asset registry and field force scheduling and mobile working systems. This investment will enable us to implement an industry leading solution and further enhance our ability to develop asset management strategies based on 'monetised risk', delivering benefits to customers through reduced IT system costs and enhanced risk-based maintenance/refurbishment/replacement planning.	■
Condition monitoring and analytics	End of life refresh of our Insights Platform, and extension to cater for an increase in the amount and diversity of data we capture from our assets. This will enable advanced analytics to be used to model the performance and condition of our assets, delivering customer benefits through improved asset intervention planning.	■
Portfolio and plan optimisation capabilities	Development of our portfolio optimisation capabilities and rationalisation of supporting systems to converge on an integrated asset investment planning and optimisation solution. Customer benefits will be realised through lower IT system costs, process efficiencies (through not having to work in multiple systems) and optimised asset intervention decision making.	■
Other asset health driven investments	End-of-life replacement of the following systems: <i>Network analysis and design</i> – complex network analysis and modelling for new connections and infrastructure investment decision making. <i>Project controls</i> – scheduling, delivery and supplier collaboration capabilities to ensure efficient delivery of our capital projects. <i>Content management and geo-spatial information</i> – replacement of secure and auditable drawing and document management systems to safeguard ET, customer and stakeholder intellectual property. Replacement of our geospatial information system and development of 3D capabilities to improve hazard visualisation, risk management and visual amenity.	■

The Investment Decision Pack(s) related to this category can be found in annexes NGET_ A14.10, A14.11 & A14.12



Projects meeting OFGEM’s competition criteria

There are four non-load related projects over £50m which meet OFGEM’s initial competition criteria. Due to their non-load nature, these projects are non-separable and only have scope for innovation in delivery. These are therefore not suitable for competition. Further information can be found on the competition criteria in chapter 7 *We will enable the ongoing transition to the energy system of the future.*

Figure 9.21 Contestability assessment and how this has been applied to NLR projects

Project Name	Total Project Costs (£m)	New and Separable	Time criticality	Certainty of need	Scope for innovation	Suitability Assessment
						Suitability for competition against our criteria: Limited suitability ○ ○ ○ ○ ○ High suitability ●
LPT2	xxx	○	○	●	○	Project already in delivery Includes multiple smaller projects (cables, substations, tunnels) Need case approved by OFGEM
Norton-Lees-Pitsmoor Cable	xxx	○	○	●	○	Rationalisation of multiple cables Only £2m in T2, rest in T3
Dinorwig–Pentir Cable	xxx	○	○	●	○	Joint driver with ESO, could fluctuate Multiple substation, cable & tunnel projects
Substation Site Cables	xx	○	○	●	○	Portfolio project covering all our substation cables

6. Our proposed costs for the T2 period

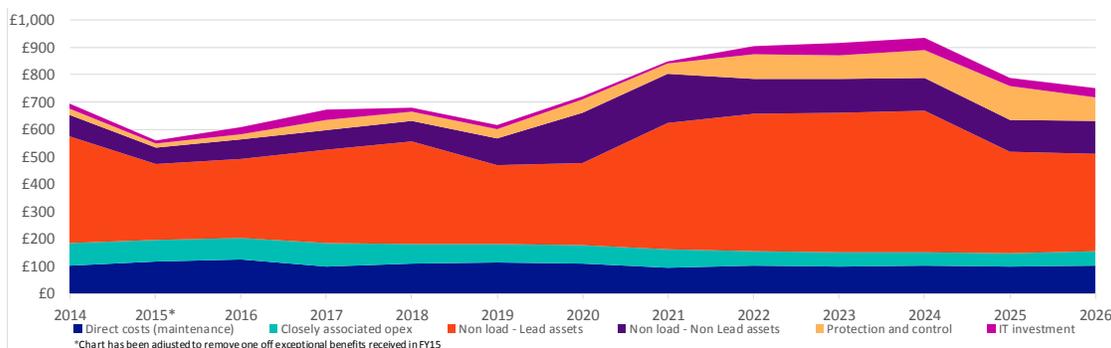
In summary, our proposed costs for delivering against our proposals for the T2 period are detailed in table 9.22 below. Further justification on how these costs have been benchmarked, and how our operational expenditure has been assessed as efficient is detailed in chapter 14 *Our total costs and how we provide value for money.*

Table 9.22 Baseline costs for the T2 period

Baseline cost	21/22	22/23	23/24	24/25	25/26	Total T2	Annual T1	Annual T2	Subject to native competition	Internal historical benchmarks	External benchmarks	Subject to UM
Lead Assets	499	510	515	369	358	2,251	340	450	✓	✓	✓	✓ (NARM)
Protection & Control (Non-lead)	88	86	102	124	89	489	31	98	✓	✓	✓	
Other (Non-lead)	129	123	120	117	118	607	87	121	✓	✓	✓	
Maintenance	103	99	102	98	103	505	109	101		✓	✓	
Operational Support	53	52	51	49	49	254	75	51		✓		
IT	30	44	42	30	30	176	18	35	✓	✓	✓	
Sub Total	902	914	932	787	747	4,282	660	856	Cost certainty: High Confidence			
Pension allocation						5						
Total						4,287						

Business Plan Data Table Reference: Lead asset, P&C, non-lead asset worksheets contained in section C - C2.2a, Maintenance - C2.21-24, Operational Support in section D – D4.5, IT D4.3a

Figure 9.23 Expenditure profile across the T1 and T2 period





The profile of spend to maintain a safe and reliable network relates directly to the volume of work required to maintain asset risk on the network. Sections 4 and 5 in this chapter described how we propose to maintain network risk, in line with what our stakeholders have told us. Due to the nature of our ageing asset base, maintaining the level of risk to the same level as the end of the T1 period results in an overall increase in volume and spend required over the T2 period. The cost impact of this volume of work has been reduced through the innovation, as we are able to deliver the volume at a lower unit cost.

7. How we will manage risk & uncertainty

There are two areas of work which have increased volumes compared to the T1 period, these are OHLs and Protection & Control.

Our planning work has aimed to ensure an even mix of work volumes across each year of the T2 period. This will support the deliverability of the plan from both a resource and a procurement perspective, ensuring that there are no spikes in volumes that might cause a risk to the deliverability of the plan.

We also considered the profile of works in each operational team. Here again, the focus was on ensuring that there is an even volume of works per year for each team, to ensure that teams can be sized appropriately for the duration of the period. We have a flexible delivery model that allows to use contractor resource to mitigate internal resource shortfalls.

Our engineering resources are mobile both zonally and nationally. We have utilised specialist mobile teams to deliver portfolios of work nationally. A new project lead role is being implemented in 2020 which will release ~60% of engineering resource time from maintenance activities, thus enabling more resource to deliver capital works. Annex NGET_A16.01 Deliverability includes further detail on how we have ensured these areas are deliverable in the T2 period.

Over the past 25 years, we have learned a significant amount about how our assets deteriorate. This is because during this period many of our assets have transitioned into their end-of-life phase. These decades of data have been used to create our 'Probability of Failure' curves and asset health scores which underpin the justification for our reliability plans in the T2 period. This evidence results in a **low risk of our assets behaving unexpectedly compared to the forecast**. Where assets do behave differently than anticipated, we will adopt Ofgem's framework proposal for managing asset health risk. This framework protects consumers from the risk of higher bills from poor management of asset health.

The types of assets on our transmission network have not changed significantly during the last 25 years, resulting in many years of repeatable work to replace and refurbish our assets. We can therefore have **high**

confidence in the costs proposed to deliver the required level of reliability in the T2 period. We also have an externally assured cost estimation process, which uses this historic data to inform our forecasts to give a high confidence in the costs we are proposing.

Following this robust process and using independently assured costs (as outlined in chapter 14 *Our total costs and how we provide value for money*) ensures this is a **high cost confidence** area.

Another factor that may influence the amount of work required to manage network risk in the T2 period is the volume of customer connection related projects. Investment decision packs A8.02 & A8.03 cover this in more detail. If the level of work (required to connect customers) changes from forecast, this may affect how many assets we need to replace as part of maintaining a safe and reliable network. It may also affect how many assets we can work on, as we are constrained by system outages and resources available for all work. The NARM framework prevents networks from benefitting from this uncertainty, by categorising this work separately. Through whole system working with our stakeholders, we will ensure we are flexible in our use of resources and outages to mitigate the impact of changes.

The T1 period was the first RIIO framework which delivered significant benefits to consumers through defining outputs for 'lead' assets, however 'non-lead' areas of work did not have outputs defined, leading to uncertainty about the work which would be delivered. In our submission, we are proposing outputs for all of the work on our assets. In section 4 of this chapter we have proposed new price control deliverables (PCDs) for our non-lead assets to give high confidence of what we will deliver for the investment proposed.

To reduced risk and uncertainty further, and provide further confidence in our plans, we will:

- complete high-quality business plan data tables (BPDTs) each year to provide transparency and make it easier to track and measure our delivery of asset health work
- make sure changes in our asset health activities are managed through a cost benefit analysis process to ensure they provide long term consumer benefit
- ensure consumers are protected by continuing to justify long-term decisions made in managing network risk
- complete high-quality justification reports to provide transparency of the benefits of innovation and reductions in cost of our planned asset health activities
- continue to improve condition monitoring, maintenance and policies to provide long term consumer benefits.

These measures provide **high confidence** in the outputs we will deliver, **low risk** of changes and **certainty** of the costs needed to deliver them.



10. We will protect the network from external threats

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification of our proposals
6. Our proposed costs for the T2 period
7. How we will manage risk and uncertainty
8. Next steps

What this stakeholder priority is about

This stakeholder priority is about how we protect our network from external threats such as cyber-attacks, physical attacks and extreme weather. It also ensures we can respond to and recover from incidents when they happen.

Due to the confidential and sensitive nature of our cyber security and physical security business plans, we are unable to fully share detailed information with stakeholders and have agreed to provide our plans directly to Ofgem for assessment. Included within our submission are the two cyber business plan documents requested by Ofgem, these are:

1. Business IT Security Plan
2. Cyber Resilience Plan

What you have told us so far

Your daily lives are becoming more dependent on an available supply of electricity. You want us to protect the electricity transmission network from threats that could impact your supply of electricity. You also want us to be able to quickly recover from incidents if they happen to minimise disruption. As well as responding to stakeholder views, many of the investments in this chapter meet new and expected regulations that have been introduced to minimise the threat against our network.

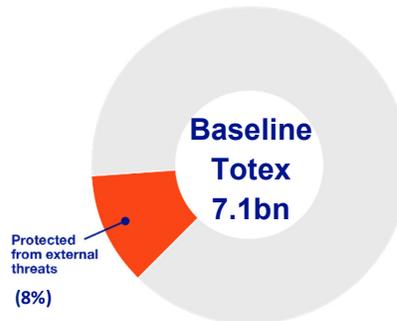
What we will deliver

We will invest over £550m to protect the network from threats such as cyber-attack, physical attack and extreme weather. As a result, we will be able to prevent, withstand, respond to and adapt to the impact and/or duration of such events.

Due to the frequent change in threats, we also propose ways in which future changes in requirements and business plans can be managed to protect consumers. The uncertainty mechanisms we propose in this chapter will help us to be agile so that we can respond to new intelligence or expected changes in the threats we face throughout the T2 period.

The total cost of delivering these baseline proposals is £555m. This represents 8% of the overall business plan as reflected in figure 10.1 below.

Figure 10.1 Proportion of expenditure





1. What this stakeholder priority is about

This stakeholder priority is about how we protect our network from external threats such as cyber-attack, physical attack and extreme weather. It also ensures that we can respond to and recover from incidents when they happen. By doing this, we will minimise the impact of any incidents on our customers and end consumers.

We will manage external threats in a way that is supported by the Government, relevant agencies and stakeholders to minimise the impact of any incident. We will invest to protect our network from a range of threats. We will also improve capabilities to respond to and recover from any incidents quickly and effectively, including incidents which cause a full or partial shutdown of the network.

Sectors that provide consumer services within the UK are more integrated than ever before. With Electricity Transmission enabling services such as transport, media and communications, it is essential that any loss of power event is kept at a minimum and that power supply is restored as quickly as possible. This has also been recognised by Government and many of the investments in this chapter are driven by increased regulation to protect the network from threats.

Some of the topics in this chapter are either of a confidential or sensitive nature which means that we have only shared a limited amount of information on our business plans with our stakeholders and the RIIO-2 Challenge Group. We have agreed that we will share the required information directly with Ofgem to allow them to assess our business plans in this area.

The investments outlined within this chapter are consistent with and complimentary to those in chapter 9 *We will provide a safe and reliable network*.

2. Track record and implications for T2

Investments in this chapter are split into five categories that improve our ability to identify, detect, protect, respond to and recover from threats. These categories are:

- 2.1 Extreme weather
- 2.2 Physical security
- 2.3 Cyber security
- 2.4 Operational Telecommunications (OpTel)
- 2.5 Black Start.

Costs and outputs in the T1 period

Our performance in T1 and the learning we take forward into our T2 plan is outlined below;

Table 10.2 Costs and outputs for the T1 period

Category	Target	Forecast	T1 allowance (£m)	Forecast cost for T1 (£m)
Extreme weather	45-55 sites	49 sites	145.4	124.57
Physical security	25 sites	33 sites	289	259.39
Cyber security (information technology)	n/a	n/a	5.8	17.92
Cyber security (operational technology)	n/a	n/a	n/a	48.79
OpTel	Control telephony at 300 sites	Control telephony at 300 sites	69	43.37
Black Start	n/a	n/a	n/a	n/a

We have delivered our planned investments efficiently and developed alternate solutions which reduced the threat (avoiding mitigation measures) and delivered more cost-effective solutions where appropriate. Further detail on these can be found within 'Innovation in the T1 period' below.

For **extreme weather**, we took a flexible approach to flood protection due to potential changing requirements. By developing site specific solutions as and when investment was required, we made sure that:

- only sites which had a risk of flooding were targeted for investment, and
- mitigation solutions could be adapted to site specific needs.

Site solutions were developed using guidance provided by the Energy Networks Association through their Engineering Technical Report (ETR) 138

'Resilience to Flooding of Grid and Primary Substations', in conjunction with the local Environment Agency and provide a coordinated energy sector response to the threat of flooding. Our investments in the T1 period and those planned in the T2 period protect from low probability, high impact events. However, events such as that at Whaley Bridge in August 2019 and the widespread flooding in northern England in November 2019, show that these investments are critical in protecting substations from flooding and the resulting impact on consumers.

Our plans to protect sites from **physical attack** changed through the T1 period as determined by the Physical Security Upgrade Programme (PSUP). The PSUP is a government mandated initiative to protect the UK's most essential infrastructure. The Centre for the Protection of National Infrastructure (CPNI) work alongside the Department of Business, Energy and



Industrial Strategy (BEIS) to combine their privileged access to information and threat intelligence to analyse and inform risk assessments. They specified the security measures we implemented.

Our physical security plans and associated allowances were managed using two re-openers; one in 2015 and one in 2018. The final agreed targets were to deliver security enhancements to 25 sites, for which we received allowances of £289m. We are forecast to deliver enhanced site security to 33 sites by the end of the T1 period. This is due to starting work on sites earlier in the T1 period, which have later been removed from the PSUP list, in conjunction with BEIS, because of a change in threat or requirements.

We did not request allowances to manage the threat of **cyber-attack** on our Operational Technology (OT) in the T1 period. At that time, we managed our cyber security at a global IT level addressing more 'established' means of cyber-attack on IT systems, for which £5.8m allowances were received for Electricity Transmission. Due to the increased threat and introduction of new requirements, we plan to invest a total of £17.92m on IT cyber resilience. This is an allocation to NGET from our IT shared service.

We actively monitor cyber threats 24/7 and use threat intelligence from specialist agencies to inform our cyber strategy and investment plans. We have been flexible to meet new cyber requirements and mitigate risks as they arose. This includes the emerging threat against OT, for which there are now requirements to protect. This has resulted in forecast expenditure of £48.79m in the T1 period. We are currently trialling solutions and vendors in preparation for our T2 cyber investments. By being agile in the T1 period, we have responded to new threats and developed long-term strategies on how to maintain a network resilient to cyber threats.

Our **Operational Telecommunications (OpTel)** network is made up of optical fibres that run on our overhead line network connecting our substations and electricity control rooms. It is essential infrastructure for the daily operation of the network and plays a vital role in the communications required to protect the network from threats. In the T1 period, we have completed the replacement of telecoms assets at 300 substations and migration of legacy services commenced prior to the T1 period. We have implemented a new telecoms network management control centre and replaced legacy end of life control telephony.

We did not receive any specific allowances for **Black Start** in the T1 period. As part of our standard performance, we have managed our assets to an agreed level to maintain security of supply and therefore any costs that support our T1 Black Start preparedness were covered by our asset maintenance expenditure.

Further information on our T1 performance can be found within the relevant Investment Decision Packs (IDP) and other requested plans as follows:

- NGET_A10.04 – Business IT Security Plan (Confidential)
- NGET_A10.05 – Extreme weather
- NGET_A10.06 – Physical security (Confidential)
- NGET_A10.07 – Black Start
- NGET_A10.08 – OpTel refresh
- NGET_A10.09 – Cyber Resilience Plan (Confidential)

Innovation in the T1 period

We have delivered our T1 plans using innovative approaches where possible. One example of which is on extreme weather. We have worked with the Environment Agency when developing site specific flood solutions in the T1 period to identify whether we can deliver joint offsite environmental solutions such as flood diversion. These solutions remove or reduce the risk to National Grid sites and drive further value for consumers by delivering more cost-effective investment. We have continued to use removable flood barriers, that can be shared between sites, where possible, to further mitigate the need for investment to protect from tidal and river flooding. These barriers have been utilised many times throughout the T1 period, including at one of our sites during the 2019 dam incident in Whaley Bridge. Figure 10.3 below gives an example of these barriers in use.

Figure 10.3 Example removable flood barrier use



We have also coordinated our threat protection activities, for example by combining the delivery of weather and physical resilience works to deliver more efficiently.

Whole system approach

Whilst we play a key role in ensuring a resilient electricity network, considerations and plans must be made across the whole system in this area. Our approach to physical security and weather resilience is guided by BEIS and provides a coordinated sector response to these threats, by defining critical and priority sites and threat mitigations. On cyber, we have engaged with the other TO's to share our view



on threats, risk against assets and required mitigation for OT both within the T1 and T2 periods. This encourages a consistent approach to risk mitigation and allows us to understand where we can work together to deliver joint solutions or share best practice and learning going forward. More information on this engagement is provided within annex NGET_A10.01 Engagement log.

Learning for T2

Our experience on weather resilience and physical security during the T1 period has provided us with credible cost data and has informed our delivery approach for the T2 period, enabling us to build proven efficiencies into our T2 proposals. Our T2 investment to protect from



External threats have the potential to change significantly in a short period of time. We must be flexible in how we manage and mitigate threats to keep our network protected. The need to adapt plans on a regular basis is a key learning from the T1 period and this is reflected in our request to include uncertainty mechanisms within the T2 period across the topics outlined in this chapter.

3. What our stakeholders are telling us

Our stakeholders want a continuous supply of electricity and want as little disruption as possible. They understand the threats we face and the impact that those threats could have on our network reliability. They want us to manage these threats in a way that is informed by relevant specialists and is appropriate and proportionate to the level of risk on our network. The [Energy Research Partnership \(ERP\) report](#) on the future resilience of the UK electricity system states:

“There is a growing trend of society and business becoming increasingly reliant upon new technology, broadband and communication; all requiring electrical energy and ultimately leading to an increased interdependency between sectors. Furthermore, the world is changing; from climate change including extreme weather events, through to an increase in malicious intent to affect networks.” (*ERP, November 2018.*)

With the growing business and societal reliance on electricity, we must protect the network from existing threats and also deliver a network that provides future

resilience beyond the T2 period. The investments we have planned will build the foundations for future resilience by addressing immediate threats, enhancing our capability to monitor and respond to incidents and conducting further research into future requirements for resilience. One key area of investment on network resilience is our OpTel network. OpTel is vital to providing overall network resilience and the capabilities to effectively monitor the network for threats and respond to them efficiently.

We are engaging with our stakeholders on the topic of resilience via established industry forums including the CIGRE Power Systems Resilience Group. The messages we are hearing highlight challenges in determining appropriate levels of resilience for the future. These challenges are consistent with those summarised in the ERP report on future resilience.

Stakeholders want us to focus on ensuring we are effectively protected from the threat of cyber-attack. Cyber-attacks have grown in both sophistication and frequency throughout the T1 period. They are now used throughout the world as a means of political attack and warfare. The threat against OT has increased and has been evidenced by several notable attacks globally including the 2015 attack against the Ukraine electricity distribution network. This attack resulted in several outages that caused approximately 225,000 consumers to lose power supply. The [Government's National Cyber Security Strategy](#) recognises the threat against OT as follows:

“The rapid implementation of connectivity in industrial control processes in critical systems, across a wide range of industries such as energy, mining, agriculture and aviation, has created the ‘industrial internet of things’. This is simultaneously opening up the possibility of devices and processes, which were never vulnerable to such interference in the past, being hacked and tampered with, with potentially disastrous consequences.” (*National Cyber Security Strategy 2016-2021*)

We have informed and consulted stakeholders where possible

We are unable to engage widely on our cyber security and physical security plans due to their sensitive nature. Our stakeholders understand the challenge with engaging on this topic and have told us that they want us to engage with the few stakeholders who have the knowledge or authority to inform our business plans to ensure our level of investment is appropriate and proportionate to the risks we face. We have provided further detail on the specific feedback received from the workshop and consultation in our engagement log.

We have also conducted willingness to pay research on Black Start, which concluded that consumers would be willing to pay more for faster response times in the event of a total system shutdown. More information on



this can be found within annex NGET_A6.04 Willingness to pay report.

We are also engaging with the Scottish TOs and DNOs who have similar risks, to help create a view of the whole electricity system and approach to risk mitigation. We have also shared best practice across the National Grid Group including Gas Transmission, NGESO and our US business.

We have worked with government and specialist agencies to develop our plans

We have engaged with government and relevant specialist agencies to ensure our plans meet those requirements and are proportionate to the risk we face. For each threat area, these stakeholders include:

- Weather** – BEIS and Environment Agency
- Physical security** – BEIS and CPNI
- Cyber security** – Ofgem and BEIS (as NIS Competent Authority – see below) and the National Cyber Security Centre (NCSC)
- Black Start** – BEIS
- Optel** – CPNI

The need for the significant increase in cyber security investment when compared with the T1 period is driven by new regulations and the increasing cyber threat. The Network and Information Systems (NIS) Regulations were implemented in May 2018. They aim to increase the overall level of cyber security across operators of essential services in the EU. We have worked with the

NIS Competent Authority (a joint role held by Ofgem and BEIS) to ensure our plans reflect the investment required to meet these new regulations. This approach has been agreed and is consistent with all other parties governed by these regulations. We provide as supporting documents to this submission the two cyber documents requested by Ofgem in their Sector Specific Methodology Decision. These are:

- 1) Annex NGET_A10.04 Business IT Security Plan, and;
- 2) Annex NGET_A10.09 Cyber Resilience Plan.

These documents have been structured to meet our requirements under both RIIO-2 Business Plan guidance and the NIS Regulations.

We have also provided our previous NIS submissions to further support our business plans. These are:

- 1) Annex NGET_A10.02 NIS Improvement Plan
- 2) Annex NGET_A10.02A NIS Self-Assessment

A summary of our engagement activities and outcomes is provided in table 10.4 below, alongside what trade-offs have been made and how stakeholders have influenced the plan. The engagement log contains detailed information on our engagement approach and outcomes. This can be found in annex NGET_A10.01 Engagement log.

Table 10.4 Summary of our engagement

Engagement on protecting the network from external threats	
Purpose and approach	<p>We have engaged with a variety of stakeholders through different methods and forums to understand general stakeholder views on resilience and protection from threats as well as specific requirements under this topic. To understand specific requirements and guidance which we were expected to follow, we engaged with stakeholders as follows:</p> <ul style="list-style-type: none"> • CPNI and BEIS – bilateral and continuous engagement throughout the T1 period to inform our PSUP risk position and action required. • NIS Competent Authority (BEIS and Ofgem) and the NCSC – bilateral meetings, specific NIS focused workshops and industry engagement within the Energy Emergencies Executive Committee to inform cyber risk position and required works. • BEIS and industry parties – through the Black Start Task Group to contribute to the discussion and proposal of a Black Start standard. • BEIS and industry parties – through the ETR138 working group to understand T2 guidance on protection from surface water flooding and BEIS’s expectations for network companies to comply.



Engagement on protecting the network from external threats	
What stakeholders told us	<p>General stakeholder views gained through our engagement are outlined within the supporting stakeholder engagement log for this topic annex NGET_A10.01 Engagement log. Due to the confidential and/or sensitive nature of our plans, stakeholders have told us to engage with relevant specialists where possible to develop and agree appropriate solutions. These relevant specialists have proposed that we:</p> <ol style="list-style-type: none"> 1. implement the revised standards set out in Engineering Technical Report (ETR) 138 (requirements for site flood protection) by the end of the T2 period. See annex NGET_A10.10 Extreme weather assurance letter 2. implement required levels of physical security on designated PSUP sites 3. implement agreed cyber security enhancements in line with NIS Regulation guidance 4. ensure rapid restoration in a Black Start scenario in line with BEIS proposals.
Key trade-offs and how engagement influenced our plans	<ul style="list-style-type: none"> • We have prioritised OT cyber enhancement works on several sites within the T1 period to implement appropriate levels of security on our more critical sites. This allows us to drive efficiencies, trial available solutions and adapt our longer-term plans to protect all sites if the threat or requirements change within the T2 period. We consider this appropriate in the short term to both protect our sites and meet NIS requirements. • We currently do not plan to protect all sites at risk of surface level flooding. Our estimates have been based on learning from sites requiring work within the T1 period. We expect some sites within flood risk zones to have appropriate landscape or infrastructure in place which reduces this threat. We also expect alternate solutions such as offsite environmental solutions to be a possibility. • Our key stakeholders have had a major influence on our T2 business plans, our engagement has informed what we do when protecting against cyber-attack, physical attack and extreme weather. • We commissioned Frontier Economics to carry out assurance of how our stakeholder engagement had been reflected within our July draft business plan. They assessed how well the logic between stakeholder evidence and business plan actions had been documented, and identified gaps or areas of improvement. Frontier note that overall, the stakeholder engagement on this topic is challenging given that security plans often cannot be shared with stakeholders due to confidentiality. However, the stakeholder engagement on this topic appears to be comprehensive and well-designed and that we have clearly attempted to provide stakeholders with a necessary level of knowledge to express informed views. One piece of feedback received and addressed within our business plan was 'On physical security, it could be made clearer in the business plan that action around the Physical Security Upgrade Programme is a government mandated requirement, and is not driven by the views of wider stakeholders'. Within the engagement log, we have provided an overview of all the feedback received from Frontier on our engagement and provided detail on how this has been addressed within our business plans.
How we've responded to the Independent Stakeholder Group and Challenge Group	<ul style="list-style-type: none"> • Due to the nature of the investments within this chapter, the Independent Stakeholder Group and RIIO-2 Challenge Group have not been able to provide a great deal of feedback on the detail of our plans, but have influenced our approach and guiding principles. • We have, however, welcomed feedback on this chapter, have clarified points about which were unclear and provided additional detail on our OpTel and cyber investments in response to feedback received.

4. Our proposals for the T2 period

Our proposals to mitigate the threat of extreme weather are similar to investments made in the T1 period, however, with a wider scope as a result of updated ETR138 requirements and the need to address threats such as erosion and climate change. Our physical security proposals address security at [REDACTED] commissioning in the T2 period in line with existing PSUP requirements.

Our plans to enhance cyber security form a significant part of our expenditure in this area. This represents an increase on T1 costs due to a step change in threat against OT and the need to follow the guidance under the new NIS Regulations. Due to the level of uncertainty around longer-term cyber investment, we have separated our T2 cyber proposals into two categories for both of the cyber plans being submitted.

1. **Baseline request** – known and measurable solutions to existing threat, with high confidence in cost
2. **Uncertainty** – expected expenditure to be requested via a reopener within the T2 period

Our uncertainty category accounts for expected expenditure where we know there is a risk that needs to be mitigated, however, the solution or costs have not yet been fully developed. It also includes investments that are planned later within the T2 period. These are not included in our baseline request due to expected changes to the cyber threat and our need to be flexible with our business plans. We also acknowledge that our forecast uncertainty expenditure may change between now and the planned reopeners due to potential change in threat or requirements.

Our Black Start plans include investment to improve the performance of key assets to achieve the proposed BEIS restoration target.

We will invest to safeguard the OpTel network [REDACTED]



supply of electricity to end consumers. They will enable us to better protect our assets and infrastructure and more effectively and efficiently respond to incidents as they occur. In conjunction with the initiatives outlined in chapter 9 *We will provide a safe and reliable network*, these proposals ensure that consumers continue to receive a secure supply of electricity that is becoming increasingly critical to their everyday lives. Table 10.5 below outlines how what stakeholders are telling us links to the proposals we are making and the consumer benefit of these proposals.

Our proposals provide a direct benefit by enhancing our resilience to incidents that threaten the security of

Table 10.5 Our proposals for the T2 period

Stakeholder feedback	Our proposals	Output type	T2 Baseline (£m)	Consumer benefit
Requirement from BEIS for all network companies to implement the revised standards set out in Flood Resilience Engineering Technical Report 138 by the end of RII0 T2.	Extreme weather: Protect our sites from surface level flooding and better understand how we protect from weather-related threats in the long term. We will enhance flood protection on a proposed 100 sites as well as addressing increasing erosion incidents and developing a long-term climate change strategy.	PCD	59.81	All sites at risk of surface level flooding will be protected by the end of the T2 period, protecting end consumers from loss of supply because of substation flooding.
CPNI/BEIS requirement to implement required levels of Physical Security on all designated PSUP sites.	Physical security: Continue to meet our PSUP requirements at all designated sites. We will enhance physical security on [REDACTED] commissioning within the T2 period.	PCD	44.63	All PSUP sites will be protected from physical attack, reducing the risk of loss of supply to consumers because of a physical security incident.
Formal legislation for all operators of essential services to implement agreed cyber security enhancements in line with NIS Regulation guidance. Final risk reduction based plan to be agreed with the NIS Competent Authority.	Cyber security: Enhanced cyber security and capabilities to a level agreed with the NIS Competent Authority. Implementation of investments across OT and Information Technology environments aligned to the NIS Cyber Assessment Framework.	PCD	16.84 (IT) 167.54 (OT)	Many cyber-attacks purposely aim to cause disruption such as loss of electricity supply. Effective protection and enhanced capabilities to respond to incidents minimises the impact on consumers if a cyber incident was successful.
Maintain a network resilient to external threats within the T2 period and beyond.	OpTel: Highly resilient and cyber secure operational telecoms infrastructure, essential for the safe and reliable operation of the system, supporting physical security management and Black Start capabilities. We will replace 1,850km of fibre-wrap , which has reached end of life, and telecoms equipment at 274 sites .	PCD	241.02	Provides ongoing overall system resilience by enabling communication and operation activities during and following incidents arising from system incidents and external threats.
Ensure rapid restoration in a Black Start scenario to meet requirements of proposed BEIS restoration standard.	Black Start: Enhanced system and people capabilities to ensure an efficient and effective response in a Black Start scenario. We will install high performance LVAC systems at [REDACTED] and resolve technical limitations on [REDACTED] .	PCD	22.19	Allows for a faster restoration of supply of electricity to end consumers in the event of a Black Start scenario.



5. The justification for our proposals

Our proposals will be delivered by the activities outlined within this chapter, which we have ensured meet the relevant requirements and guidance available for each threat area. The solutions that have been selected have been through a robust process which considers various options to deliver the required output, with Cost-Benefit Analysis (CBA) being conducted where possible at this stage. Lessons learnt have been captured from previous investment and incorporated into future projects. The proposed expenditure is efficient and has been subject to unit cost comparisons, cost audits and benchmarking where appropriate.

We have provided our view of our less certain costs under the cyber uncertainty category to ensure these proposals can be further developed and allowances requested once these costs and solutions can be well justified. The proposed reopener mechanisms will also ensure allowances can be adjusted appropriately should requirements change in the T2 period.

Key drivers

There are two key drivers for all the investments included within this chapter, these are:

1. **change in threat**
2. **change in requirements.**

Most importantly, we must ensure that the network is adequately protected from the threats we face and ensure that any impact on end consumers is minimal. To help assist with this, there is legislation and guidance in place to ensure appropriate levels of security and capability exist. The legislation and guidance that we are following for each threat category are listed below:

Extreme weather – ETR138 (guidance on flood protection) and request from BEIS that this is implemented within the T2 period.

Physical security – PSUP (BEIS requirements advised by CPNI to apply to all CNI sites on the PSUP list).

Cyber security – NIS Regulations (Ofgem and BEIS governed legislation)

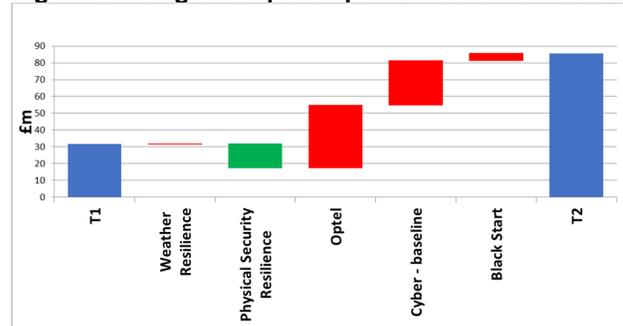
Black Start – Proposed BEIS standard (to be introduced into legislation or industry code)

OpTel – Industry standards (guidelines adopted by NGET, consistent with other TOs)

The impact that this legislation and guidance has on our expenditure in comparison to our actual capex expenditure in the T1 period is illustrated in figure 10.6. This graph has been provided in response to a request from the RIIO-2 Challenge Group. The figure compares annualised capex expenditure for the first six years of the T1 period with our proposed T2 investments. The main increase in expenditure is as a result of enhancing our cyber security and the refresh of the OpTel network. This is due to new cyber threats and requirements which have emerged throughout the T1 period and our OpTel assets (which were commissioned in the 1990s)

reaching end of life. Due to the significant progress made in protecting the network from physical attack within the T1 period, there is a net reduction in physical security expenditure, with extreme weather expenditure remaining flat in the T2 period. Figure 10.6 does not include forecast investment of c£200m, primarily in extreme weather, physical security and cyber in the last two years of the T1 period which would result in annualised expenditure of £62m. Cyber expenditure in the remainder of the T1 period is in response to NIS regulations and helps to prepare for delivery of our T2 investments.

Fig 10.6 Change in capex expenditure from T1 to T2



Increasing consumer and economical reliance on a constant flow of electricity as demonstrated through the ERP report findings, and through our own engagement with stakeholders, drives a need for higher levels of resilience across the whole network. The need for greater resilience on our network is driving our investment in Black Start and OpTel, as well as consideration of other whole system solutions.

Consideration of options

All of our proposed investments have undergone options assessment, considering different options available to mitigate the threats we face. The options considered for all investments included the options to;

1. **do nothing**
2. **defer investment to T3 or beyond.**

As there was a need to address priority threats within the T2 period, the majority of options considered related to timing, value of investment or level of protection or capability applied. Consideration of these options ensured we are taking an approach that is proportionate to the risk against our network. In all cases, we are taking an approach to protect our most critical or vulnerable assets and sites to ensure maximum benefit. This option will be deliverable and ensures we are not investing more than necessary for consumers, whilst still meeting the guidance and requirements available. In some cases, this has led us to phase investment across the T2 and T3 periods. We have also conducted Cost-Benefit Analysis (CBA) where appropriate to compare options. Further information on our options assessment and CBA for individual investments can be



Our plans for **extreme weather** and **physical security** are based on existing requirements for which we have delivered programmes of investment within the T1 period. Our costs have been based on historic spend, building in efficiencies where possible for T2. T1 PSUP costs have been subject to independent technical and value for money audits and align with comparable Gas Transmission benchmarks. The majority of costs passed technical and value for money audits with no issues, with a small percentage of costs referred to Ofgem for their review. All these works in T2 will be competitively tendered.

The majority of our T2 expenditure on physical security will be on [REDACTED] sites requiring security measures to be in place, resulting **£24.4m** investment. The remaining **£3m** is to be spent on ongoing maintenance activities. The remaining **£17.2m** of costs outlined within our cost table are ongoing opex costs for managing the physical security on a day to day basis.

The majority of our **cyber security** investments are in response to new threats and requirements. For this reason, our costs have been supported by external benchmarking and tenders where possible. In late 2019, we conducted benchmarking on our approach, methodology and costs for the investments included within our Business IT Security Plan. This concluded that we were within range on cost and level of capability when compared to utilities worldwide. Further information about our benchmarking activities against our key cyber investment areas can be found within annexes NGET_A10.04 Business IT Security Plan, NGET_A10.09 Cyber Resilience Plan and NGET_A10.11 Cyber Benchmarking (Gartner).

Where we have not been able to provide sufficient justification for our costs, these have not been included within our baseline allowance request. Further research into viable options and assessment of costs for chosen solutions will be completed prior to requesting adjustments to allowances within the T2 re-openers.

Black Start costs are based on efficiently incurred costs for LVAC asset replacement in the T1 period, and standard times for maintenance and testing activities.

Our **OpTel** costs are based on learning and experience from OpTel and associated projects during the T1 period, and efficiently incurred costs for the deployment of Optical Path Ground Wire (OPGW) during our T1 overhead line refurbishment plan. Our OpTel costs incorporate planned efficiencies from aligning OpTel and overhead line refurbishment work in the T2 period and are phased to deliver capacity at the point when it is required.

Benchmarking and efficiency

Gartner conducted a benchmarking exercise, see annex NGET_A10.11 Cyber Benchmarking (Gartner), on our cyber resilience methodology and business plans. This

demonstrates our proposed cyber investments are aligned to market costs for equivalent capabilities based on scale, scope, geography and complexity. Our plans have not changed as a result of this benchmarking since October 2019. Our physical security costs have been subject to a value for money audit within the T1 period and are comparable to Gas Transmission benchmarks. The remainder of our costs are informed by historical costs and efficiencies from the T1 period.

We are also making stretching commitments to future efficiencies, applying a **£3m productivity commitment** to improve the productivity of our people by 1.1% year on year. Further detail is provided in Chapter 14 – *Our total costs and how we provide value for money.*

BAU Innovation

The NIS Regulations are driving cyber investment in the T2 period. This has enabled us to engage with the NIS Competent Authority and implement enhancements to our cyber security within the T1 period. [REDACTED]

[REDACTED] We will continue to utilise options for delivery on physical security and flood protection as used within the T1 period, aligning these investments to minimise impact and drive efficiencies.

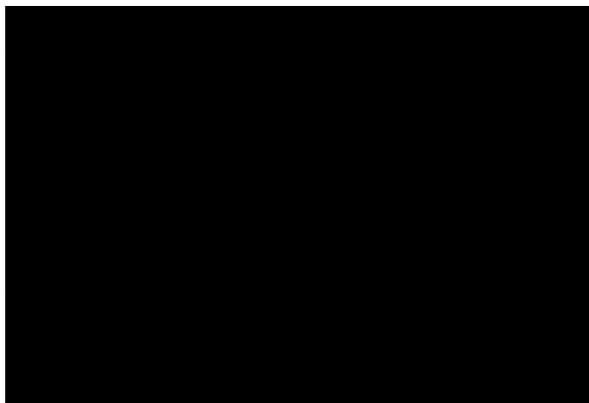
Enabling whole systems

As mentioned previously, cyber security on OT is a fairly recent need and therefore we have not yet explored all options for whole system solutions in this area. We have engaged with the Scottish TOs to understand where this will be possible as the risk to OT spans the entire network. We will expand our engagement to other network companies and consider opportunities to develop whole system solutions. The decision to allow for re-opener opportunities within the T2 period also allows us to engage further and develop whole system solutions in this area.

How we will deliver on cyber security

We are currently working with the NIS Competent Authority to develop and agree strategic plans for how to improve our cyber-security within the T2 period. Our investments will focus on [REDACTED]

[REDACTED] These plans are being developed using a risk-based methodology to ensure we are prioritising our most critical risks and systems.



- A10.05 – Extreme weather
- A10.06 – Physical security (Confidential)
- A10.07 – Black Start
- A10.08 – OpTel refresh
- A10.09 – Cyber Resilience Plan (Confidential)

6. Our proposed costs for the T2 period

Our proposed expenditure in T2 is detailed in table 10.8 below. Further justification on how these costs have been benchmarked, and how our operational expenditure has been assessed as efficient is detailed within Chapter 14 *Our total costs and how we provide value for money*.

Table 10.9 shows the cyber uncertainty costs which are not included in our baseline submission but are included for transparency of our current view of T2 re-opener value.

Our detailed justification of our business plans for this chapter are included within the following annex documents:

A10.04 – Business IT Security Plan (Confidential)

Table 10.8 – Proposed baseline costs for the T2 period*

Baseline cost	21/22	22/23	23/24	24/25	25/26	Total T2	Annual T1	Annual T2	Subject to native competition	Internal historical benchmarks	External benchmarks	Subject to UM
Extreme weather	4.30	8.76	14.28	16.15	16.33	59.81	15.57	11.96	✓	✓		✓
Physical security	4.27	3.48	4.47	27.85	4.57	44.63	32.42	8.93	✓	✓	✓	✓
Cyber security (IT)	5.30	6.41	5.13	0.00	0.00	16.84	2.24	3.37	✓	✓	✓	✓
Cyber security (OT)	33.61	38.62	40.90	30.24	24.17	167.54	6.09	33.51	✓	✓	✓	✓
OpTel	26.71	42.47	66.39	48.22	57.23	241.02	5.42	48.20	✓	✓		
Black Start	4.39	4.39	4.47	4.47	4.47	22.19	n/a	4.44	✓	✓		✓
Supporting IS investment	0.52	0.67	0.64	0.53	0.51	2.86	0.17	0.57				
Total	79.09	104.80	136.28	127.46	107.28	554.90	61.91	110.98	Cost certainty: High confidence			
Pension allocation						1.08						

*Business Plan Data Table References: Extreme weather – C2.24, Physical security – D4.4a, D4.4b, OpTel – C2.25, Cyber Security (IT) – D4.8b, Cyber Security (OT) – D4.8a, Black Start – C2.12

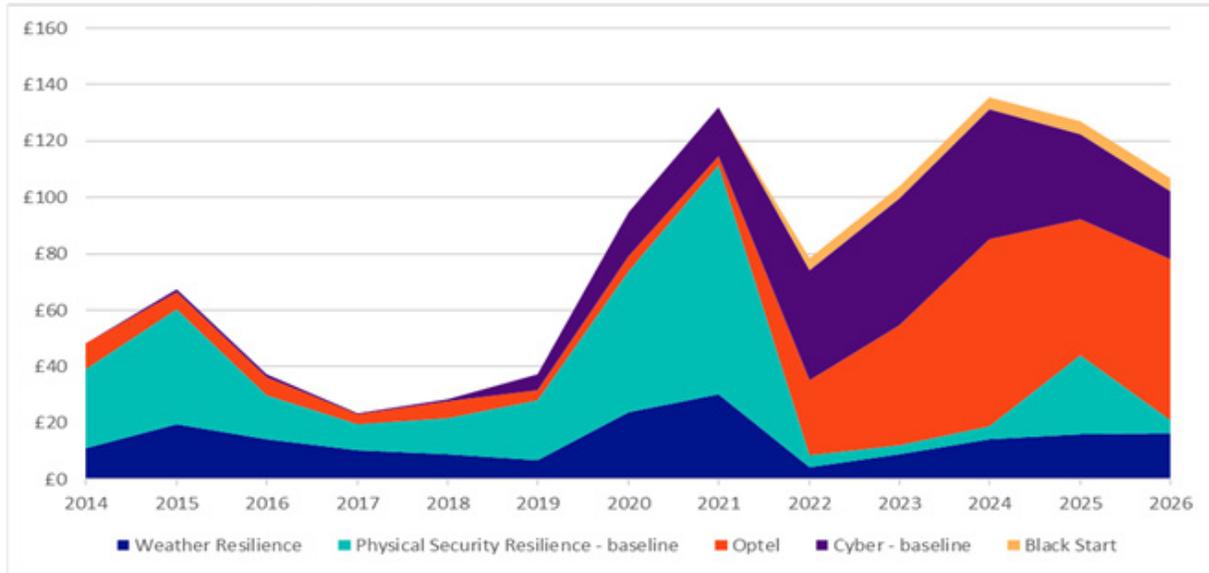
Table 10.9 – Other potential expenditure for the T2 period

Other potential expenditure	Totex (£m)	Not in baseline due to...	Covered by UM
Cyber Security (Information Technology)	12.56	Costs for years 3 & 4 of our plan have not been included to account for likely change in cyber threat. This allows for projects to be delivered later in our T2 plan to be subject to further development and take advantage of newer solutions available within the T2 period.	Proposed uncertainty mechanisms for cyber security
Cyber Security (OT)	364.38	We are continuing to develop our cyber plans for the T2 period with the completion of some trial works within the T1 period. This allows us to test solutions and vendors for works to be requested through a T2 re-opener when the scope, solution and costs are more certain.	Proposed uncertainty mechanisms for cyber security

The figure below shows the baseline spend across the T1 period and proposed T2 expenditure for this topic.



Figure 10.10 Expenditure profile across the T1 and T2 period



Within the T2 period, we will be investing more in the areas of Black Start, cyber security and ensuring a resilient OpTel network. We are making these investments to ensure an approach in which there are several layers of defence from threats. This means that if an attacker was able to break a control, they would not necessarily be able to gain access to the information/data they seek or cause the disruption intended.

Our cyber security enhancements on OT are co-ordinated with our asset replacement and maintenance programme to drive efficiencies where possible and minimise any disruption to customers and end consumers. For the avoidance of doubt, the cyber investments in this chapter are above and beyond our general asset maintenance and IT investments.

7. How we will manage risk and uncertainty

We have no control over the nature of external threats, how they change and how quickly they change. In line with historic trends, we can expect that they will become more frequent and

sophisticated in nature. We will manage the risk they pose by monitoring threats and having flexible business plans that we can adjust or reprioritise.

To ensure we can deliver the protection needed and that consumers only pay for what is necessary, we are proposing the following approach to managing risk and uncertainty:

- Baseline allowances for investments with known and deliverable outputs.
- Uncertainty mechanisms to account for uncertain costs or solutions, as well as potential changes to requirements in the T2 period.

The uncertainty mechanisms we are proposing will allow us to address new and emerging threats, respond to the latest threat mitigation guidance and meet new requirements as they arise. This will ensure that we can constantly assess the threats against the network and take the required action (as agreed with relevant authorities) to effectively protect the network and continue to deliver a secure supply of electricity to end consumers. We summarise the proposed uncertainty mechanisms in table 10.11 below.



Table 10.11 – Proposed uncertainty mechanisms for the T2 period

Topic	Why it is needed	Mechanism	Frequency
Extreme weather	Potential change to requirements outlined in ETR138 due to change in flood risk or extreme weather threat.	Re-opener	Once within the T2 period
Physical security	Potential change to physical security Upgrade Programme (PSUP) requirements or site-specific requirements. This may result in more or less sites requiring site security enhancements.	Re-opener	Twice within the T2 period (mid-way and end)
Cyber security	Change in threat, advance in technology, new requirements, greater certainty about appropriate solutions, reprioritisation of deliverables required.	Re-opener	Twice within the T2 period (at the start and mid-way) *
Black Start	Potential change in BEIS requirements.	Re-opener	Once within the T2 period.
Ensuring a resilient electricity network	Potential requirements resulting from ongoing engagement with stakeholders about applying enhanced levels of overall resilience to the network. This could also address enhanced resilience to new threats not currently addressed within T2.	Re-opener	Once within the T2 period.

*Within their Sector Specific Methodology Decision, Ofgem stated that there would be two re-openers for works included within the Cyber Resilience Plan (OT) and one re-opener for works included within the Business IT Security Plan (Information Technology). The threats we face are constantly evolving [REDACTED] For this reason, we consider it appropriate to also allow for a second re-opener for the uncertainty within our Business IT Security Plan.

We understand that it may be Ofgem’s intention only to allow the first re-opener for OT if network companies chose not to submit their business plans in December 2019. Given the evolving cyber landscape on OT, we have provided a proposal for investments in which we have high confidence in scope, cost and deliverability with a view of required projects for which we are not currently seeking allowances.

The work we are completing to enhance OT cyber resilience within the T1 period will enable us to be in a more informed position at the first T2 re-opener opportunity to request allowances for these works. We therefore request that Ofgem allow network companies that have provided business plans in December 2019 to have use of the first re-opener within the T2 period. We expect a re-opener mechanism to take the form of a one-off submission to Ofgem within a defined scope of investment, that will be assessed and result in an agreed adjustment to allowances within the T2 period.

Probability and impact

The probability of requiring the use of a re-opener varies between topics. We consider it very likely that we will be requesting adjustment to allowances through the cyber re-openers in the T2 period. As the cyber NIS Regulations are relatively new, we expect to have frequent ongoing engagement with the NIS Competent Authority. This engagement will help us to keep up to date with their view of cyber risk, whilst also being informed by other sources and monitor delivery of our

investments. We expect that this engagement will inform changes required to both our IT and OT cyber plans throughout the T2 period and subsequently inform adjustments requested to allowances through the available re-openers.

We do acknowledge that Ofgem have proposed that the Business IT Security Plan and the Cyber Resilience Plan should have separate regulatory treatment, with the Cyber Resilience Plan managed on a ‘use it or lose it’ basis. For this reason, we propose that the Cyber Resilience Plan is reviewed at the end of the T2 period to take account for any changes to plans and allowances through the re-openers.

On topics like extreme weather and physical security, requirements are clear and the threat is not expected to change quickly or significantly. The use of these re-openers is less likely but we consider them necessary in ensuring that changes to requirements can be addressed in a timely and efficient manner if required.

We are also proposing a re-opener mechanism that covers the need to enhance resilience of the electricity network. The electricity sector will experience significant change over the next ten years, with electricity increasingly used to decarbonise other sectors (e.g. transport and heat), leading to an increasing dependence on electricity, requiring greater resilience. Through ongoing engagement with stakeholders on future network resilience, we will continue to progress our focus on resilience measures and solutions. Further detail on how we plan to manage uncertainty can be found within the relevant Investment Decision Packs and also annex NGET_ET.12 Uncertainty mechanisms.

Next steps

We welcome questions from Ofgem on our proposals and propose ongoing engagement with Ofgem, CPNI, BEIS, and the NIS Competent Authority.



11. We will care for the environment and communities

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification of our proposals
6. Our proposed costs for the T2 period
7. How we will manage risk and uncertainty

What this stakeholder priority is about

This priority is about the steps we, as a responsible business, will take to improve the environment and serve communities and society. It covers our contribution to tackling climate change, reducing waste, improving the natural environment and improving the visual impact of our assets. It also covers how we support local communities, wider society, act as a responsible employer and promote ethical practices in our supply chain.

What you have told us so far

You have told us that you want us to continue to enhance the environment and make a positive lasting difference by:

- enhancing the environment by reducing our greenhouse gas (GHG) emissions, improving the natural environment and the visual impact of our assets in protected landscapes, for everyone to enjoy
- making a positive and long-term contribution to society and the communities we work in.

Supporting the fuel poor and vulnerable attracts mixed views – we have addressed this by prioritising education and employment and by funding our local community commitments both via consumer bills and our business.

What we will deliver

For the environment, we will:

- reduce our scope 1 & 2 GHG emissions by at least 34%¹ by 2025-2026, and 50% by 2030 in line with a net zero pathway
- show **SF₆ leadership**, taking brave steps to help the market develop faster to meet needs
- reduce our office energy use by 20% and source **100% renewables** for our metered electricity
- replace **100% of our fleet** with electric vehicles, where market alternatives are available today

¹ Target changed from July plan, previously stating 45% from a 2012/13 baseline - now stating 34% from a 2018/19 baseline - is

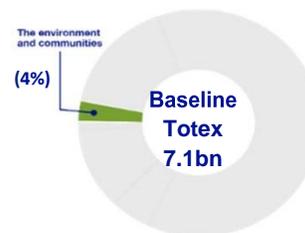
- achieve **net-zero GHG** emissions for our construction activities by using PAS 20280
- **act as leaders** with tools and data to advance environmental good practice
- improve the natural environment at our sites by increasing the **environmental value** of our non-operational land by 10% by 2025-2026
- improve the **visual impact** of our assets at specific sites, which will improve natural landscapes for people to enjoy
- use **circular economy** principles to minimise the amount of waste produced and maximise reuse

For communities and society, we will:

- **support those affected by our construction** activity with up to £7.5m of investment
- **focus on low income communities** providing access for **6,000 young people** to skills development, tracking their progress to potential employment
- create an **Urban Improvement Provision** to improve our assets or public spaces in areas of **urban disadvantage**
- drive our **real living wage** commitment further into the supply chain, by verifying at Tier 1
- require an annual upskill of **5% of the technical headcount** and **drive responsible** practices further into the supply chain

The total cost of delivering these baseline proposals is £255m. This represents 4% of the overall business plan as reflected in figure 11.1 below.

Figure 11.1 Proportion of expenditure



compatible with our verified 50% reduction by 2030, as defined by the Science Based Institute to deliver a net zero pathway



1. What this stakeholder priority is about

We are facing an unprecedented global emergency. **Urgent action against climate change** is required if we are to prevent further increase in events which could entirely change life as we know it today, especially for those in **vulnerable circumstances**. We fully support the UK government's introduction of legislation to achieve net zero by 2050. Our work to facilitate a low- carbon future energy system is covered in chapter 7 *We will enable the ongoing transition to the energy system of the future*. This chapter focuses on our commitment to **net zero** and the **ecological crises**, through our direct impacts on the environment and communities.

Our vision is to exceed the expectations of our communities. We believe that we, as a business that operates both nationally and locally, have a great opportunity to support citizens of **disadvantaged** backgrounds earn more, and fully participate in society and the green transition. Our commitments will focus on achieving **social**



mobility outcomes via our community touchpoints, enabled by **skills education** and **employment**, as a practical fit for our business expertise. We will also continue to listen to the needs of those we impact. These areas of focus are shown in the diagram above. This chapter is structured around two main areas:

1. **Enhancing the environment**, which includes:
 - i) our climate commitment and sustainability leadership
 - ii) enhancing the natural environment and preserving precious resources
 - iii) improving the visual impact of our assets in protected landscapes
2. **Making a positive contribution to society** and the communities we work in, which includes:
 - i) supporting local communities
 - ii) supporting wider society
 - iii) community prosperity through employment and our supply chain

Consumer value proposition (CVP)

The CVP looks at the value we are providing above Ofgem's minimum requirements that we can robustly monetise. This chapter contains the following CVP items:

- CVP5 - Caring for the natural environment (value of £14.67m)
- CVP6 - Supporting local urban communities (value of £22.58m)

For more detail, please see chapter 5.4 and the CVP annexes ET.07 to ET.07C.

2. Track record and implications for T2

2.1 Enhancing the environment

We have an Environmental Management System (EMS) that is certified to ISO14001:2015 (an international standard that specifies requirements for an effective EMS, covering all our operational and non-operational businesses in the UK). For further information on this system, please refer to annex NGET_A11.01 EMS.

In 2019 we published our Electricity Transmission Environmental Future strategy, [here](#), which outlines our performance and targets in the T1 period.

i) Our climate commitment and sustainability leadership

Our climate commitment focusses on the GHG emissions that our business is directly (scope 1&2) and indirectly (scope 3) responsible for. SF₆ is the only current financially rewarded output in the environmental topic.

SF₆ incentive performance - SF₆ is a particularly potent GHG. It has a global warming potential (GWP) 23,500 times stronger ([according to the latest IPCC data](#)) than CO₂. In the T1 period we were incentivised to reduce harmful GHGs from SF₆ leakage and to support the transition to low GHG alternative gases. The incentive allows a calculated leakage as a % of total volume, discounting volume from replaced assets. We have delivered a solid performance against the defined leakage allowance, saving 11.8tonnes or 283,000tCO₂e and forecast a total reward of ~£12m. This is illustrated in figure 11.2 below. For further details, please see our T1 period reporting [page](#) and annex NGET_ET.06 ODIs, which details the methodology for current SF₆ gas leakage measurement.

Figure 11.2 SF₆ incentive performance



Track record for T1 incentive output		
GHG Performance	T1 O/P	T1 Performance
SF ₆ leakage	Incentive	Average 16% ahead of target



Innovation in the T1 period - to materially benefit climate change (for further information see annex NGET_A12.02 Innovation)
 We continue our three main SF₆ work streams:

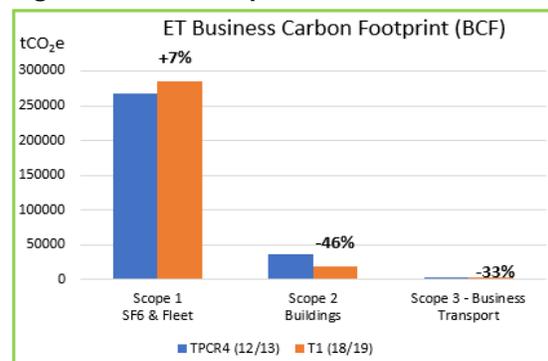
- **new build alternative gases** – we were the first to trial g³ (GWP:346) on gas insulated busbar (GIB) at Sellindge
- **retrofit gas alternatives** – investigating replacement of SF₆ in switchgear
- **leak repair techniques** – working with Cardiff University to study long term effectiveness and performance in an electric field.

ii) Other environmental performance

During the T1 period, we have decreased our scope 2 and scope 3 GHG emissions considerably but, due to a poor performing year on SF₆ in 18/19, our scope 1 emissions have increased by 7% overall from the end of the TPCR4 period. A different approach for SF₆ and fleet emissions is required for the T2 period to create greater reduction. Please see table 11.3 which compares 2012/13 to 18/19 ET GHG performance.

Innovation in the T1 period. In 2015, we developed an innovative tool with AECOM to recognise and account for the value of natural assets (Natural Capital)
 the benefit is biodiversity enhancement, habitat protection, access to **green spaces for communities**, carbon capture and potentially lower site maintenance costs.

Figure 11.3 ET GHG performance 2012/13 to 2018/19



As well as having a regulatory incentive for SF₆, we have a self-imposed ambitious target of 20% reduction in the T1 period which was set in the March 2019 environmental strategy. In 2018/19, the overall increase in SF₆ was principally due to an increase in leak rates at the highest leaking sites. Assessments have been made on these assets and repairs have been prioritised to achieve the best cost, risk and performance balance. We still work hard to achieve our 20% voluntary reduction target; our opinion however is that reactive repair alone is not a sustainable solution to SF₆ emissions reduction. An outline of our other voluntary environmental performance can be seen in table 11.4 below.

Table 11.4 T1 environmental performance

	Category	Voluntary Commitment	T1 Performance at 2018/19	
Climate and leadership	SF₆ leakage	Yes – 20% reduction in controllable BCF	7% increase on 2012/13 leakage	
	ET Fleet		30 vehicles purchased for EV pilot	N/A
	Buildings		Decreased energy usage by 46% in our offices	N/A
	Mileage		Decreased carbon from business travel by 33%	N/A
	Capital Carbon	Yes - 50% reduction in carbon intensity from 2015/16 to 2020/21	From 2015/16 to 2018/19 we achieved a 50% reduction in carbon intensity, from 232 to 117tCO ₂ e per £1m of construction spend	
	Supply Chain	Yes – 80% of suppliers reporting through the carbon disclosure process (CDP)	96% of Top 250 National Grid suppliers reporting through CDP	
	Leadership – no T1 target		<ul style="list-style-type: none"> • Engaged closely with TO peers to share ways to standardise processes on capital carbon and net gain • Engaged with a variety of environmental groups, e.g. The Aldersgate Group, We Mean Business, Business in the Community and CDP • Embedded an internal carbon price in to our network development progress • Created a new environmental page on our website to transparently share our environmental performance with our stakeholders 	
Resources and waste	Natural Capital	Yes - Improve natural capital on 30 sites and achieve net gain on all major build projects by 2020	<ul style="list-style-type: none"> • 29 of 30 sites and 34% natural capital increase at the sites • on track for net gain on major construction projects • collaboration with over 40 local groups and organisations like the Wildlife Trusts, councils and local beekeepers 	
	Waste	Yes - Reuse/recycle 100% of recovered assets, 100% landfill diversion from our offices and 95% on operational sites and remove all single use plastic from sale by 2020	<ul style="list-style-type: none"> • asset recovery to be measured from 2019/20 • today 95% of office, 93% operational waste is diverted from landfill with 45% of operational waste recycled • on track to remove all single use plastics from sale in our offices by 2020 – video here 	



iii) Improving the visual impact of our assets in designated landscapes

We run a scheme called the Visual Impact Provision (VIP) project to reduce the visual impact of our existing transmission infrastructure (overhead lines) in England and Wales in National Parks and Areas of Outstanding Natural Beauty (AONBs). As part of the T1 framework, Ofgem allocated £500m (2009/10 prices) from which the three British transmission owners could apply to fund projects to improve designated landscapes. We established an extensive engagement process with stakeholders to select and deliver projects, including creating an independent Stakeholder Advisory Group (SAG). Ofgem approved our VIP policy and process; using these, we identified overhead line sections suitable for undergrounding and a larger number of opportunities for smaller landscape enhancement projects.

Any project approved by Ofgem during the T1 period will be funded from the £500m provision, regardless of when the spend occurs. To date, we have been awarded £120m (2018/19 prices) to deliver a project in the Dorset AONB, of which 90% is allowed in the T1 period and the remaining 10% in T2. The Dorset project will replace 8.8km of overhead line near Dorchester with an underground cable, permanently removing 22 pylons from the landscape. We anticipate making further funding submissions for major undergrounding projects during the T1 period and our baseline forecast for the T2 period reflects spend if these were approved.

Launched in May 2016, the Landscape Enhancement Initiative offers grants of up to £200,000 for local visual improvement projects. Each of the 30 National Park Authorities and AONB Partnerships covered by the initiative can submit applications for projects. These are assessed by a sub-committee of the independent Stakeholder Advisory Group, before making a funding submission to Ofgem. As of 31 March 2019, Ofgem has approved £1.6m of LEI projects. This funding will be passed directly to the independent organisations who are leading on delivering these LEI initiatives.

We recognise that there will be short-term landscape impacts during construction. However, the long-term benefits will outweigh this, as outlined by the Dorset planning committee. This would be similar for all the VIP projects: *'...Natural England is satisfied that the temporary impacts are far outweighed by the long-term benefits of the scheme.'* - **Natural England.**

Figure 11.5 Planned removal of a section of overhead line in the Dorset AONB



Innovation – for the future

We have been working hard on innovations which will reduce the cost and environmental impact of future underground transmission.

- We've been exploring a version of gas-insulated line which uses a gas mix with a lower GWP than SF₆ – the benefit being **whole-life cost reduction and reduced environmental impact.**
- We are also testing 'liquid soil' at Cardiff university. This **new backfill material is innovative** as it can conduct heat away from a cable better than standard backfill – **resulting in the use of higher cable ratings, rather than installing larger more expensive cable.**

Innovation in the T1 period- Dorset project

- Placing the **cable in a duct** rather than directly burying it - **the benefit is faster reinstatement of land with less disruptive maintenance and eventual replacement.**
- **Jointing** - cables must be joined together on site, normally under a tent system. Here, using a new container system to house the jointing and welding equipment – **the benefit is higher quality and productivity compared to before.**
- Reduced joint bays - cable manufacturers have designed **new transport**, meaning longer lengths of cable can be added to a single drum - **the benefit being reduced vehicle movement and fewer joints.**

2.2 Making a positive contribution to society and the communities we work in

i) Supporting local communities and wider society –

we engage local communities around our major construction projects to understand how we can minimise the impact on their lives and look for opportunities to leave a positive legacy. Some of our achievements in this respect, for the UK in the T1 period include:

- achieving 50% local employment (30/60) against a required 17% on the Hinkley project, on track to engage with all 237 of the local schools to inspire STEM and upskilling 150 people every year (prioritising the hard to reach) – 50% going on to employment
- raised £2.24m for our charities of the year
- through matched giving, funded £1.25m to charities chosen by our employees
- supported over 5,000 hours of community volunteering
- we have so far invested £137m for 32,000 first-time central heating systems to many UK vulnerable consumers through the Warm Homes Fund
- We have funded £1.55m of community grant projects near to our construction activities or operations



ii) Community prosperity through employment and our supply chain - we passionately believe that having an inclusive and diverse workforce as well as a supply chain that focuses on human rights,

will help us thrive. Further information is provided in annex NGET_A11.02 Inclusion and Diversity Policy. Some of our achievements in these respects, for the UK, are listed below:

Social Mobility	BAME	Gender	Support for SMEs	Supply chain – modern slavery	Supply chain – real living wage
Top 50 employers- Social Mobility Foundation 2018	Best 'UK Employers for Race - top 70 list' from 'Business In The Community' (BITC)	-gender pay gap of 4% (we strive for 0%) against UK industry average of 15% -secured a place on The Times Top 50 Employers for Women	A target for 33% of contract spending should be with small and medium-sized enterprises by 2020	"National Grid are part of a small cluster of leaders tackling modern slavery and human trafficking." - Business & Human Rights Resource Centre.	"It felt good to have a pay rise, I can support my family more and I don't have to borrow money to support myself..." - 14Forty employee , after 2018's real living wage uplift for 26 contractor employees
Social mobility employer Index #31	nearly doubled our UK core BAME from 8% ² to 14% (18/19 average)	% UK core female from 18% ² to 20% (18/19 average), against a UK industry average of 11%	UK regulated businesses achieved our annual target of 27% SME contract spending last year	Business and Human Rights Resource Centre ranked us 12th in its FTSE100 Modern Slavery rating index.	Members of Living Wage Foundation since 2015

3. What our stakeholders are telling us

A summary of our engagement activities and outcomes is provided in table 11.6 below, alongside what trade-offs have been made and how

stakeholders have influenced the plan. The engagement log contains detailed information on our engagement approach and outcomes. This can be found in annex NGET_A11.08 Engagement log.

Table 11.6 Summary of our engagement

	Engagement relating to the Environment
Purpose and approach	To understand our stakeholders' views about our impact on the environment, including carbon emissions and local environmental impacts and the improvements we could make. Establish the values business and domestic consumers feel they should pay for certain visual impact activities and which projects would deliver the most value.
What stakeholders and consumers have told us	<ul style="list-style-type: none"> All stakeholders, especially consumers, want us to take ambitious action on climate change and potentially use carbon offsetting to make relevant activities carbon neutral as well as adopting responsible use of assets. We should reduce the overall volume of SF₆ we leak and continue efforts to find alternative insulating gases. Recent consumer testing has indicated that reducing emissions is almost as important as safety and reliability. With no associated costs, 60% of consumers want us to be a carbon neutral business by 2030 or 2040 with younger citizens and women being the most supportive. Some consumers said they'd prefer our efficiency savings to be channelled in to environmental investments. We should make investment decisions based on the whole-life cost of each option, including the cost of carbon, and use this approach to help minimise our overall carbon emissions. We should minimise the local impact of construction on the environment. We should achieve environmental net gain at our construction projects, provided the costs are reasonable. We should be more ambitious in improving biodiversity. We have an established assessment methodology for assessing the VIP project priorities, created by an independent landscape specialist and an independent Stakeholder Advisory Group, consulted on and approved by Ofgem. This methodology, along with extensive engagement reduced the shortlist down to 12 potential projects and then prioritised four for initiation in the T1 period. Regarding the cost of the T1 VIP projects, most bill payers (66%) found it acceptable for the cost of VIP to be socialised via household bills.

² Note these 2012/13 statistics included the Gas distribution business and our 2018/19 values do not



Key trade-offs and how engagement influenced our plans	<ul style="list-style-type: none"> • There is a wide mixture of views on visual impact from those most impacted stakeholders who feel that we should do anything possible to avoid negative visual impact, and are willing to pay for this to those who are less impacted and don't want to pay. Whilst the views are mixed, stakeholders feel that the current stakeholder-led approach, assessing visual impact on a case-by-case basis, is robust, therefore the decision to continue the T1 approach into the T2 period is valid and supported by nationally representative consumer data. • In shaping our proposal to meet net zero, the option to remove the risk of SF₆ leaks through the use of non-SF₆ cable makes a trade-off against the £150m investment to achieve a 34% reduction.
How we've responded to the Independent Stakeholder Group / Challenge Group	<ul style="list-style-type: none"> • Following the Independent Stakeholder Group challenge, we provided data on our external industry benchmarking exercise and undertook engagement with external experts to validate the ambition of our targets. Because of the comprehensive engagement with vehicle manufacturers we have reduced our investment plan from 70% EVs by 2026 to 60% based on current and forecast availability of suitable vehicle products. • For VIP – the Independent Stakeholder Group asked us to provide value for money and innovation information which was included in July's draft submission. • The RIIO-2 Challenge Group requested details of our proposed greenhouse gas targets, justification for cost and ambition. In response to this, and our ambition to support net zero, we have set out our two key investments relating to fleet and SF₆ as well as detailing our roadmap to net zero in the executive summary.

Engagement relating to the Communities	
Purpose and approach	<ul style="list-style-type: none"> • To understand the views of local communities and how we can best support them. • To understand the areas where our business activities affect society and understand how we can maximise our total societal impact (TSI – meaning the total benefit to society from a company's products, services, operations, core capabilities, and activities).
What stakeholders and consumers told us	<ul style="list-style-type: none"> • We should engage deeply with local communities affected by our construction projects. We should do more to help such local communities and consumers are willing to pay a material amount for us to carry out more community activities but this always comes out at one of the lowest priorities overall as the beneficiaries are narrower than the overall carbon goals. • We should be a responsible and sustainable business. We should work closely with business, our supply chain and consumers to achieve shared goals. • Our investors expect us to make our contribution to society a central axis of our long-term strategy, leading the energy transition. • Our total societal impact work suggested that we will have by far the biggest effect by advancing clean energy systems. Our contribution could be large in each area of electricity, transport and heat. Interviews and surveys also highlighted the priority that the public places on securing and accelerating the energy transition and doing so in a way that ensures fairness and equal access to the benefits of the transition. • However, through our consumer qualitative research, against a value of £10m per year, strong support was seen for improvements in disadvantaged communities as <i>'people should be able to be proud of where they live and some people don't have a choice'</i>.
Key trade-offs and how engagement influenced our plans	<ul style="list-style-type: none"> • Most engagement supports doing more for local communities, and that minimising the impact on local communities is a priority. However, there are some organisations (particularly organisations that have direct interests in new connection projects) that are more ambivalent about impacts on local communities. The view of these organisations has been largely downgraded given these commitments would do little to negatively impact their interests and that consumer research overall supports our community proposals. • Supporting the fuel poor and vulnerable attracts opposing opinions. Some feel it should be a given whilst others feel it's not our role. We have addressed this by prioritising education and employment and by shared funding of our community commitments via both consumer bills and our business which is supported by the consumer acceptability testing and research. Further community impact will be measured by the engagement we undertake for large infrastructure projects.
Response to the Independent Stakeholder Group / Challenge Group	<ul style="list-style-type: none"> • The Independent Stakeholder Group asked us to clarify what our visual amenity policy was in deprived areas. We have created an additional commitment to improve our assets or public space in deprived communities as a direct response to this challenge – this has received excellent support from consumers in our acceptability testing workshops on the assumption that Ofgem approves efficient costs and impacted stakeholders select the projects to be completed. • Following a suggestion also from the Independent Stakeholder Group that we should provide centralised resilience advice, we concluded that this is more appropriate for distribution networks due to their direct connections to the relevant organisations.



4. Our proposals for the T2 period

The table below outlines how, what stakeholders told us, links to the proposals we are making and the consumer benefits. Further environmental commitments are listed in our annex NGET_A11.05 Environmental Action Plan

Table 11.7 Our proposals for the T2 period

Stakeholder Topics - Environment	Our proposals	Baseline	Output	Output type/ NGET /UK/ Group	Consumer benefit
1.i) Environment – our climate commitment and sustainability leadership	1 of 3 net zero pathway investments towards a science based target (SBT) of 34% scope 1 & 2 emissions reduction i) agree funding with Ofgem and deliver a targeted SF₆ asset replacement programme ii) leakage control ODI – volumes to be independent of replacement programme. iii) stop designing with 132kV SF ₆ assets in new builds by 2021 iv) stop using 275/400kV SF ₆ assets in new builds by 2024 (once two solutions are available), sending clear market signals to support this (in 2020) v) continue to use collaboration and innovation to develop alternative technologies so that we no longer have to buy equipment that uses SF ₆ as an insulating gas. Measure: tCO₂e	280,472 tCO ₂ e in 2019 (using AR5, SF ₆ = 23,500 times CO ₂)	-33% Scope 1 emissions (SF ₆), down to 187,916 tCO ₂ e by 2026	NGET i) Uncertainty Mechanism (UM) or ODI >£150.00m - not in baseline ii) ODI – not in baseline iii) & iv) Commitment (no funding request)	Reduces the impacts of climate change , cleaner air in urban areas and climate progress across industry
	2 of 3 net zero pathway investments towards a science based target (SBT) of 34% scope 1 & 2 emissions reduction i) Operational fleet - replacing 100% with alternative fuel vehicles, where alternatives are available today (2019) ii) this commitment translates to 60% ET fleet replacement at today's market availability iii) the benefit will be a 54% reduction in ET fleet emissions and -1% of scope 1 emissions iv) we will install and maintain charge points across 234 ET sites to enable our fleet commitment v) work with DNOs to ensure efficient use of infrastructure. Measure: % vehicle replacement	3.59% (30/836) electric fleet in 2019	60.00% (499/836) electric fleet by 2026, -1% scope 1 emissions	NGET i)-v) PCD (£47.49m in baseline) ODI for above 60% replacement - not in baseline	
	3 of 3 net zero pathway investments towards a science based target (SBT) of 34% scope 1 & 2 emissions reduction - Purchased electricity – We will focus on an efficiency-first approach to decrease the carbon emissions from our office energy use by 20% - We will purchase 100% of our metered electricity from renewable sources. Measure: tCO₂e and date of renewables contract	19,279 tonnes of CO ₂ e in 2019	15,432 tonnes CO ₂ e, and renewable sources -100% scope 2 emissions	NGET Commitment (no funding request)	
	- We will continue to report annually on the actions we have taken to reduce the transmission losses induced by our network as well as any activities that have impacted on the losses. Measure: Actions taken	LO to report on actions	LO to report on actions	NGET Special license condition 2K	



	<p>- Substation usage - We will create a substation energy efficiency programme Measure: tCO₂e</p>	Ad hoc initiatives	Energy efficiency upgrades	NGET Commitment (no funding request)	
	<p>- Capital carbon - Achieve net-zero carbon construction by 2025/26 by further implementing PAS2080, supported by an offsetting policy and based on current business assumptions that 180,000tCO₂e can be offset with up to £2.5m. Measure: tCO₂e</p>	31,000 tonnes of CO ₂ e in 2019	~0 tonnes of CO ₂ e in 2026	NGET -PCD (£2.50m in baseline)	
	<p>- Business transport - Reduce carbon emissions for our business transport by 10% from T1 to end of T2 - reduce vehicle use by promoting rail and virtual meetings and promote EVs on company car scheme and install electric car charging points at ET substations Measure: tCO₂e</p>	3,494 tCO ₂ e, T1 average	3,145 tCO ₂ e in 2026	NGET Commitment (no funding request)	
	<p>- Supply chain - 75% of National Grid's top 250 suppliers (by category/spend) will have carbon reduction targets Measure: % of suppliers with reduction targets</p>	49% with emissions targets	75% with emissions targets	NG Group -Commitment (no funding request)	
	<p>- We will lead in transparency on capital carbon and natural capital using data and tools to collaborate and drive environmental progress Measure: We aspire to a consistent industry approach to capital carbon and natural capital by 2026</p>	Individual company strategies	We aspire to a consistent network approach	NG UK Commitment (no funding request)	
<p>1.ii) Environment – enhancing the natural environment and preserving precious resources</p>	<p>-10% increase in environmental value on all non-operational land by the end of the T2 period – prioritising deprived urban areas. -The ET estate is currently 2798 hectares and environmental value is measured in Biodiversity units and £ natural capital Measure: £ natural capital and Biodiversity units #</p>	Baseline to be defined in 2021	+10% on 2021 baseline by 2026	NGET Commitment to 10% ODI above 10% (no funding request)	Better local environment for communities, improved ecosystems and reduced climate change.
	<p>- Deliver 10% net gain in environmental value (including biodiversity) on all construction projects (including those delivered by third parties) Measure: #projects and % net gain</p>	Baseline to be defined in 2021	+10% net gain on all construction projects from 2021	NGET Commitment - no funding request)	
	<p>- We will reduce the waste we create at our offices (waste tonnage) by 20% from a 2019/20 baseline - Reduce water use in our offices by 20% by the end of RIIO-2 compared to a 2019/20 baseline Measure: tonnes and # litres</p>	-Water and waste to be baselined in 2019/20	-20% water use and waste tonnage from 2020 to 2026	NG UK Commitment (no funding request)	Reduced consumer bill and finite resource use.
	<p>-We will recycle 60% of our office and operational waste - On construction projects, we will achieve zero waste to landfill and we will increase the recycling or reuse materials by 2026 - baseline and set a target for construction waste recycling - we will reduce the waste intensity of our construction projects year on year Measure: % of waste recycled, % to landfill and tonnes of waste / £100,000</p>	46% office recycling 45% operations in 2019 -2019/20 waste intensity baseline	60% office and operational recycling by 2026	NG UK (office) and NGET Commitment (no funding request) ODI above 60%	



	- We will maintain our high standards of oil containment and pollution management Measure: # litres of oil lost in to environment	Maintain agreed ENA/EA standards for cable leaks		NGET Commitment and LO (no funding request)	
	- We will implement the ISO20400 sustainable sourcing process Measure: alignment to ISO20400	Gap analysis complete	Align with ISO20400	NG UK Commitment (no funding request)	
	- We will pilot and implement circular economy principles across the business Measure: # of pilots that implement circular economy principle, circularity metric defined and process to purchase products that can be recycled/reused.	No standards yet	Align with BS8001 – circular economy standard	NGET Commitment (no funding request)	
1. iii) Environment – improving visual impact	- Existing infrastructure in designated landscapes - We will continue with the stakeholder-led approach for Visual Impact project Provision project selection. Measure: # of kms of overhead line removed	Dorset in progress	Dorset and other T1 funded projects	NGET PCD (£202.36m currently in baseline subject to T1 funding submissions)	Improved areas of beauty for society to enjoy

Stakeholder Topics - Communities	Our proposals	Baseline	Output	Output type	Consumer benefit
2.i) Communities -supporting local communities <i>*here we define a 'major project' as one lasting a year or more</i>	- Communities close to a major* project - assign up to £7.5m (0.3%) of construction projects to focus on local employment and STEM engagement with every local state owned school -continue to fund the community-led grant scheme of up to £20k near to a construction project and £10k near our operations Measure: £m spent, # of schools engaged and % local employment	Engagement & employment driven by DCO £1.55m on community grants in T1	100% state School STEM engagement and local employment	NGET Commitment (no funding request) NG UK for grant scheme	Enabling more diverse citizens to take part in the green transition and improved community spaces – helping to build pride and wellbeing in the local area.
	- Communities close to assets - stakeholder-led prioritisation of budget to benefit urban disadvantage through an <u>Urban Improvement Provision</u> by improving our assets or public spaces (focused in the top 30% most deprived areas, per the index of multiple deprivation (IMD)). Measure: stakeholder group satisfaction & # of projects implemented in IMD1.0-3.0	Currently no fund	To be defined by stakeholder-led panel	NGET UM (£50.00m) <i>-not in baseline</i>	
2. ii) Communities – supporting wider society	- Provide skills development which will increase employment potential for 6000 people, focussing on the low-income communities we serve Measure: #people trained	Graduate, academy and apprentice training	6,000 external people trained by 2026	NG UK Commitment (no funding request)	Supports vulnerable consumers nationally, using core skills and expertise
2. iii) Communities – prosperity through employment	- We want to better represent the communities we serve and we will increase our hires from diverse backgrounds every year - We will report transparently on our entire workforce representation at all levels Measure: % of BAME and % offemale	UK Core: 14% BAME 20% female Group 18% BAME 24% female	Focus on increasing diversity annually	Group Commitment (no funding request)	Improved employee wellbeing and ability to serve our



and the supply chain -Further supply chain commitments are listed in annex NGET_A11.06 Ethical Procurement Action Plan	- We require all our suppliers, to pay the real living wage to their UK workers and will verify this at Tier 1 in relevant categories. Measure: # of individuals with wage increase as a result of National Grid commitment	Contractual obligation only	Contract verification to Tier 1 for relevant categories	NG UK Commitment (no funding request)	stakeholders Access to opportunity, fair pay and skills development can support social mobility.
	- Promote skills development in the supply chain by requesting that a minimum of 5% of the supply chain technical headcount is upskilled annually Measures: # of suppliers signed up to Skills Accord and % technical headcount under training plans	Technical headcount numbers calculated annually	5% of technical headcount trained annually	NG UK Commitment (no funding request)	
	- Use influence to identify and address potential human rights exploitation in the supply chain Measure: Modern Slavery Index (MSI) rating #	MSI #12	MSI #	NG UK Commitment (no funding request)	
	- Promote equal opportunities in the supply chain Measure: # events supported to identify and # of projects using CompeteFor (a tool used to advertise opportunities in the supply chain)	27% contracting with SMEs in 2019	#events #CompeteFor projects	NG UK Commitment (no funding request)	
We also have a proposal for an environmental scorecard associated with this topic which will drive us to push further beyond our baseline commitments. For further information please see annex NGET_ET.06 Output Delivery Incentives. For further information on our two proposed uncertainty mechanisms, please see annexes NGET_ET.12 Uncertainty mechanisms, ET.12A Uncertainty mechanism snapshot table, and NGET_A11.09 SF ₆ uncertainty mechanism					

5. The justification for our proposals

5.1 Enhancing the environment

We must act now to achieve net zero. Inaction could cost more to future consumers and risks escalating disastrous climate events. Our commitments for the environment and communities are influenced by net zero, global and government ambitions, stakeholder, society and end consumer impacts. We are signatories to the United Nation’s Global Compact, support their strategy to achieve the Sustainable Development Goals (SDGs) by 2030 and [report annually on our sustainability commitment](#). These goals promote prosperity while protecting the planet. Information on how these SDGs map to our business is [here](#) and how they map to our Environmental Action Plan is in annex NGET_A11.05. We have engaged with external experts to confirm that our commitments are stretching, as well as performing an external benchmarking exercise for our environmental and procurement activities. These can be found in annexes NGET_A11.03 Environmental Benchmarking and NGET_A11.04 Procurement Benchmarking.

It is important to us that we put back more than we have taken away and we leave a positive legacy for the long term. Guided by our construction [stakeholder, community and amenity policy](#), we already look for opportunities to enhance the environment and provide other lasting community benefits for those affected. For example, we have improved public pathways, planted trees, created new public spaces and even donated finds from archaeological investigations to local museums. One of the key challenges to becoming more sustainable is culture change and to address this we have included leadership targets in annex

NGET_A11.05 Environmental Action Plan (EAP).

These include both internal targets - to enable our employees to become leaders for change - and external activities to drive the agenda beyond our network.

i) Our climate commitment and sustainability leadership

Our stakeholders have been clear that they want us to focus on decarbonisation of our own business as the highest priority in this plan topic. As well as the increased awareness of society around the impacts of GHG emissions, the government has now legislated net zero which we fully support. The four largest direct contributors to our emissions are:

- electrical line losses, where electricity is lost as heat when transmitting electricity
- leakage of insulation gases that we use in our equipment, primarily SF₆ – scope 1
- transport – the fuel emissions from our operational fleet vehicles – scope 1
- energy use from our buildings – scope 2.

Figure 11.8 sets out our vision for how we can achieve a net zero pathway and what we need from Ofgem and the supply chain to achieve this. For more detail on our industry targets for net zero, please see the Executive Summary, net zero section and chapter 7 *We will enable the ongoing transition to the energy system of the future.*



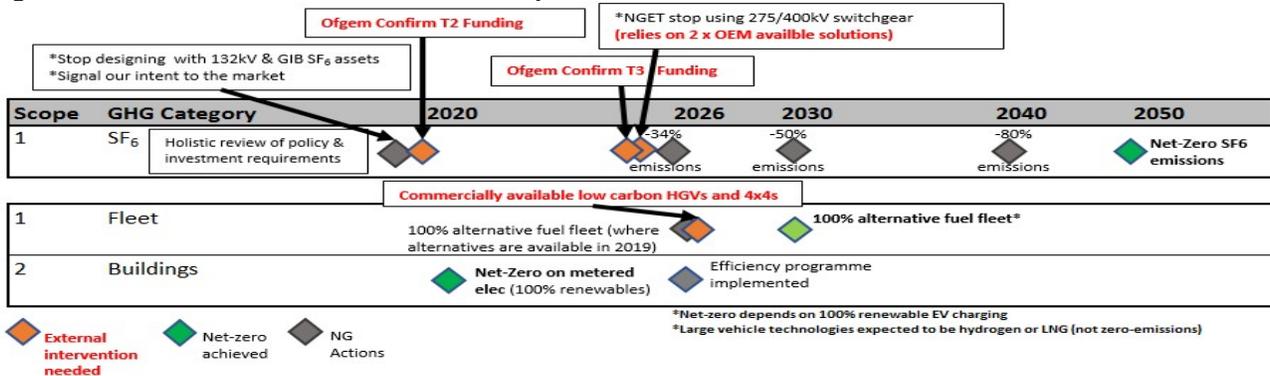
Transmission Line Losses

Category	Output	Cost (£m)
Transmission line losses	- report annually on the actions taken to reduce transmission losses – special license condition 2K	0.00

Key drivers – the largest source of carbon emissions is from transmission line losses (~1.5% of total)

electricity transmitted and 1,295,484tCO₂e in 2018/19), which increases as the distance between generation and demand are increased. This is primarily influenced by the generation mix at any moment and the resulting system operation. As electricity generation continues to decarbonise, the carbon emissions from the losses will decrease. A transmission owner can influence only a small portion of losses through the assets they select for the system infrastructure.

Figure 11.8 Controllable GHG net zero roadmap

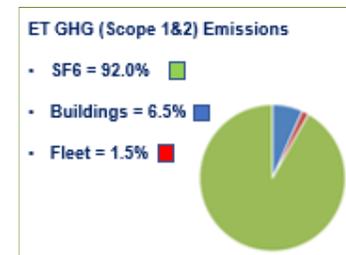


Options considered – We factor these losses in to our whole life value framework by applying a different carbon price to different conductors, which is how we select investments that are economically justified. For example, when selecting a transformer, loss capitalisation figures are applied to the investment. This capitalised loss figure is used in the tender evaluation ensuring that a lower cost/higher loss transformer is not favoured over a higher cost/lower loss unit. There is a trade-off between the reduction of losses and the associated increase in material costs required to achieve such a reduction. For the T2 period, we will improve how we report what we have done about transmission losses each year as part of our annual report on our EAP and to review our Transmission Loss Strategy - Special Condition 2K 2014, please see annex NGET_A11.11 T1 Transmission losses strategy.

SF₆ Emissions – Scope 1

Category	Output	Cost (£m)
SF ₆ Emissions Reduction UM	Reduce GHG emissions from insulating gases by at least 33% in the T2 period	UM
Leak detection and repair	Continue with leakage control through our incentive	ODI
Build with clean assets available now	Stop designing with 132kV SF ₆ assets in new builds by 2021	0.00
Plan to build with infrastructure with clean assets	Stop using 275/400kV SF ₆ assets in new builds by 2024 (once 2 solutions are available), sending clear market signals to support this (in 2020)	0.00
Total:		Dependant on output

Figure 11.9 England and Wales ET GHG emissions



Key drivers – SF₆ is the largest controllable element of our direct emissions at ~280,500tCO₂e in 2018/19. The RIIO-2 business plan guidance mandates a Science Based Target

(SBT), which externally verifies targets to limit global warming by 1.5 degrees Celsius. The SBT Institute have confirmed that ours would be a **50% reduction by 2030**, from a 2018/19 baseline. Our interim target for 2026 is calculated as 34% assuming a linear pathway. Given the SBT must be reached by scope 1 and scope 2 independently, and that fleet accounts for only 1.6% of scope 1, SF₆ alone must be reduced by at least 33%. In our recent consumer research, 60% of consumers want our business to be net zero by 2030 or 2040. SF₆ is a strategic issue for the energy industry, country, and indeed the world. We believe that to meet our stakeholders' needs **we must be more ambitious** than the SBT pathway defined.

Options considered – We are building on a set of principles developed from the initial draft investment programme, outlined in our October submission to allow: 1) the flexibility to respond to changing leaks within T2, 2) the flexibility to assess the best intervention for the asset and leak and 3) the ability to stretch beyond the Science Based Target (SBT) net



zero pathway. This uncertainty mechanism will fund us to make reductions in SF₆ emissions with the long-term aim for continued and permanent reduction that our stakeholders expect to see from us.

Ofgem asked that we provide information on what is needed to remove SF₆ from our system and where the carbon price is sensitive. **These investments are carbon price sensitive and the cost of carbon doesn't currently cover the investments required within this mechanism, with a focus on longer-term benefit.** There are two proposed treatments within this mechanism which we have named level 1 and level 2 below.

Level 1 – For reductions in SF₆ emissions up to our SBT net zero pathway in the T2 period, we are considering an approach which will build a value of SF₆ leakage reduction (or prevented) in £/kg.yr. For level 1, the uncertainty mechanism funding in £/kg.year would be based on the value delivered and expected period of effectiveness (life of the intervention). This rate will need to be defined through engagement with Ofgem ahead of T2.

Level 2 – For reductions in SF₆ emissions beyond the SBT net zero pathway in the T2 period, we propose an extension to the level 1 approach which would use the same mechanism but it would require a different calibration for the funding rate in £/kg.yr because in level 1 the simplest assets with the highest leak rate will have already been targeted. Thus, the remaining assets will be more complex and the volumes of leaks will be smaller, requiring us to spend more to get the same benefit. We expect level 2 to be defined by a non-linear calculation.

We will engage with Ofgem and consumers to fully develop this approach over the coming months, aiming to have both parts of the mechanism in place for the start of the T2 period in 2021. SF₆ reporting for the T2 period is covered in business plan data table A6.5_IIGs_SF6_Incentive, and all other emissions in table A4.3BCF.

Cost certainty – the specific £/kg.yr will need to be defined through additional consumer and stakeholder engagement ahead of the T2 period. Further information is provided in annex NGET_A11.09 SF₆ Uncertainty Mechanism and NGET_ET.12 Uncertainty mechanisms.

Fleet Emissions – Scope 1

Category	Output	Cost (£m)
Purchase and maintain 100% low carbon fleet, where market alternatives are available today (2019)	2 of 3 investments towards -34% emissions - to achieve a SBT net zero pathway -reduction of ~54% fleet emissions and -1% of scope 1 - we will install and maintain charge points across ET sites to enable our fleet commitment - work with the DNOs to ensure infrastructure efficiency. - ODI above 60%	PCD 36.05 11.43
Total:		47.49

Key drivers – The need to rapidly decarbonise the transport sector is recognised. Transport is the largest single sector contributing to Britain's emissions and also a major contributor to poor air quality in many of our cities, which is responsible for around [40,000 deaths a year](#)³. We have 836 commercial vehicles in our fleet, made up of panel vans, 4X4s and HGVs, and this contributes to 1.6% and ~4,500tCO₂ per year of scope 1 emissions.

Options considered – We want a 100% low carbon fleet by 2026, but today product availability limits us to 60%. We hope that by 2030 there will also be commercial availability of, low carbon 4x4s and HGVs so that we can complete the transition to alternative fuel fleet vehicles. We considered continuing with diesel vehicles throughout the T2 period and although ~£6m additional investment is needed for the EV switch, at a total of £36.05m, we will achieve a 54% reduction in GHG emissions and a 60% reduction in air pollutants by 2026. This will then be the starting point for the T3 period. The calculated societal benefit for improved air quality and climate mitigation is ~£0.5m. We also expect cost parity in the T3 period once EV technology has matured. Our 60% alternative fuel fleet plan has been verified through engagement with all mainstream low carbon vehicle manufacturers as well as some start-up businesses. Any progression beyond this could only be realised by changes in manufacturer product availability.

There is a strong requirement for charging infrastructure to support the fleet. As we are unable to rely on home charging being sufficient for longer distance travel or multiple users and there is uncertainty about the development of public infrastructure in the T2 period, we must install vehicle charging points at 234 of our 273 sites to service 60% of the fleet. The cost of this is £11.43m for installing and maintaining this charging infrastructure over the T2 period and this cost is now included in our baseline numbers. We will take a **Whole System** approach, working with the DNOs to ensure optimum rollout of charging infrastructure.

Cost certainty – Cost justification is based on quotations provided directly by vehicle manufacturers and quotations for charging infrastructure at a sub-set

³ per the Royal College of Physicians



of pilot substations. Details can be found in annex NGET_A11.10 EV Fleet Justification Report.

Buildings Emissions – Scope 2

Category	Output	Cost (£m)
100% renewable sources for metered electricity at offices and substations	3 of 3 investments towards 34% emissions reduction to achieve a SBT and a net zero pathway - PCD	0.00
Efficiency First - Offices	We will decrease the carbon emissions from our office energy use by 20%	0.00
Efficiency First - Substations	We will create a substation energy efficiency programme	0.00

Key drivers – Buildings emissions account for all of our scope 2 emissions as defined by Ofgem and are currently around 19,000 tCO₂e annually and 6% of our total business carbon footprint.

Options considered – There are limited options when switching energy provider besides ensuring a competitive deal and a guaranteed renewable supply. There is a risk that as commitments to renewables become more mainstream for businesses, renewable tariffs will become more expensive. This additional premium for a renewable tariff is currently 1-1.5% on top of standard tariffs, and could increase further. Therefore, we will focus firstly on the efficiency of our energy use, reducing it down by 20% in our offices and implementing an efficiency programme in our substations too. We will then ensure additional renewable generation is secured and contracted long-term, to meet our needs, which will both protect consumers from potential market induced premiums, and contribute to the additional clean generation that is needed on the grid. Within our energy efficiency programme, there will be many options for improvement including switching to LEDs, installing solar power and improving the efficiency of buildings. We believe that many of the options will have a clear pay-back period within the T2 period and therefore no funding is requested for this work.

Indirect Emissions Reduction - Scope 3

Category	Output	Cost (£m)
Business travel	Reduce carbon emissions for our business transport by 10%	0.00
Capital carbon (construction)	Net-zero emissions – based on applying PAS 2080 and current business assumptions	2.50
Supply chain emissions	75% of National Grid's top 250 suppliers (by category/spend) will have carbon reduction targets	0.00
Total:		2.50

Key drivers – There are GHG emissions associated with our construction projects. These 'capital carbon' emissions are from the extraction of raw materials to make equipment, transport, manufacture and finally installation of this equipment on our sites. These are not included in our business carbon footprint (BCF) calculations but at ~31,000tCO₂e, are currently equivalent to ~9% of our BCF (excluding losses). As

well as benefitting the climate, there is a direct correlation between reducing capital carbon and reducing cost on our projects. Our data shows that saving 10% of carbon correlates to up to 4% reduction in capital costs. However, it is difficult to fully attribute savings to efficiencies that are solely driven by a focus on carbon. As well as our own direct emissions, we have started to track our supply chain carbon through the carbon disclosure process, where we can generate even larger societal benefits.

Options considered – To minimise carbon from our construction projects, we follow the principles of build less, build clever and build efficiently, as outlined in PAS2080. During the T1 period, we have successfully implemented many initiatives enabling us to design and build more efficient projects, one example includes reusing foundations as the new default which was a significant change to our civil engineering specifications. We have also developed a carbon hotspots report so we can target these areas where our emissions are highest. In addition, are working with procurement to ensure that carbon reduction is embedded within our contract frameworks, pushing the improvements through our supply chain.

For the T2 period, we will continue to further align to PAS2080 and embedding best practice and carbon reduction opportunities with the ambition to achieve net-zero carbon construction by the last year of the T2 period. We will offset any remaining emissions that cannot be eliminated cost effectively or technically. There are several offsetting options available to us including afforestation, reducing deforestation, supporting woodland management, energy efficiency projects and supporting community renewables. Our focus will follow a best practice framework using a hierarchy which starts with the use of our own land in the first instance, then within the local communities impacted by our projects and then using national projects to achieve the best environmental and social outcomes.

Cost certainty – Using our current estimates for the T2 period and the carbon impact of historically tracked schemes in the T1 period, our conservative estimate against a forecast £870m of capital delivery schemes capex in 2025/26, will equate to a maximum of 180,000tCO₂e (approx. 207tCO₂e/£1m spend). A value of £2.50m to offset this been estimated, using an approximate carbon price of £13/tonne of CO₂ and assuming that this offsetting is achieved through afforestation. This estimate is based on two quotes, one from the Woodland Trust to purchase 750,000 trees to offset the 180,000 tCO₂e at £2.70m and the second from the Carbon Trust at £2.30m. We are confident that as this forecast spend is in the last year of the T2 period, we will have better defined the chosen option and associated costs. There is a risk that increased sustainability in business will drive up offsetting or low carbon material costs. Therefore, we



will cap the offsetting spend at £2.5m, to protect consumers from the risk of increase in offsetting costs in 2026.

Sustainability leadership

Category	Output	Cost (£m)
Lead in transparency on natural capital and capital carbon	We aspire to a consistent industry approach to capital carbon and natural capital impact evaluation	0.00
Lead in responsible business reporting	An annual report detailing progress on our environmental and fairness focused charter commitments	0.00

We are industry leaders on reducing carbon in capital projects and on our approach to natural capital. We will openly share expertise, data and tools with our stakeholders, primarily the other TOs, with the aim of accelerating improvements across the Whole System.

We will be **advocates for sustainable and responsible business** across industry and with our consumers by:

- publishing a transparent annual report of progress on our responsible business commitments
- being active members of industry and working groups
- continuing to engage with the public through our education centres and community events.

To show environmental leadership in our own organisation, we will:

- develop a **culture** which empowers employees to reduce their environmental impacts
- embed sustainability in our decision making by expanding our approach to carbon pricing and looking at other areas of environmental impact
- implement employee remuneration driving accountability for environmental performance.

ii) Enhancing the natural environment and preserving precious resources

Category	Output	Cost (£m)
Improving environmental value by 2% annually	10% increase in environmental value on all non-operational land by the end of the T2 period, prioritising deprived urban areas. ODI above 10%.	0.00
Construction project net gain	10% net gain on all construction projects including 3 rd party works	0.00
Waste and water usage	20% water (litres) and waste (tonnage) reduction	0.00
Recycling	Zero waste to landfill for Construction. Baseline and set a target for construction waste recycling in 2020/21. Achieve 60% for ops and office	0.00
Oil Management	We will maintain our high standards of oil containment and pollution management	0.00
Sustainable sourcing	We will implement the ISO20400 sustainable sourcing process	0.00
Extending asset life, designing for reuse / recycling and using recycled materials	We will implement circular economy pilots across the business	0.00

Drivers – The 2019 report by [RSPB, The State of Nature](#), suggested that the UK is one of the most nature-depleted countries in the world. More recently the [UK Government's 25 Year Environmental Plan](#), published in January 2018, sets out a comprehensive long-term approach to protecting and enhancing the environment. The vision at the heart of the plan is that the current generation will be the first to leave the environment in a better state than it was found.

Additionally, the Natural Capital Committee's recommendation to the UK Government, calls for organisations to create their own register of natural capital that they are responsible for, is a responsibility that includes maintaining the quality and quantity of the assets listed. We expect a 10% net gain to be legislated circa 2022 for all construction projects subject to the Town and Country Planning Act.

Options considered – We own significant areas of land across the UK, 2798 hectares for ET. When we construct and maintain our assets, we have an impact on the land and local habitats, and therefore want to ensure we leave the land in a better state by following the principles of net gain in environmental value (and biodiversity). If left unmaintained, natural habitats will depreciate with time.

We will use our natural capital valuation tool to build a natural capital inventory of assets we own and are responsible for and will include Biodiversity. We plan to increase the value and resilience of our natural assets, to make sure they can deliver the ecosystem services that we and our wider beneficiaries need, in the most cost-effective way possible.

We will work collaboratively in the T2 period to develop and pilot a robust methodology for assessing natural capital impacts and opportunities associated with electricity transmission activities. The approach will reflect best practice and complement the biodiversity net gain methodology. We will also expand our approach of achieving a net gain in environmental value in major work by applying it to all construction projects that impact our non-operational land. We will not seek funding for these outputs.

Throughout the T2 period, we will continue to focus on resource use throughout the asset lifecycle of procurement, operation, refurbishment and decommissioning. We have also set specific targets for our construction programme, which we will work with our contractors to deliver. Some of these will be baselined over the remainder of the T1 period so that we can set quantitative targets for the T2 period.



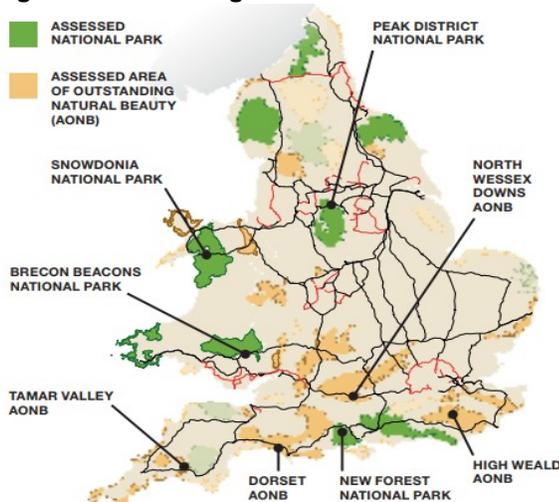
iii) Improving the visual impact of existing infrastructure in designated landscapes

Category	Output	Cost (£m)
Visual Impact Provision	# of kms of overhead line removed from designated landscapes	202.36
Total		202.36

Key drivers – We have received feedback from consumers in several large studies (willingness to pay/acceptability testing) demonstrating that people support the undergrounding of existing pylons to improve landscapes. This is especially important in National Parks and Areas of Outstanding Natural Beauty, where our pylons can be considered to have a negative visual impact. Ofgem’s 2018 sector specific consultation concluded that there should be a T2 provision for reducing visual impact in designated landscapes, and that the Landscape Enhancement Initiatives (LEI), which historically is for lower-cost projects, should also continue. On average, over 10m visitors spend over £1bn in National Parks each year, which provides an economic benefit to the local area. Per our 2016 acceptability study, 66% of people in the lowest income group have visited National Parks, which demonstrates how people from all walks of life would benefit from the improvement of our natural landscapes.

Options considered – We will continue with the robust stakeholder-led process for selecting VIP projects for the T2 period, which has received excellent feedback. The Stakeholder Advisory Group (SAG) have reviewed the original shortlist of projects identified, aiming to select several projects for approval within the T2 period. We have not yet carried out detailed design work to confirm their feasibility. However, we have estimated that the cost of delivery of these could range from £50m - £750m, depending on the number of new T2 projects that are approved. This is within the cost limit identified in the latest Willingness to Pay study, and much of the spend would fall in the T3 period. We have included a forecast of £202.36m in the T2 baseline business plan

Figure 11.10 The original shortlisted sites for VIP



to cover the cost of completing projects that have, or we hope will have, been approved by Ofgem during the T1 period.

VIP methodology – Below is an outline of the steps within the robust project selection process, set up in the T1 period.

- Landscape and visual impact assessment – identifying sections of overhead lines that have the most significant impacts on the landscape.
- Development of options – exploring the technical feasibility of schemes with input from environmental and landscape consultants.
- Progression to development – we assess the merits of each option by comparing it against the VIP guiding principles.
- Agree schemes – development of the chosen projects to allow an informed funding application to be sent to Ofgem. This includes a planning application for each scheme and associated tenders for their construction.

Cost certainty – To ensure value for money on the T1 projects, we are running specific market tenders. For Dorset, Ofgem undertook a rigorous bottom-up cost analysis exercise where they agreed that our procurement process was robust and approved efficient costs (£120m of £122m in 2018/19 prices). The £2m reduction was associated with identified risks that hadn’t materialised and some of the non-tendered costs. We have a dedicated team who continue to compare our undergrounding costs with previous projects so that we can benchmark this with received tenders.

For new VIP projects in the T2 period, the size of the provision will be set based on new willingness to pay studies and other relevant information. As in the T1 period, this provision will be released during the T2 period by TOs making successful funding submissions. Ofgem’s decisions in this area mean that it is not appropriate for us to define these projects now in our baseline business plan, because we are not seeking funding as part of this price control review process. For LEI projects, Ofgem have decided that the T2 funding will be set at an indicative 2.5% of the final provision. A stakeholder-led change for the T2 period is that the £200,000 individual project limit has been removed, which stakeholders feel could lead to more ambitious projects being proposed. We also propose to improve the T1 period process by appointing a grant management company to oversee the funding applications from stakeholders, which will streamline the process. In line with Ofgem’s consultation, we are proposing that the independent sub-panel of the SAG would decide on the funding requests for the LEI and report annually on project delivery and expenditure.

We will continue to work with Ofgem, the Scottish TOs and other stakeholders to assess the size of the T2 provision for new projects. For further information on



our proposal for the T2 project provision, please see annex NGET_A11.12 VIP Project Provision Proposal. If you would like to submit your views, please contact the VIP team, visualimpact@nationalgrid.com

5.2 Making a positive contribution to society and the communities we work in

The recent '[State of the Nation' report from the Social Mobility Commission](#) presented worrying findings that social mobility has stagnated. More must be done by all both public and private sectors to support citizens of disadvantaged backgrounds earn more and contribute equally to shaping our society.

We want a future where disadvantaged citizens have the same opportunities to take part in the green transition as the rest of society. We also believe that as an engineering business, it is vital to commit to maximising the current workforce and stimulating the industry pipeline of future engineers for this purpose.

To meet our vision to 'exceed the expectations of our communities', our commitments will focus on social mobility outcomes through education and employment, continuing to listen to the needs of the communities we impact.

i) Supporting local communities

Category	Output	Cost (£m)
Communities impacted by construction	Communities close to a major project - assign up to £7.5m of construction projects to focus on local employment and STEM engagement with every local state owned school - above what is mandated through planning	0.00
Community-led grants	A community-led investment, where a local project can apply to us for up to £20k where they are impacted by our construction works and £10k near our operations.	0.00
Communities impacted by operation	Urban Improvement Provision (UIP) to improve our assets or public spaces near to our operations.	50.00 - not in baseline
TOTAL	*major project - defined as lasting 1 year or more, in this case	50.00

Key drivers – We recognise that whenever we are developing our transmission network, it can impact and be disruptive for a community. We receive consistent feedback that we should take care of the communities we work in and do more to support them, where this fits with our core skills. The Independent Stakeholder Group have also asked us to consider our visual impact policy in urban areas.

Options considered – As a large employer of STEM skillsets, we have a fantastic opportunity to engage and stimulate an interest in these subjects. We initially looked at engaging with every school in and around a construction project, however, we have decided to focus on state schools and those in **deprived communities first**. This will enable us to prioritise our strategic direction on supporting low income communities to achieve social mobility outcomes. As

well as inspiring the future workforce, we will prioritise the current **local workforce** for our work on major construction projects.

We know that in some cases, education and employment alone might not be the right fit and therefore have decided to continue to offer the **community-led grant scheme** through the T2 period. This scheme offers communities impacted by our work, the opportunity to choose their own positive enhancement project.

We have responded to a challenge from the Independent Stakeholder Group by creating a commitment to **disadvantaged urban communities**. Having received strong support from consumers, through our acceptability testing workshops, we believe this commitment will add value. We propose that the fund would be governed by an independent stakeholder group, consisting of regional representation and an independent chair. Projects would be proposed to the group for assessment and prioritised against a hierarchy which looks to improve our existing assets first, then close public space or improving our assets in other areas where there are known asset opportunities. These projects could include, for example, green spaces, substation screening or heating local sites from our transformers.

Cost certainty - We will refer to this commitment as the Urban Improvement Provision (UIP) and we propose a maximum pot size of £50m. We will liaise with the Scottish TOs to assess whether this provision would also be relevant in Scotland. This provision been calculated based on the VIP pot size of £500m equalling £4.14 in the willingness to pay results for National Parks. Consumers were willing to pay an additional £0.67 for visual improvements outside of National Parks. Taking the same ratio against the two values, across the three TOs, this amounts to circa £86m in total with 58% of that being £50m for spend in England and Wales.

ii) Supporting wider society

Category	Output	Cost (£m)
UK Skills Pipeline	Provide skills development which will increase employment potential for 6,000 people, focussing on the low-income communities we serve	0.00

Key drivers – Our stakeholder opinions on support for the **vulnerable and fuel poor** are mixed because we don't have direct consumer contact. We strongly believe however that everyone in the energy system has a responsibility to help those in fuel poverty.

Nationally, the STEM shortage continues. The [Engineering UK 2018 report](#) showed that engineering



companies will need 203,000 more people with Level 3+ engineering skills every year, to meet demand up to 2024.

Options considered – As well as looking to inspire future generations locally to our construction projects, we have an opportunity to impact the national skills pipeline. We are developing national and local skills development partnerships and initiatives, with a focus on the lower income communities we serve. We aim, across the UK businesses to give access to 6,000 young people from these communities over the next five years, tracking their progress from first interaction right through to potential employment in National Grid, our partners, our suppliers, or adjacent companies and industries. We will also focus all our employee volunteering towards developing skills for low income communities to take part in the green transition.

We received a suggestion from the Independent Stakeholder Group that we should work with organisations that support vulnerable consumers to provide centralised resilience advice. These organisations connect to distribution networks, not transmission, and so it's not appropriate for us to deal with them directly. However, we will continue to play an active part in local resilience forums, including working with DNOs where relevant.

iii) Community prosperity through employment and our supply chain

Category	Output	Cost (£m)
Inclusion and diversity	Increase numbers of diverse hires every year and transparently report on workforce diversity.	0.00
Living wage champion	We require all our suppliers, to pay the real living wage to their UK workers and will verify this at Tier 1 in relevant categories.	0.00
Supply chain skills	Request that a minimum of 5% of the supply chain technical headcount is upskilled annually.	0.00
Modern slavery and human rights	Address potential supply chain human rights risks and continue to measure our position in the index of modern slavery .	0.00
Supply chain equal opportunities	Promote equal opportunities in the supply chain .	0.00

Key drivers – Being disadvantaged means that there are more barriers a person must overcome before they or their family can change their circumstances. People from **working class backgrounds** face the highest levels of unemployment. We believe more needs to be done to champion social mobility outcomes within business.

Diversity and inclusion are also very important to us because **by being diverse** we amplify the range of ideas and innovation that our people can generate as well as enabling our people to thrive in a culture that represents the communities we serve.

Our reach as a business is wider than our direct impacts. In the same way as our daily activity can drive change, we want our **procurement activities** to drive a positive environmental, social and economic impact too.

Options considered – We have signed the [social mobility pledge](#) and we will work towards adopting apprenticeship and recruitment practices that **remove barriers to entry** and **promote a level playing field**.

We have committed to pay all our employees and contractors working in the UK the **real living wage** as defined by the Living Wage Foundation (LWF). In the T2 period, we will now assure this is being applied at Tier 1, in relevant low wage categories. We will also request that Tier 2 sub-contractors do the same. We need to expand our ambition for inclusion and diversity from our current focus on minority group representation to greater inclusion as an essential characteristic for our leaders and workforce. This approach will offer support across all diversity groups. We believe that we, and the wider energy industry, should be more representative of, and reflect, all aspects of diversity in the communities we serve. Every year, we will increase the number of hires from diverse backgrounds at a greater proportion than within the overall National Grid workforce today. We are committed to transparency and reporting annually on our progress on BAME and female representation on our Board, at Manager level, amongst new joiners, and our workforce as a whole.

We will use our position as a large purchasing organisation to drive positive change down the supply chain. We will further embed sustainability and responsible sourcing in the procurement tender process and be more proactive through our contract management in the T2 period. We will hold our suppliers to account in relation to the Supplier Code of Conduct and encourage adoption of the Supplier Code of Conduct beyond our Tier 1 suppliers.

Our investment expenditure on the environment and communities is relatively small because costs are mostly embedded in the way we construct and operate our network. Although the VIP programme started at the beginning of the T1 period, because of our extensive engagement with stakeholders, the first project (in Dorset) only gained approval in 2019 and is due to complete in 2022. Therefore, expenditure increases in 2020. Our plan includes our best view of the projects we have started in the T1 period. For further information, please see annex NGET_A11.06 Ethical Procurement Plan Action Plan.

Cost justification – Past successful engineering and asset management efficiencies are built into our forecast costs for this stakeholder priority. We are making stretching commitments to future efficiencies, applying a **£1.3m productivity commitment** to improve the productivity of our people by 1.1% year on year. Further detail is provided in Chapter 14 – *Our total costs and how we provide value for money*.



6. Our proposed costs for the T2 period

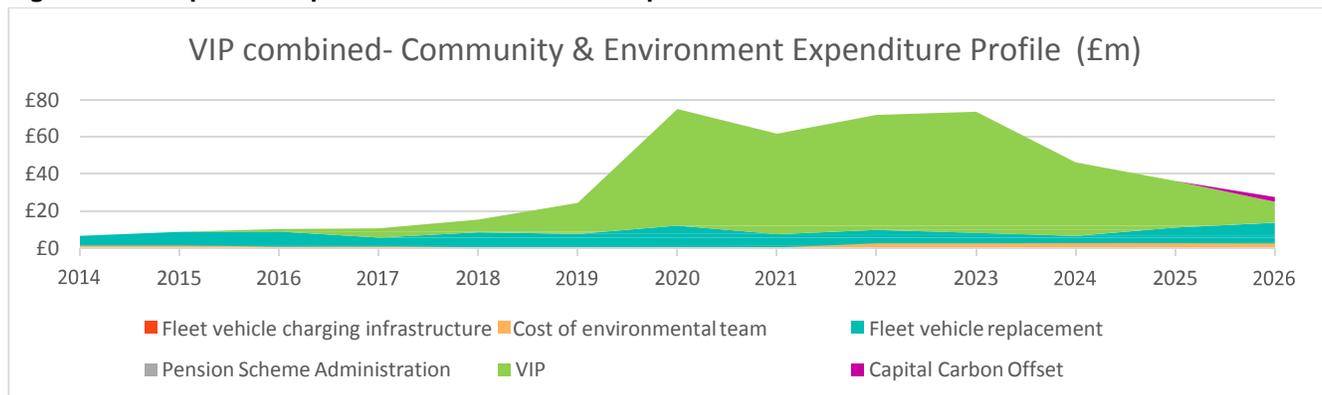
Table 11.11 Proposed baseline costs

Baseline proposals £m 2018/19	21/22	22/23	23/24	24/25	25/26	T2 Total	T2 Annual	T1 Annual	Subject to native competition	Internal historical benchmarks	External benchmarks
Environment team	0.51	0.51	0.51	0.51	0.51	2.54	0.51	0.99	✓	✓	✓
Fleet vehicles	7.19	5.66	3.80	8.30	11.11	36.06	7.21	7.41	✓	N/A	✓
Fleet vehicle charging	2.24	2.28	2.41	2.36	2.14	11.43	2.29	-	✓	✓	✓
Capital carbon offset	-	-	-	-	2.50	2.50	0.50	-	✓	N/A	✓
VIP - Dorset	11.35	0.41	-	-	-	11.76	2.35	13.23	✓	✓	✓
VIP - Snowdonia, Peak East and North Wessex Downs	50.36	64.49	39.40	25.08	11.26	190.59	38.12	4.82	✓	✓	✓
Sub Total	71.65	73.35	46.12	36.25	27.52	254.88	50.98	26.45	High cost confidence		
Pension allocation						0.48					

*Business Plan Data Table Reference Opex for environment team, fleet maintenance and offsetting costs D4.5 CAI, fleet & charging capex D4.3a, VIP C2.26

Additional UM proposals	21/22	22/23	23/24	24/25	25/26	T2 Total	T2 Annual	T1 Annual	T1 Total	Proposed as UMs
Urban Improvement Provision (UIP)	10	10	10	10	10	50.00	50.00	0.00	N/A	Proposed as UMs
SF ₆ Emissions Reduction UM	TBD	TBD	TBD	TBD	TBD	150.00	30.00	0.00	N/A	
Total	TBD	TBD	TBD	TBD	TBD	200.00	200.00	0.00		

Figure 11.12 Expenditure profile across the T1 and T2 period



7. How we will manage risk and uncertainty

For net zero – we will work with Ofgem ahead of the start of the T2 period to confirm an appropriate Uncertainty Mechanism which will allow investment to flex for critical SF₆ interventions. We need flexibility to do due diligence on the right solutions which balance existing work and system access, with technical solutions, our emissions targets, ambitions and affordability, in-line with stakeholder needs.

For VIP - Ofgem agreed the funding for the Dorset T1 period visual impact project based on a latest assessment of the costs of the scheme. We will go through an approval process with the other T1 period schemes with Ofgem using the most up-to-date costings. This will give us fixed allowances for these

projects. For new T2 period VIP projects, the SAG will conduct the agreed assessment process to

determine which are the most beneficial projects.

Once the SAG has identified the T2 period schemes and done more detailed costings, we will need to apply to Ofgem for the funding, which they will scrutinise in detail and if applicable, approve the funding within the T2 period. This process means the decisions on funding will reflect the most up-to-date cost estimates. We will continue to work with Ofgem, the Scottish TOs and other stakeholders to assess the size of the T2 provision for new VIP projects. For further information on our proposal for the T2 project provision, please see annex NGET_ A11.12 VIP T2 Project Provision Proposal. For details of our proposed Uncertainty Mechanisms, please see annexes NGET_ET.12 and NGET_ET.12A.



12. We will be innovative

What this stakeholder priority is about

The need to transition to clean energy, and drive down current and future consumer costs are driving rapid changes in our energy system.

Everything we do is for our customers, stakeholders and ultimately the end consumer. They are telling us they want us to be innovative, and deliver an affordable network that is safe, reliable and resilient, and play a role in decarbonising the UK economy. We can make a real, meaningful difference, leading the way to a safe and sustainable future.

Our Innovation Strategy has been developed with our stakeholders, resulting in the following focus areas:

- Delivering Cleaner Energy
- Delivering Cheaper Energy

We will continue to roll-out previously proven innovation, delivering innovation benefits within the period on our Business As Usual (BAU) innovation projects. We will improve our external collaboration, stakeholder engagement and innovation culture (through our IDEO cultural survey commitments in section 4 of this chapter) to ensure we deliver benefits to consumers, customers and stakeholders. You will find evidence of our innovation activities throughout each chapter of the business plan.

What you have told us so far

We have asked our stakeholders what is important to you. You have told us that we should innovate more on decarbonisation, as well as providing a reliable energy system and lower energy bills. We have changed our plans to increase our focus on decarbonisation. You want us to invest in innovative ways of delivering this which creates benefits both now and in the future. You have told us that we are not accessible enough, we need to be more open and transparent. You want us to share our innovation challenges earlier, and encourage more Small and Medium Enterprises (SMEs) to be involved.

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification for our proposals
6. Our proposed costs for the T2 period
7. How we will manage risk and uncertainty

What we will deliver

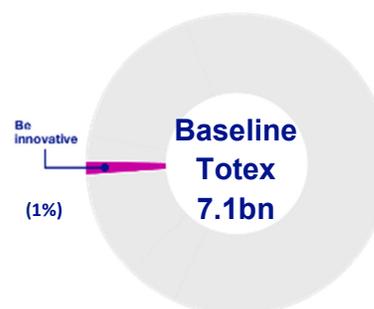
Our innovation BAU activities will create benefits in the T2 period, funded through our totex allowance with no additional innovation stimulus funding. We will invest £84m into a number of Network Innovation Allowance (NIA) funding propositions, 10% of which will be funded by ourselves, delivering benefits in the T3 period and beyond for the whole energy system. This represents 1.2% of the overall business plan as reflected in figure 12.1 below.

For Ofgem's Strategic Funding Innovation Pot (SFIP), we propose that these are focussed on the nationally significant challenges in our strategy: future of transport, heat and network resilience.

We have embedded cost savings into our business plan as a result of our T1 innovation activities. This has delivered £748m of consumer value within the T1 period and has led to a £707m reduction in T2 costs. Further detail can be found in chapter 9 *We will provide a safe and reliable network* in tables 9.13 to 9.17.

This chapter demonstrates our success in delivering great financial benefits for consumers through investment in innovation.

Figure 12.1 Proportion of expenditure





1. What this stakeholder priority is about

The whole electricity system is becoming more integrated and other sectors are becoming ever more dependent on energy (e.g. transport) as they drive towards net-zero emissions.

Innovation is integral to both our core regulated business in the UK and US, and National Grid Ventures. Innovation in NGET covers everything from everyday continuous improvement through to step change technological breakthroughs and brings added value to our long-term ambition.

In this chapter, we refer to our innovation activities, which deliver our strategy and respond to our stakeholders and consumers needs. We will:

- contribute to the delivery of the energy system of the future by embedding innovation into our culture
- be more open and transparent,
- be more accessible
- deliver innovation benefits in the T2 period as part of our business as usual activities (included in each chapter)
- meet our NIA commitments in section 4 of this chapter.

Our board **has made a commitment on T2 innovation**, they commit to:

1. Deliver the ambition and approach outlined in the T2 business plan.
2. Take responsibility for setting a baseline and a five-year measurable target for increasing the innovative culture of the organisation.
3. An annual deep dive of progress against target, forward innovation workplan, tracking of innovation benefits, and embedding lessons learned.

This can be viewed in annex NGET_A12.04 Innovation Charter

Consumer value proposition (CVP)

The CVP looks at the value we are providing above Ofgem’s minimum requirements that we can robustly monetise. This chapter contains the following CVP items:

- CVP7 - Developing alternatives to SF₆ (value of £13.10m)
- CVP9 – Deeside innovation centre (value of £26.13m)

For more detail, please see chapter 5.4 and the CVP annexes ET.07 to ET.07C.

2. Track record and implications for T2

Costs & outputs in T1

Our Network Innovation Allowance (NIA) in the T1 period was 0.7% of NGET revenue. We agreed a voluntary split of NIA funding with the Electricity System Operator (ESO) such that we retained 0.5% of NGET revenue and the ESO had 0.2% of revenue. This voluntary split was formalised as part of the legal separation.

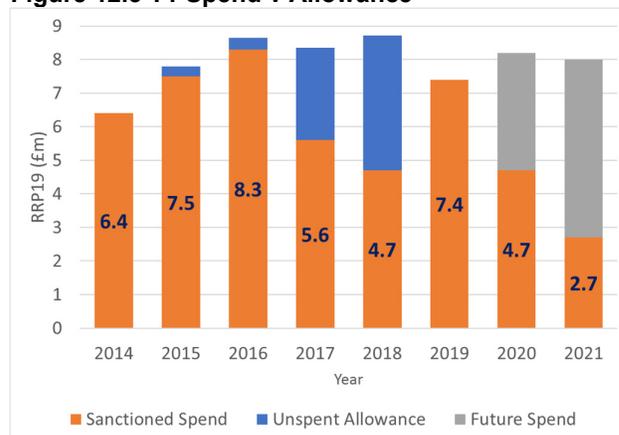
Our expenditure against 0.5% of NGET revenue for NIA is shown in figure 12.2. We have spent £47.3m of our allowance, leaving £7.3m not claimed (a ‘use it or lose it allowance’).

Figure 12.2 T1 Innovation costs

Funding source	Number of projects	Investment
NIA	161	£47.3m NIA
Deeside Centre of Innovation (NIC)	1	£10m NIC £14m NGET
GIL Innovation Partnership (Totex)	1	£3m Siemens £3m NGET (sanctioned)
	163	£77.3m

Figure 12.3 shows the breakdown of NIA spend against the allowance.

Figure 12.3 T1 Spend v Allowance



In 2017 and 2018, we had a strategic review of our innovation programme, focussing on building our capability and improving our plans. We focussed on closing down innovation projects to allow benefits to be rolled out. Due to this, we did not fully utilise our allowance (blue) in these years. As this is a ‘use or lose it’ allowances, this funding was returned to consumers. We have projects in the early stages of planning (shown in grey) which will fully utilise our innovation allowance for the final years of the T1 period.



Collaboration in the T1 period

To ensure that we remain responsive in this fast moving environment we have increased our stakeholder engagement.

We collaborate across all the networks and the Electricity Networks Association (ENA) and leverage funds to create more value, but we recognise that our wider collaboration could be improved.

Evolution of our innovation culture

We have started on our journey, equipping our people with the tools to make it easy for them to be creative and productive, and driving a diverse and resilient culture. This is underpinned through the adoption of Performance Excellence. We have learnt how to find innovative ways to solve problems, using tools like sprints and scrums, as well as good collaboration across the organisation. We are continuously exploring more ways to understand and enhance our innovation culture, and recognise that there is more to do.

We have supported our continuous improvement programme with a business change capability to support the teams when the implementation of the solution is more complex. During the T1 period, in addition to our NIA investment, we invested over £34m on continuous improvement and lean capabilities which make us more agile. And within ET today, we have over 60 business improvement projects identified and being tracked by our business change colleagues.

Historically, our innovation culture has been technically focussed. We have an ambition for innovation to be culturally focussed, and part of what everyone does but we have a long way to go to achieve this.

National Grid Partners (<https://ngpartners.com/>), is a 100% shareholder funded organisation, designed to strengthen our innovation capability across National Grid. Through this we are introducing our colleagues to innovation and an entrepreneurial culture as well as looking to partner with companies that provide clean, disruptive and unconventional solutions to help us drive change.

Our colleagues already get exposure to this culture through our regular employee communications using our internal channels: Town Halls, Round table sessions and knowledge sharing sessions. In the T2 period we will also run boot-camp style sessions for some of our colleagues, which will deliver training in lean start-up methodologies and agile delivery.

Through NG Partners we are evaluating innovative products from several USA based companies including:

- **Climacell** - who produce location specific weather forecasts that will allow for better balancing of weather-dependent renewable generation.
- **Sparkrecognition** - who utilise artificial intelligence to detect zero-day cyber security threats, which if

successful will deliver costs savings by reducing the risk of those threats and the risk of data breaches.

T1 benefits are embedded into our T2 plans

All our innovation projects with cost savings identified have been incorporated into our T1 plans and baked into our T2 plans. Chapter 9 *We will provide a safe and reliable network* provides further detail (in tables 9.13 to 9.17). For example, we innovated in alternative coatings for our transmission towers which allowed us to reduce the amount of steelwork that needed to be replaced as more could be refurbished. This contributed to a reduction in T1 costs by £148m (half of which is returned to consumers within the period) and T2 costs by £124m (100% of this is a consumer saving).

In the T1 and T2 periods, the completion and implementation of these innovation projects also provided non-financial benefits in terms of improved safety or reducing environmental impact. More detail can be found in annex NGET_A12.02 Innovation T1 Performance where we detail our innovation in overhead lines, transformers, protection & control, underground assets, safety & environmental, HVDC, Deeside & decarbonisation.

Comparison to external benchmarks

The external benchmark for a typical innovation programme delivers a return of £4 for every £1 spent. We have performed positively compared to this benchmark, completing 161 projects at a total cost of £47.3m. These projects are expected to deliver £748m of consumer benefit within the T1 period, providing evidence that your money is safe in our hands. As a guide, the potential benefits in the T2 period are expected to be at least £4 for every £1 invested.

Whole system approach

We have co-funded 8 projects with other transmission and distribution companies through NIA funds, and supported the implementation and roll-out of 27 other projects across the UK. This collaboration often provides opportunities for leveraged funding where we are contributing part of the funding towards a project with access to all the learning and outputs from that project. Over the T1 period, we have been able to leverage £250m of innovation for an investment of £13.2m.

Learning for the T2 period

One of the key things we have learnt is that to successfully deliver innovation in a particular period (e.g. a 5-year price control period), some innovation projects are required which enable innovation benefits in future price control periods. We have included within our plans the ability to develop this future benefit.



There is further information about lessons learnt in section 4 and section 7 of this chapter.

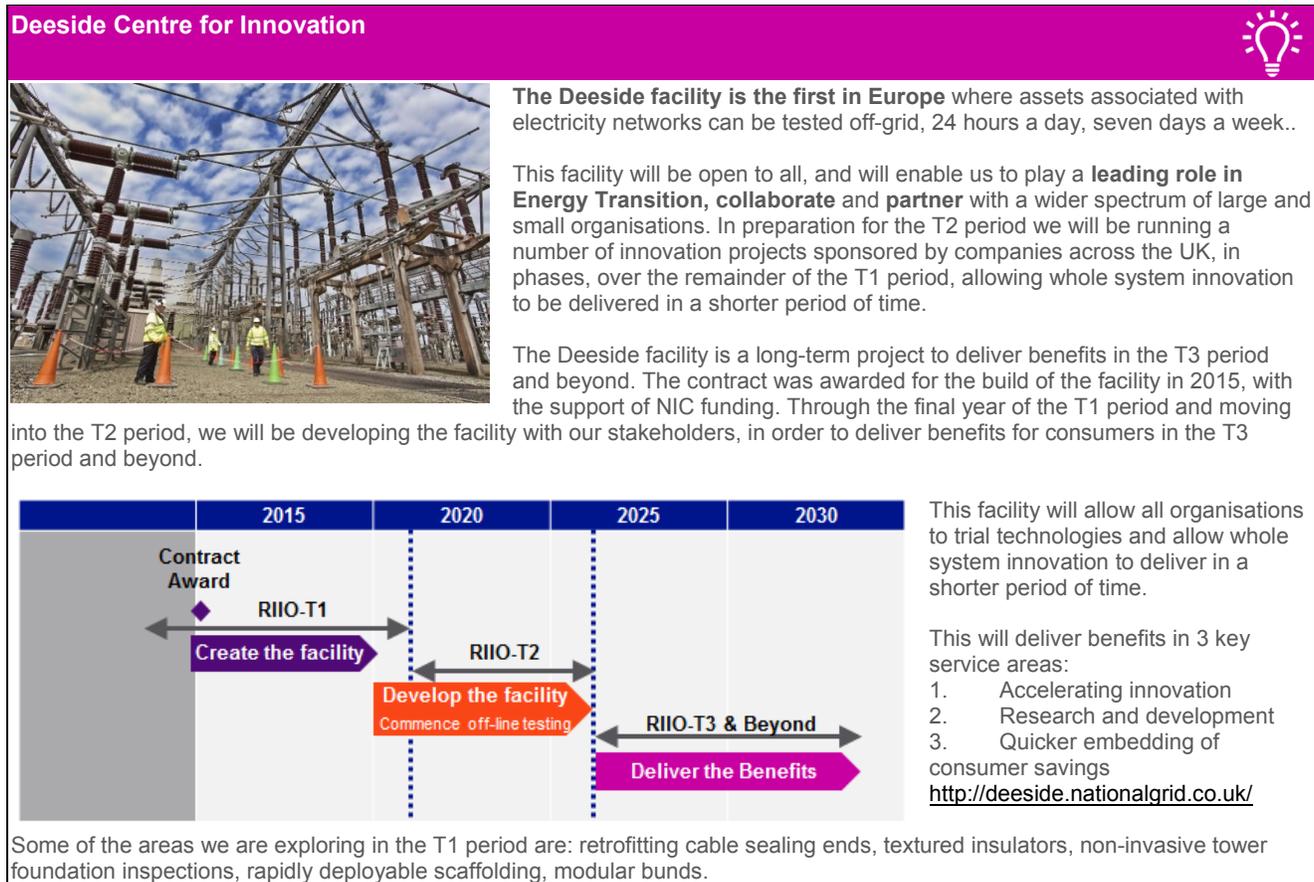
Over the T1 period, the number of parties we are collaborating with across the whole energy system and technology areas has increased, although we recognise our stakeholders need us to do more in this area. And so in the T2 period, we will continue to increase the number of parties with which we will engage and collaborate.

T3 and beyond

Our long-term strategy includes decarbonising future networks. Our **Deeside Centre for Innovation** is open for business for the industry, and is pivotal in enabling the future transition of energy. We are already delivering whole system benefits through collaboration and partnership at Deeside. The cross-sector Technology Advisory Board consists of transmission and distribution

companies in the UK and academic partners, and ensures we have an independent board representing the views of all stakeholders and new market entrants. We have shared the benefits of Deeside with the Electric Power Research Institute (EPRI), which includes collaboration with over 100 international electricity utilities on 21 projects, and through the Engineering and Physical Sciences Research Council (EPSRC), through joint working with academic institutions in the UK and over 300 UK and international organisations. We have also supported our suppliers and other UK infrastructure companies such as Highways England in ideation workshops as part of an Open Innovation programme. We are committed to making Deeside more accessible to SME's in the T2 period.

Figure 12.4 Deeside Centre for Innovation





3. What our stakeholders are telling us

Figure 12.5 Summary of engagement

	Engagement on innovation
<p>Purpose and approach</p>	<p>Throughout the T1 period we have systematically increased our stakeholder engagement on innovation. This stakeholder engagement has moved from being primarily focussed on collaboration and seeking leveraged funding, to a stakeholder engagement framework where we seek stakeholder input to our strategy and innovation programme. In recent years, we have developed a stakeholder strategy and modified our governance to embed stakeholder feedback into our yearly plan which include:</p> <ul style="list-style-type: none"> • two stakeholder workshops per year • sharing & collaborating through industry forums & conferences (e.g. Low Carbon Networks & Energy Networks Association https://www.smarternetworks.org) • transparency and sharing of information through our 'imagining-tomorrow' website https://www.nationalgridet.com/imagining-tomorrow/innovation • regular social media communication (podcasts, twitter etc.) • monthly meetings with our strategic partners • sharing & collaborating at EPRI Conferences • exhibiting at Utility Week Live • collaborating and Engaging with CIGRE • leading & participating ENA Innovation Forums. <p>For the T2 period, our stakeholder engagement has been strategic in nature, leading us to carry out the following engagement activities:</p> <ul style="list-style-type: none"> • large workshops • supported by an online consultation • presentations at conferences • bilateral meetings • strategic partnerships with academic institutions • podcasts and social media (Twitter). <p>Our aim was to understand:</p> <ul style="list-style-type: none"> • our stakeholders' views on our proposed strategy • how important innovation is for our stakeholders in our business plan • what topics we should be focussing on • whether there are any views on how we should be funded for innovation activities moving forward • whether stakeholders agreed with our propositions and proposed funding levels.
<p>What stakeholders & consumers told us</p>	<p>We asked stakeholders multiple choice questions and open text questions. We developed the following conclusions:</p> <ul style="list-style-type: none"> • We need to share our challenges with you. This will allow our suppliers to propose innovative solutions earlier in the process delivering an increased number of cheaper solutions • We need to be more accessible, and more consistent. • We need to collaborate more. Tackling major challenges as a whole energy industry delivers better solutions for stakeholders. Pro-actively collaborating with a wider group of partners will deliver greater benefits. • We need to share more data. Getting the balance right between security and transparency is crucial in allowing our stakeholders to understand our challenges and propose better solutions. • We need to make it easier for SMEs to collaborate with us. • We should focus our innovation on the wider societal priorities of clean energy, driving down current and future consumer costs and opportunities for digitisation as well as the integration of the whole energy system and clean energy solutions for other sectors. • We should be transparent about how we have embedded our innovation into business as usual, ensuring that savings made in the T1 period are baked into our plans for the T2 period. • We should focus more investment on decarbonisation, and less on self-sustaining funding models and embedding culture (should be BAU). <p>61% of consumers surveyed felt that NGET should be a 4 or 5 on a scale where 5 is 'highly innovative.'</p>
<p>Key trade-offs and how engagement influenced</p>	<p>Embedding a culture of innovation across the business is a key topic for the Independent Stakeholder Group. We understand the benefits that this will bring. We identified this as a separate funding proposition for the T2 period, however our stakeholders informed us that we should be focussing more NIA investment on decarbonisation and less on culture.</p>



our plans	<p>We decided to remove this from our NIA propositions, and commit to improving our culture through our BAU activities by committing to deliver cultural improvements measured through the IDEO cultural survey (section 4 of this chapter).</p> <p>We were also informed that we should invest more on decarbonisation, hence we increased our proposals in this area, balanced from the reduced spend in other areas.</p>
How we've responded to the Independent Stakeholder Group and Challenge Group	<p>We have been challenged hard on our innovation proposals, these include:</p> <ul style="list-style-type: none"> • Strategy – we have shared our Innovation Strategy, and included a summary in this chapter. • Culture – we will continue on our journey to embed an innovation culture in our business, and have made it clear what our world looks like at the end of T2 through our IDEO survey commitments in section 4 of this chapter. • Engagement – we have broadened the stakeholders our engagement covers. • Monitoring – we have committed to work together with stakeholders to develop a joint transparent innovation monitoring framework. • Propositions – we have carried out further engagement to test our proposals with stakeholders.

4. Our proposals for the T2 period

The diagram below summarises the Innovation Strategy we have developed with our stakeholders, and how this links to our proposals for the T2 period.

Figure 12.6 Our Innovation Strategy





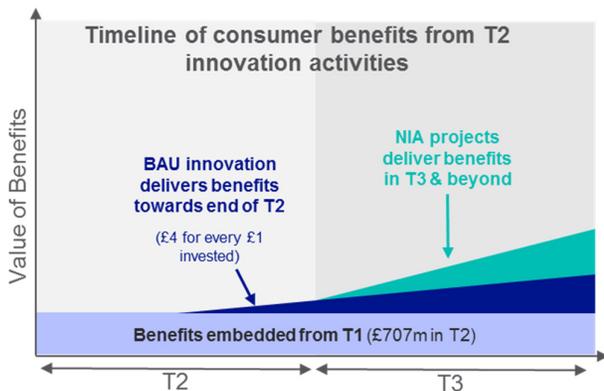
Additional allowance for rolling out previously proven innovation

We do not need any additional totex allowance in the T2 period to 'roll out' previously proven innovation. We are rolling out all our previously proven innovation through our BAU activities, which is already 'baked in' to our T2 business plans, reducing our business plan by at least £707m. Detail of this can be viewed in annex NGET_A12.02 Innovation T1 Performance.

T2 Innovation delivers benefits across different periods

Figure 12.7 shows how our T2 innovation activities will deliver benefits in different timescales. T1 innovation benefits which have been rolled out continue to provide benefit throughout the future, as we embed these into the business. Our BAU innovation activities will start to deliver benefits in the T2 period, and continue to deliver benefits as these are embedded into our T3 activities. T2 investment in our NIA projects will start to deliver benefits in T3 and beyond. Further detail can be found later in this chapter.

Figure 12.7 Timeline of T2 innovation benefits



BAU Innovation

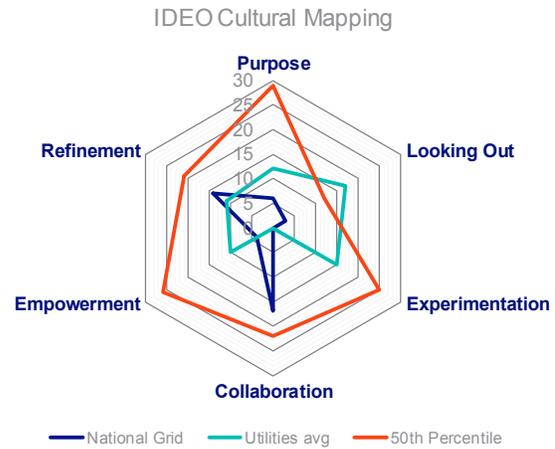
Our T2 BAU Innovation will be funded through our baseline Totex Allowance, with no additional innovation stimulus funds. Projects which deliver consumer benefits in the T2 period are included within our business as usual activities. Table 12.9 provides some further detail.

Innovation culture commitments

Our Innovation Strategy includes our ambition for National Grid is to be 'fit for the future' and change quickly to adapt to the changing external environment. We have created a roadmap to develop our leadership and management behaviours, and foster a creative environment, to augment and strengthen the culture of innovation across the organisation. We will measure our progress through year on year improvements on the IDEO Creative Culture survey, asking the Independent Stakeholder Group to challenge our delivery against our ambition. with the aim of developing from our current 'novice' status through the 'learning' phase and ultimately achieving 'expert' status within our organisational field.

The diagram below compares our current results (in blue), against an average for other utilities (cyan), and the 50th percentile (orange) covering all organisations.

Figure 12.8 Cultural Survey Mapping



To achieve these aims, we will introduce a targeted action plan focussing on critical improvement areas identified for each of the 6 creative qualities:

- **Purpose:** Empower employees through improved use of line of sight with organisational goals.
- **Looking Out :** Encourage teams to seek expert best practice and collaborate externally to improve decision making.
- **Experimentation:** Introduce prototyping to de-risk ideas and test/refine key elements early.
- **Collaboration:** Integrate innovation and execution functions through use of multidisciplinary teams with shared goals.
- **Empowerment:** Continue to improve delegated authority into the teams supported by a clear decision making framework.
- **Refinement:** Create an innovation forum with internal and external stakeholders to respond with agility and pace to changing stakeholders needs.

By the end of the T2 period, we will demonstrate above average performance on all areas of the creative quality index when compared to similar organisations, and be clearly on the **path to 50th centile performance** across all organisations on our key target qualities of Purpose, Empowerment and Collaboration. Delivering on this commitment will create a business that is built around a listening and collaborative culture, and which is focussed on meeting our stakeholders needs and requirements. We will be responsive, and visibly open to disruptive technologies and ideas that will transform our business in order to deliver the energy transition. Our stakeholders will see an agile business that is willing to experiment and try new ideas, and which is happy to dispense with accepted processes, procedures and technologies in order to continually develop, improve and grow. Through improved transparency, our ability to transform concepts and ideas into real world solutions which meet our strategy goals will be clear to all.



Table 12.9 BAU innovation activity areas

BAU Innovation Creating T2 benefits and a platform for the future		
Key areas	Description	Commitments
Embedding a culture of innovation	Improving our 'innovation culture' throughout the organisation	<ul style="list-style-type: none"> • Board level commitment to embed innovation into our BAU culture • Use IDEO cultural survey to improve purpose, experimentation, collaboration, empowerment, looking out and refinement • Adopting National Grid Partners 'centre of excellence' which establishes a shared understanding of the value innovation can bring, ensures consistent execution, tracking & enhances collaboration
Rolling out proven T2 innovation	Creating new innovation projects which deliver benefits within the period and rolling out the benefits	<ul style="list-style-type: none"> • Deliver technical innovation in OHLs, SGTs, Protection & Control, Cyber Security, Cables, Power Electronics & Network Management
Improving collaboration & attracting 3rd parties	Being open and accessible, and attracting a wider set of external stakeholders and 3 rd parties, including SMEs and other industries	<ul style="list-style-type: none"> • Hold annual conferences with other electricity networks to disseminate learning from innovation activities • Share specific learning through presentation at other network conferences and events • Create new data sets from our wider stakeholder set • Stakeholders will experience a consistent approach • Develop a portal for our innovation website where 3rd parties can submit ideas • Hold joint 'whole system' gas & elec calls for proposals and run yearly challenges on NIA propositions
Monitoring progress and outcomes	Developing a joint monitoring framework across the industry for a common method of measuring the progress and benefits of innovation activities	<ul style="list-style-type: none"> • Work with other network companies and the ENA to deliver a joint monitoring framework, which is publically available (see annex on Benefits Framework)
Being more transparent	Sharing our work, benefits and progress externally	<ul style="list-style-type: none"> • Be consistent in our approach • Striking the balance between open source data and the security of our network

Network Innovation Allowance

There are some projects which do not deliver benefits in the T2 period, or deliver benefits to the whole energy system. These require additional innovation stimulus funds as it is not possible to derive a benefit for the consumer within the T2 period. We are therefore requesting additional innovation funds for the following areas, which deliver benefits relating to the energy transition or consumer vulnerability in the T2 period, T3 and beyond.

Our proposals for Health & Safety do not deliver benefits relating to the energy transition or consumer vulnerability, but reflect the need to continue to deliver a change in this area across the energy industry.

Table 12.10 NIA Proposals

Network Innovation Allowance (NIA) Creating cost and environmental benefits in T2, T3 and beyond				
Proposition	Description	Commitments	Consumer benefits	T2 Baseline (£m)
Reducing our carbon footprint	Reducing our reliance on harmful materials, and finding new materials that are more environmentally friendly	<ul style="list-style-type: none"> • Investigate alternatives to SF₆ which can be retro-fitted, avoiding the need for more costly asset replacement • Identify methods for reducing or eliminating cement requirements • Implement solutions with novel materials with a lower carbon footprint and which also help with the reduction of visual and environmental impacts • Create enhanced methods of measuring SF₆ leakage 	<ul style="list-style-type: none"> • Lower greenhouse gas emissions • Lower costs associated with the management of SF₆ • Quicker availability of lower carbon products within the supply chain • Delivers our commitment to the energy transition 	8
Facilitating whole systems energy innovation	The Deeside Centre for Innovation is a unique facility that will enable innovation that provides benefits in T1, T2, T3 and	<ul style="list-style-type: none"> • We will collaborate with other network companies and expand the facility in the T2 period, allowing the facility to be truly whole system and not just for electricity 	<ul style="list-style-type: none"> • Faster implementation of newer low-carbon technologies • Reduced costs through quicker and safer 'off- 	30



	beyond. This facility will be available to all networks to benefit the whole energy system, not just our network	<ul style="list-style-type: none"> • Include a facility to trial gas (hydrogen and liquefied natural gas) integration, electric transport technologies, and zero-carbon generation technologies • Open up the facility to SMEs • We will be transparent about the activities at Deeside, to allow all parties to share and collaborate regardless of fuel or network 	line' testing and commissioning	
Facilitating decarbonisation of wider industries	<p>We know that helping society to decarbonise is the biggest contribution we can make to the environment</p> <p>We will use our expertise in this area to engage with and support other industries to decarbonise their processes</p>	<ul style="list-style-type: none"> • Lead the way to a low carbon future by implementing the government's Clean Growth Strategy • Facilitate electricity network's role in the transition to electric vehicles • Actively explore opportunities to support and work with other industries (transport, steel, cement) to identify and implement decarbonisation activities • Explore the appetite of other industries to move toward a hydrogen economy and the implications for transmission networks • Support industry in the development of technology and systems to help them participate in the future energy market 	<ul style="list-style-type: none"> • Overall reduction in greenhouse gas emissions across other industries supporting the UK to achieve its emission targets • Greater flexibility in charging points for electric vehicles • Greener options available for heating in the home, transport, products and services 	13
Digitisation (Further detail on our digitisation strategy can be found in annex NGET_A14.13 – IT Transform)	<p>The future energy system will interact, and be more dynamic than ever before. To respond to these challenges, we want to transform our business through digitalisation</p> <p><i>We have separately published our Digitisation Strategy on our website and provided a link to Ofgem. This strategy outlines how we will use technology and data to digitally transform our business and includes some initial thoughts on our response to the recommendations of the Energy Data Taskforce report on 'A Strategy for a Modern, Digitalised Energy System'</i></p>	<ul style="list-style-type: none"> • Investigate tools and techniques to allow the digitisation of maintenance, monitoring, and testing of equipment with automated archiving and analysis of information • Research and investigate algorithms for the mixture of data with various levels of accuracies and time-frames • Investigate risk in real-time to maximise asset performance and value • Investigate the potential of artificial intelligence, robotics and research sensors • Explore how artificial intelligence can be applied to our asset, financial and other data sets • Share data across the whole energy system (heat, transport, energy) 	<ul style="list-style-type: none"> • Reduced whole system costs through the ability to collaborate with a common data platform • Reduced costs through improved real-time asset information allowing more informed risk based decisions • Improved analytics and intelligence in business support systems will provide information to allow lower cost decisions • Improved collaboration and sharing of data will create a more agile system, allowing cleaner technologies to access the system quicker 	22.5
More responsive & agile for our customers	<p>Future customers (solar farms, windfarms, industry etc.) want quicker and easier access to the system, to allow them to produce clean energy as efficiently as possible</p> <p>In the T2 period, we will develop tools which allow us to respond to our customers' needs, connect them to the network more quickly and cheaply, and allow us to deliver our future work more efficiently</p>	<ul style="list-style-type: none"> • Produce offline tools to replicate our live network, allowing us to respond to customers more quickly • Create new assets and installation methods that can be quickly deployed and moved around the UK to support the fast connection of customers 	<ul style="list-style-type: none"> • Lower costs through improved optimisation of network operations • Quicker connection of renewable generation • Improved customer experience 	7.1



Addressing vulnerable consumers	The initial transition to cleaner energy could have a negative impact on consumers who could be left behind by the transition	<ul style="list-style-type: none"> • Collaborate with parties closer to consumers (suppliers, DNOs, supply chain) • Explore our role in this area with stakeholders (leadership or supporting) • Collaborate with SMEs to develop further understanding in this area of how we can support vulnerable consumers 	<ul style="list-style-type: none"> • Ensuring vulnerable consumers are not 'left behind' in the transition to cleaner energy • Focussing our strategy to deliver cheaper energy to vulnerable consumers • Employment and education opportunities 	2.2
Step change in Health & Safety	The safety of the public, our staff and our stakeholders is our number one priority. Our aim is that there are no injuries resulting from our operations	<ul style="list-style-type: none"> • Lead research into new safety technology for the whole energy industry 	<ul style="list-style-type: none"> • Improved safety for the public and for our staff 	1.2

Strategic Funding Innovation Pot (SFIP)

The SFIP replaces the the Network Innovation Competition (NIC) which was successfully utilised to progress the initial stages of our Deeside Centre for innovation. There have been no funding proposals set out yet by Ofgem, we therefore propose that this pot is focussed on the following areas:

1. Enabling the transition to net zero by 2050. Additional stimulus funds in this area will allow us to meet our commitments set out in our business plan on net zero.
2. Finding solutions to nationally significant challenges such as the future of transport, heat and network resilience.

5. The justification for our proposals

Your innovation money is safe in our hands. We have an excellent track record of providing benefits which exceed external benchmarks. Despite our excellent track record, we recognise that there are areas that we must improve on in the T2 period. We have committed to making a step change in culture.

We are requesting a **single allowance** for NIA in the T2 period. This provides efficiency benefits and savings over an annual allowance or project by project framework.

We are proposing to **fund 10% of the NIA spend ourselves**, reflecting our confidence in our track record of creating benefits through our innovation activities.

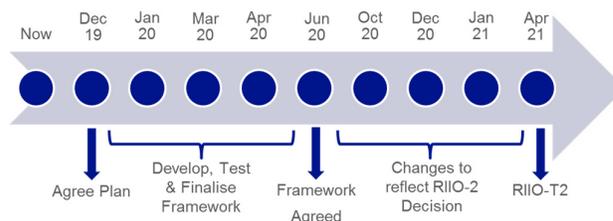
We conducted our first **IDEO cultural survey** in August 2019 across the whole electricity transmission organisation. We are committing to use this approach as our mechanism for measuring innovation culture. We have used these results to target what we need to do and to define our target for innovation culture by the end of the T2 period.

Delivering a joint monitoring framework for innovation

Under the ENA Gas Innovation Governance Group (GIGG) and Electricity Innovation Managers (EIM), Gas and Electricity Networks have worked collaboratively in preparation for the T2 period to inform the wider industry of the adoption of a benefit tracking methodology that delivers a wide range of benefits to network customers and wider stakeholders.

The timeline for developing the framework is shown below in figure 12.11.

Figure 12.11 Innovation benefits tracking timeline



A copy of the ENA Benefits Reporting Framework can be found in annex NGET_A12.03 Innovation Benefits Framework.

International standard for innovation management

In 2019, a new international standard on Innovation Management: ISO 56000 is expected to be published. This is aimed at providing organisations with guidelines and processes that enable them to get the most of their innovation projects. This includes:

- tools & methods for innovation partnership
- innovation management assessment
- innovation management system.

We have collaborated with the consultation process providing input into the standard, and we are committed to being one of the first to achieve the new international standard.



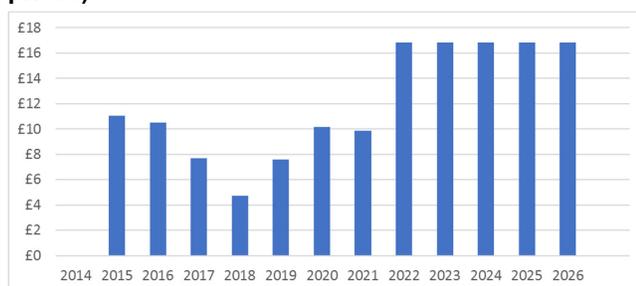
6. Our proposed costs for the T2 period

Our proposed costs for delivering against our propositions for the T2 period on this priority are detailed within table 12.12 below. We are proposing to fund 10% (£8.4m) of the NIA projects ourselves, leaving £75.6m to be funded through the allowance).

Table 12.12 Proposed baseline costs for the T2 period

Output type	Non-Totex NIA (£m)
NIA	84
TOTAL	84
Pension allocation	0.1

Table 12.13 T1/T2 NIA Expenditure Profile (£m 18/19 prices)



T2 profile is deliberately flat to reflect NIA projects not yet developed.

Innovation spend governance

Our innovation governance has two parts:

- Annually, our Innovation Strategy is updated using the outputs from stakeholder engagement. This Innovation Strategy is discussed and approved at the electricity transmission executive committee and includes key themes we are seeking to address based on this stakeholder feedback.
- Individual projects are developed to address this strategy and are approved following our investment process with the approver being dependent on the

level of spend based on established delegated authority levels. This means smaller schemes are approved in the line and larger schemes are approved at our investment committee.

7. How we will manage risk and uncertainty

In the T1 period, there are 14 NIA projects that we have decided not to implement because they will not deliver benefits for consumers. We always review unsuccessful projects for lessons learnt.

The following are specific lessons we have learnt from unsuccessful projects:

- the technology is not yet mature enough for the intended application
- the cost of implementation outweighs the benefits
- the complexity of solution if implemented would cause an unacceptable level of risk
- the outputs of the project will not deliver in a timescale where the benefits can be realised.

We deliver innovation as a portfolio of projects. The risk of a project being unsuccessful is managed against the consumer benefits that innovation can bring. Stakeholders want us to take additional risk in the T2 period and invest more in innovation that benefits the whole energy system and other sectors.

We recognise the changing picture within the energy industry, and the rapid pace in which decarbonisation is affecting all of our lives. The pace of change is so high that our current plans in 2019 may not deliver our stakeholders' requirements at the start of the T2 period in 2021. To manage this uncertainty, we propose an uncertainty mechanism in the shape of a **reopener** in 2022. This will allow us to change our plans, in agreement with Ofgem and our stakeholders, to ensure we continue to meet the needs of all of our stakeholders.



13. We will be transparent about our performance



What this stakeholder priority is about

Public trust in energy companies is low and rebuilding this trust is one of the key challenges we face in the coming years. Stakeholders have told us that high levels of transparency are a key aspect of earning their trust, alongside having a positive impact on the environment, customers and communities we serve.

If we want to truly earn the trust of our stakeholders and earn their confidence in what we do, we need to:

- demonstrate how what we deliver is in the interest of our stakeholders;
- explain our financial and operational performance in a clear and open manner; and
- clearly link our leadership and team incentives to deliver the outputs our stakeholders want.

What you have told us so far

You want:

- to have confidence that the revenue we earn is fair and that it reflects what we accomplish for our customers;
- easy-to-understand and easily accessible information about our financial and operational performance; and
- us to be a fair and responsible business.

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. What our stakeholders are telling us
4. Our proposals for the T2 period
5. The justification of our proposals
6. Our proposed costs for the T2 period

What we will deliver

Based on your feedback, we will be delivering the following commitments:

- We will be clearer about what we deliver for you and how this links to our financial performance, and we will publish key metrics in one place.
- For the first time the Independent Stakeholder Group will challenge us on our delivery of outputs and transparency of our performance.
- We will ensure our leadership team's remuneration is clearly aligned with delivering outputs for you.



The Sustainability Reporting Performance of the FTSE 100
Annual Report | September 2019

RANKED 8th and leading utility company

We are really pleased to be recognised as the leading utility company in the FTSE 100 for sustainability reporting

eccact



1. What this stakeholder priority is about

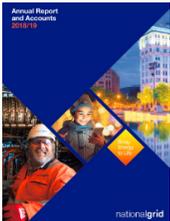
We know you have high expectations of us as the provider of a vital service. We've been closely following the debate about whether private companies should provide essential services and we recognise that some of you are concerned about this. We want to build greater trust in our business by providing full transparency and acting responsibly.

This stakeholder priority is about how we demonstrate that we are transparent in our financial and operational performance, how what we deliver is in the interests of our stakeholders and how we will make sure that we deliver on our outputs and commitments that improve society.

[Citizens Advice has set out five principles](#) for the T2 period. This stakeholder priority aligns to Citizen Advice's principle that "Companies are required to publish complete information on their performance, financial structures, gearing and ownership."

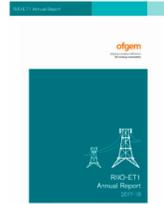
2. Track record and implications for T2

As a large company listed on the London and New York stock exchanges, we already identify and implement best practice. We report significant amounts of information on our financial performance to financial markets, and Ofgem, or through external publications. This provides a greater level of transparency on how we are operating and performing as a business. Our most significant reports are:



Our Annual Reports and Accounts, which detail our financial performance, in line with international accounting standards, and our strategy, vision and significant events. [Annual Reports and Accounts 18/19](#)

Our annual performance report to inform our stakeholders how we are performing against our T1 outputs, refer to annex ET.09 Our Performance to see the latest report.



The annual Regulatory Reporting Pack (RRP) we provide to Ofgem to inform their assessment of our performance [RIIO ET1 annual report 2017/18](#). This reporting pack provides details of our expenditure, the outputs we've delivered and our financial returns. It demonstrates our performance against our regulatory outputs and allowances.

We continue to take a responsible approach to tax. We manage our tax affairs so that we pay and collect the right amount of tax, at the right time, in accordance with the UK tax laws. Our approach to tax is consistent with the Group's broader commitment to be a responsible and sustainable business and therefore continues to be guided by our purpose and values.

Learning for the T2 period

The Regulatory Instructions and Guidance (RIGs) set out what we must report in the RRP each year. In the T1 period, the RIGs have required a more detailed breakdown of our capital expenditure data, increasing the number of input cells from around 15,000 to more than 200,000. We want to establish whether we can provide better information to our stakeholders, including Ofgem, at a lower cost to consumers. We may be able to achieve this, simply by focusing more closely on what our stakeholders want to know, rather than provide information on what we think they want to know.

A key learning point for us from the T1 period is that more of our T2 business plan should be covered by outputs so that our stakeholders will be better able to see how we are delivering against our business plan and provide more coverage on different outputs. We also recognised that we needed to link the Annual Report and Accounts to our regulatory performance, which now has the strategic performance overview, providing clarity on how we are performing.

3. What our stakeholders are telling us

We took the opportunity to engage with stakeholders to understand what aspects of transparency are important to them.

The engagement log contains detailed information on our engagement approach for this priority and how we have responded to challenges from the Independent Stakeholder Group. It details how we have reached the proposals outlined in this plan based on that engagement. This log can be found in Annex NGET_A13.01. A summary of our engagement activities and outcomes is provided in the table 13.1.



Table 13.1 Summary of our engagement

Purpose and approach	Understand views from a wide variety of stakeholder in relation to transparency, our current reporting and what else might be needed through bilateral meetings, a webinar, publications and consultations on our website and a number of workshops with Ofgem and other stakeholders.			
What our stakeholders are telling us	Consumer Groups, Environment Groups and Others <ul style="list-style-type: none"> Want a clear line of sight between activities, operational performance and financial reward Want to understand difference between allowed costs and actual costs with narrative focussed on the 'why' not just the 'what' Want to be able to compare performance across the different networks (Environment elements) 	Customers (generation and demand) and Network Operators <ul style="list-style-type: none"> Want granular detailed operational information at frequent levels Want communication to continue in order for us to meet our licence obligations Want transparency reporting in relation to the new regulatory financial performance reporting set by Ofgem Want to be involved with setting out the priorities of our business plan 	Energy Suppliers <ul style="list-style-type: none"> Want to have sight of our business planning process Want to understand what is subject to change in our business plan 	Regulator <ul style="list-style-type: none"> Want analysis to ensure we have delivered what we have been given allowances for Want to have enough analysis and justification that our business is run efficiently Want to be able to understand financial performance and if this is valid Want consistent reporting across networks and sectors where possible

4. Our proposals for the T2 period

The table below outlines how what stakeholders are telling us links to the proposals we are making and the associated consumer benefits.

Table 13.2 Our proposals for the T2 period

Stakeholder Feedback	Our proposals	Output type	T2 Baseline cost £m	Consumer benefit
Want a clear line of sight between activities, operational performance and financial reward which is easy-to-understand and easily accessible	<p>Increase the scope of our annual performance report and communicate our performance to our stakeholders</p> <p>Publish the data and reporting requirements for annual regulatory reporting process to Ofgem and prepare our system for the data exchange service</p>	LO	1.2	<p>Ensure consumers only pay for the work we must carry out</p> <p>Better understanding of the role we play in the industry and society</p> <p>We are an inclusive organisation which helps promote future talent</p>
Want to have confidence that the revenue we earn is fair and they want us to be a responsible and fair business	<p>Retaining the Independent Stakeholder Group to hold us to account on our reporting</p> <p>For proposals that relate to us being a responsible and fair business, refer to section 4 in Chapter 11 <i>We will care for the environment and communities</i></p>	Commitment	N/A	
Want to have sight of the business planning process and what has changed	Introducing the annual business planning process – see chapter 6 section 3 <i>Giving stakeholders and consumers a stronger voice</i>	Commitment	N/A	
Need to ensure that pay and reward is aligned to our business plan outcomes	We are all aligned and committed in delivering the right outputs for the T2 period	Commitment		



5. The justification of our proposals

In developing our proposals, we have reviewed what others have done, used benchmarking to determine the options we are progressing.

The step change in transparency from the T1 period is that we will be reporting on more aspects that will include output measures, financial metrics and key societal benefits, using online digital platforms.

5.1 Increase the scope of our annual performance report and communicate our performance to our stakeholders

We will do this by:

- making a stronger link between the activities we carry out, our performance metrics, and the financial reward we receive for the whole business plan
- explaining the outputs we have to deliver and the progress we have made towards delivering them and explaining how we have returned any funding for outputs we have not delivered
- providing comparisons with other companies where we can – one example is that we are working with the Scottish Transmission Owners on common environmental metrics
- explaining how our costs have differed from our forecast costs and why
- focusing our reporting on how our financial performance relates to how we've delivered for our customers and consumers
- report on all the key metrics in one place.

We are committed to widening the scope of our performance reporting to include key societal measures. This will demonstrate how we are operating as a fair business and making a positive contribution to the society that we serve. We believe this is an attractive proposition for all our stakeholders, including investors. You told us that we should continue our reporting in the annual performance report, so we will ensure that we enhance the reporting to include what has been discussed.

We will tailor our reporting to our stakeholders' needs and clearly and simply set out what you want to know in a proactive manner. We will continue to engage with you to improve our annual performance report and adapt it to your changing needs.

To increase the accessibility of data and reporting, we plan to invest in our insights platform to structure our data to support Ofgem's energy data exchange service. We will do this by:

- working with our stakeholders and Ofgem to maximise the value of data held in our business and ensure that key data items are accessible
- integrating our insights and enterprise resource planner platform with the portal to service key financial and performance data

- proposing an allowance of £1.2m to be included in the business plan to deliver this requirement.

We will ensure that we are compliant with best practice with regards to accessibility to the website and other publications by using industry standard IT applications to deliver external communication or collaboration platforms. These will enable best practice for accessibility to different content across our website. The IT costs to deliver this have been benchmarked by Gartner Inc, demonstrating our investments are in line with external benchmarks. The need and justification of the reporting can be found Annex NGET_A14.01 IT Transform.

5.2 Delivering the regulatory reporting obligations

We will:

- deliver the regulatory reporting requirements for Ofgem based on the enhanced business plan data table requirements, and review these to ensure they continue to be of mutual benefit for T2 reporting
- assure that the data is robust and reliable when submitting to Ofgem
- closely collaborate with colleagues within the business, seeking opportunities to drive efficiencies within the RRP process via automation, including close working with Ofgem on their data exchange initiative.

5.3 Our proposal to retain the Independent Stakeholder Group during the T2 period

An enduring role for the Independent Stakeholder Group in T2 period would add significant value to our business, our customers and consumers. In an enduring capacity, the Independent Stakeholder Group members will bring the following important characteristics to the forum:

- independence
- expertise
- challenging and stretching mindset on our reporting and transparency
- 'out of sector' insight.

An effective Independent Stakeholder Group will therefore be an important, integrated part of our broader stakeholder engagement programme; increasing confidence across the T2 period, improving transparency, challenging our decision-making and our reporting.

The challenge and scrutiny provided by the Independent Stakeholder Group will confirm whether our business decisions reflect what stakeholders have told us. Please refer to chapter 6 Giving stakeholders and consumers a stronger voice which contains more information on the group and associated costs.



5.4 Our proposal to ensure that we are all aligned and committed in delivering the right outcomes

We believe that our people play a vital role in delivering the commitments set out in our business plan. Our aim is to provide a fair and balanced reward framework, that is competitive within the market, to ensure we continue to attract, recruit, retain and engage the right calibre of employees to support the achievement of our business plans, while not over-paying. Our base salary, short-term and long-term incentive levels and pensions are benchmarked against appropriate energy and general industry comparator groups and we aim to position our overall reward at mid-market.

Our short-term bonus plans incentivise the delivery of both financial, strategic and operational measures (such as customer, stakeholder, network delivery, environment, safety and people measures) and the demonstration of our leadership qualities and living our values; measures are subject to change to ensure we reflect the right focus on our priorities. This ensures a clear line of sight between individual performance and contribution and delivery of our business strategy and key objectives, which overall will provide value for our customers and investors.

The annual bonus scheme currently comprises of two elements. The first element has 5 components; bonus will be based on reducing costs (12%), T1 output measure for Network Output Measures (12%), safety (12%), customer satisfaction (12%), employee enablement (12%). The second element relates to personal objectives (40%) that are aligned to priorities of the year, for example this year our focus is on delivering the customer experience transformation as

well as delivering our operational and financial commitments. Now that the corporate responsibility focus is confirmed as decarbonisation and fairness, we expect there to be a strong influence from this strategy through to executive objectives as we move in to the T2 period. We will continue with this framework into the T2 period as this allows the leadership and teams to focus on what is important to our stakeholder and will drive the greatest benefit for consumers.

Our long-term incentive plans also include key performance measures taking account of our financial, strategic and operational priorities. The targets are set by the remuneration committee which is chaired by a non-executive board member. To reinforce the long-term nature of incentives, awards are made in shares after the three-year period. Both our short-term and long-term incentive plans are subject to malus and clawback.

6. Our proposed costs for T2

The costs for these proposals are outlined in table 13.3 below and are captured within our business support functions and operational expenditure. These have been benchmarked and assessed as efficient, which you can read about in chapter 14 Our total costs and how we will provide value for money. We are forecasting an increased cost in reporting requirements to meet the annual reporting obligations expected in the T2 period. The increased cost is primarily due to the further categorisation and granularity of data sought by Ofgem.

Table 13.3 Proposed baseline costs for the T2 period*

Baseline cost	21/22	22/23	23/24	24/25	25/26	Total T2	Annual T1	Annual T2	Subject to Native Competition	Internal benchmarks	External benchmarks
IT Investment	0.2	0.3	0.3	0.2	0.2	1.2	0.2	0.2	✓	✓	✓
Total	0.2	0.3	0.3	0.2	0.2	1.2	High confidence				

*Business Plan Data Tables 4.3a Non-Ops Capex



Part 3

Delivering our stakeholder priorities

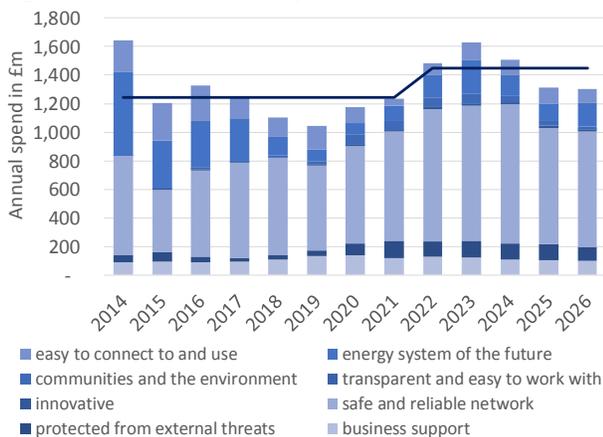


14. Our total costs and how we provide value for money

Our baseline plan costs are £7.1bn

We are proposing to spend £7.1bn over the five years of this plan in the baseline scenario. This is the sum of our operating costs and capital investment to deliver the range of priorities that stakeholders want.

Figure 14.1 Annual totex profile



On an annualised basis, including our forecast of RPEs, this is an increase of 18% compared to T1 because we will be delivering a greater volume of capital investment in T2 required for the future. We are also committing to £383m of future price efficiencies (compared to a 2018/19 baseline) to keep this increase to a minimum.

Our plan embeds efficiencies from the T1 period and contains future efficiency commitments

We recognise that budgets are tight, and we have challenged ourselves hard during the current period to reduce our costs, ensuring we embed those into our T2 plan, as well as making further efficiency commitments for the future T2 period. We estimate the combination of these has reduced the cost of this business plan by £1.1bn (or 13%).

We have systematically built the benefits of our past improvements, engineering and asset management innovations into our plan with an

What you can find in this chapter

1. What this stakeholder priority is about
2. Track record and implications for T2
3. Total costs and headline cost drivers
4. Approach to testing cost efficiency
5. Efficiency of our capital expenditure
6. Justification and efficiency of our Information Technology investments
7. Justification and efficiency of our operating costs
8. Our future efficiency commitments totalling £383m
9. Proposals for managing price uncertainty
10. How our plan provides value for money
11. Our Native Competition Plan

estimated capex saving of £707m over the T2 period.

To ensure we remain efficient over the T2 period, we have also committed to efficiencies in five areas:

- delivering and sustaining the forecast benefits of our UK efficiency programme;
- reducing our capital unit costs to below industry mean;
- reducing some support function costs to align with benchmarks;
- further improving our opex and capitalised labour productivity by 1.1% year-on-year; and
- applying our proven engineering innovations more widely.

These future efficiency commitments add up to a further £383m of savings.

Our costs benchmark well for efficiency

Our network capital costs, the operating costs of running the business and our IT investments have been independently benchmarked by specialist organisations and we are in line with or better than current benchmarks.

This chapter demonstrates our costs are efficient and that we will provide value for money for consumers in the T2 period.



1. What this stakeholder priority is about

The eighth stakeholder priority is about how we will deliver stakeholders’ priorities for the electricity transmission service in England and Wales in a cost-effective way. It is about us providing a value for money package for the T2 period.

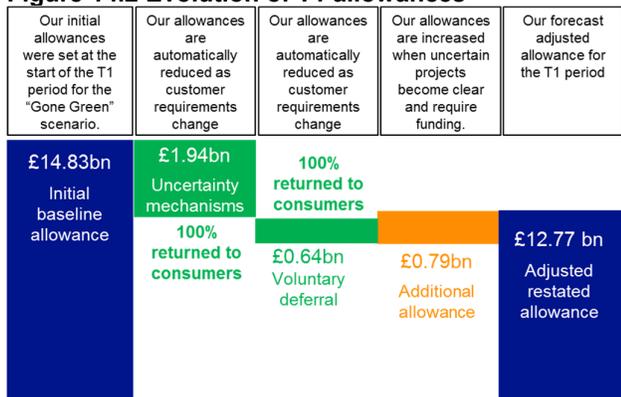
Chapter 6 *Giving stakeholders and consumers a stronger voice* explains that we have tested whether we are providing value for money by collecting evidence on consumer preferences and acceptability and by inviting stakeholders to scrutinise our plan. In summary, stakeholders have told us that they expect us to meet their priorities efficiently and to deliver value for money, over the five years of the T2 period and the longer term.

This chapter covers how we have made sure our proposed expenditure for the T2 period is efficient, including capital expenditure (capex), information technology (IT) expenditure and operating expenditure (opex).

2. Track record and implications for T2

Uncertainty Mechanisms have protected consumers

Figure 14.2 Evolution of T1 allowances



Our T1 totex allowances were set on a ‘baseline’ energy scenario. As our customers’ requirements for generation connections, demand capacity and network reinforcements changed during the T1 period, we needed to invest less than was assumed in the baseline. A range of uncertainty mechanisms adjusted our allowances down to reflect these changes in requirements, and some new projects were funded within period (for example the stakeholder-led visual impact mitigation projects).

In 2016, we recognised that there were some investments we did not need to make during the T1 period that were not covered by uncertainty mechanisms or the mid period review. As a result, we were the first network to voluntarily defer c£600m of allowances into future periods, refunding consumers in T1. Other networks then followed suit.

The learning for the T2 period is that uncertainty mechanisms (acting around a baseline scenario) should be retained. There is scope to refine uncertainty mechanisms to track as closely as possible the underlying drivers of cost. They should also be expanded to cover more areas where requirements are potentially uncertain. This protects consumers from inaccurate forecasts, ensuring they only pay for outputs that are needed.

Treatment of Real Price Effects gave consumers stability over accuracy

A significant portion of our cost base is impacted by the global price of materials, such as copper, which are outside our control and are not adequately dealt with through RPI indexation (these are known as Real Price Effects, RPEs). In RIIO-T1, an ex-ante forecast of RPEs was made and a fixed allowance granted. This placed price volatility risk with networks and gave stability of charges to customers, but exposed consumers to ex-ante RPE forecast error. The indices for RPEs to date have outturned lower than forecast leading to the perception of windfall gains for networks.

Our learning for T2, which was also our position in T1, is that it more appropriate to manage the effects of RPEs for costs outside of our control through an RPE indexation mechanism. Rather than a fixed forecast, the mechanism would see RPE allowances track relevant indices through the period. Whilst this adds marginally to customer charge volatility, it also protects consumers from errors in forecasts of RPEs.

The move to strong totex incentives has driven significant capital efficiencies

We have delivered £1.4bn of capital efficiencies in our asset management activity through innovation and finding ways to deliver our outputs for less. The RIIO-2 Challenge Group and the Independent Stakeholder Group have challenged us to demonstrate how these efficiencies have been carried forward into our T2 plan.

Figure 14.3 below shows the efficiencies achieved in T1 and how these have been included in our T2 plan. We quantify the benefit of these efficiencies in our T2 plan because it is possible to derive a robust counterfactual.

Figure 14.4 below shows the efficiencies achieved in T1 which have also been included in our T2 plan, but we do not believe it is possible to quantify the effects on the T2 plan robustly.

Our learning for T2 is that the framework should continue to provide strong totex incentives to drive innovation and efficiency. Outputs should be expanded to include more of the investment cost base and tracking and reporting should be improved to ensure full clarity over why cost changes occur.



Figure 14.3 Efficiencies for which we have been able to establish counterfactuals for the T2 period

What did you do to generate savings in the T1 period?		How has this been included in this T2 plan?	How much cheaper is this T2 plan as a result?		
Life extension. Worked with university and commercial research partners on specific asset-related projects, rolled out new technology for collecting asset data, invested in more-advanced data analytics and carried on with long-term programmes of testing failed and decommissioned equipment.	Transformers	215	Knowledge gained allowed extension of technical lives of some asset families, reducing the amount of replacement that would have been due in the T2 period.	Using today's unit costs and multiplying by the volume of work that is not now due in the T2 period, the saving is described in Chapter 9 <i>We will provide a safe and reliable network</i>	97
	Overhead line conductor	0			204
	Overhead line fittings	86			84
Targeted replacement. Taken on more design responsibility to focus replacement activities on higher-risk or life-limiting components, engineering new equipment to interface between old and new components to allow us to retain reliable infrastructure.	Overhead line fittings	138	Used cost benefit analysis to check new interventions are in consumers' long-term interests and to determine on which assets to use them.	Net savings systematically embedded in our plan by creating new Cost Book rates.	132
	Protection and control	231			66
Application of innovation project outcomes.	Recovery of corroded tower steelwork via enhanced coatings.	45	Ongoing use has been assumed.	Estimated saving based on forecast volume.	124
Total 8-year T1 efficiency = £715m			Total 5-year T2 efficiency = £707m		

Figure 14.4 Other T1 efficiencies without counterfactuals for the T2 period

Efficiency driver	Investment area impacted	T1 efficiency (£m)
Targeted replacement. Taken on more design responsibility to focus replacement activities on higher-risk or life-limiting components, engineering new equipment to interface between old and new components to allow us to retain reliable infrastructure.	Switchgear bay replacement and refurbishment	158
	Revised cable programme based on updated network risk	176
Lean working practices. With our supply chain, we have reviewed working methods and procedures to remove bureaucracy and improve productivity, reducing job duration and cost. Our refurbishment facilities were one of the first areas to apply our Performance Excellence approach to improve efficiency. In-sourced project development and strengthened project controls to better control risks in project delivery.	Installing replacement circuit breakers in existing bays	43
	Extended in-house switchgear refurbishment capability	54
	Demountable barriers instead of site-specific flood protection (and decreases due to flood risk category changes)	18
Contracting efficiencies. Introduced a new suite of competitively-tendered, multiple-tier frameworks, in addition to direct competitive tendering, to ensure fit-for-purpose contracting across all sizes of project. We have increased competition by introducing new suppliers through broadening our sourcing strategy. We have also established a specialist, in-house cost estimating function to ensure we understand the fair price for work.	Bulk purchases and use of Tier 1 contractors for switchgear	41
	Best-country sourcing, contracting and scoping of transformer work	46
	Bundling efficiencies, e.g. replacing wallbushings as part of larger projects	50
	Competitive tendering and proactive risk mitigation on London Power Tunnels 1	58
	Lessons learnt from LPT1 and early adoption of Project 13 approach for London Power Tunnels 2 (LPT2)	97
Other smaller cost changes (required to balance to total efficiency number)	Changes in project scope, land purchases, strategic spares, tower foundations, etc	-44
Total 8-year T1 efficiency = £697m (+ £715m = £1412m)		



3. Total costs and headline drivers for T2

In the remainder of this chapter, we bring together the total cost of our plan for the T2 period and evidence why costs are efficient now for the services our stakeholders want, and how our embedded efficiency ambitions will keep our costs at the efficient frontier.

Figure 14.5 shows the cost of our proposed baseline plan based on the common energy scenario. The costs are broken down across each of the key stakeholder priorities and between Capital Expenditure (capex), Operating Expenditure (opex) and Network Innovation Allowance (NIA). We are also making some future

efficiency commitments. For our operating costs, these have been embedded in the opex shown. For our capital costs, these have not been embedded and are shown as an 'overlay' line.

We are proposing a baseline plan of £7.1bn totex

The total controllable cost of delivering the key stakeholder priorities in our base plan is £7.1bn (excluding Real Price Effects, as required by Ofgem). The total impact on household and customer bills of these controllable totex costs, RPEs and non-controllable costs is described in Chapter 15 *How our plan should be financed*.

Figure 14.5 Cost of delivering key stakeholder priorities

Key stakeholder priorities	T2 cost in £m			
	Capex	Opex	NIA	Total
1. We will enable the ongoing transition to the energy system of the future	933	3	0	936
2. We will make it easier for you to connect to and use our network	396	21	0	417
3. We will provide a safe and reliable network	3,523	764	0	4,287
4. We will protect the network from external threats	447	108	0	555
5. We will care for communities and the environment	232	23	0	255
6. We will be innovative	0	0	84	84
7. We will be transparent about our performance	1	0	0	1
Business Support	159	491	0	650
Additional capex efficiency commitments (not embedded in stakeholder priorities)	-81	0	0	-81
Total Baseline Plan Costs	5,610	1,410	84	7,104
Forecast of Real Price Effects, RPEs	271	54		325

The table above includes NGET's direct opex associated with inspecting, maintaining and repairing assets and the opex associated with mainly office-based staff involved in planning our work, central asset management activities and undertaking customer-facing roles.

To calculate the overall totex for the T2 period, we then add our business support costs which are required to support the delivery of stakeholder priorities, albeit indirectly. These include costs for functions that are needed to run any large organisation, such as human resources, finance, IT, regulatory compliance, contract management, insurance and property management. We operate a shared services model for these functions, where a single department provides services across a number of National Grid Group businesses. The table shows NGET's proportion of those shared function costs.

Our forecast average annual totex expenditure for the T2 period is £1.4bn; if forecast RPEs are included, this is an 18% increase compared to T1 average spend. Figure 14.6 shows that the increase in expenditure is driven by the need for a greater volume of capital investment in T2. Figure 14.7 then outlines the key drivers for changes in capital investment requirements.

Figure 14.6 Profile of Opex and Capex from T1 to T2

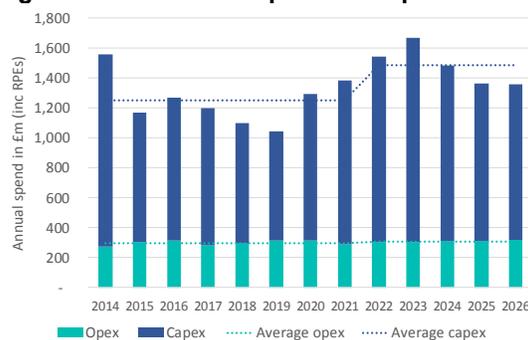
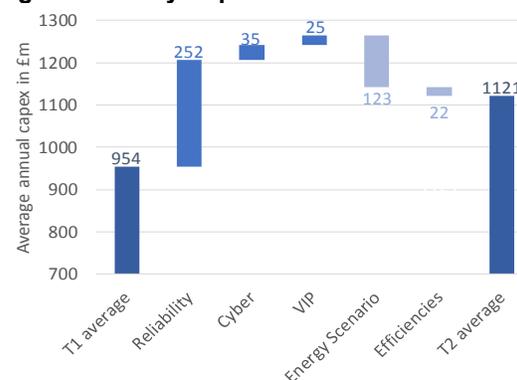


Figure 14.7 Key Capex Cost Drivers from T1 to T2





The drivers of capex changes between the T1 and T2 periods

The key drivers of changes in capital investment from T1 to T2 are:

Reliability – As explained in Chapter 9 *We will provide a safe and reliable network*, we will need to replace and refurbish more assets than in the T1 period to maintain the current level of reliability that our stakeholders are asking for. This is because our network was not installed uniformly, but in peaks, largely in the 1960s and 1970s. The condition of our assets means more of the network falls due for replacement in this period than the last. Replacing these assets is essential to ensuring a strong and reliable network for the future as society becomes increasingly reliant on electricity in the transition to a net zero energy system.

Cyber – As explained in Chapter 10 *We will protect the network from external threats*, the threat of cyber-attack has increased significantly over the last five years and is expected to grow further through the T2 period, requiring a firm level of baseline investment in cyber security to address known risks. We must invest in technology and infrastructure to protect against this threat in order to continue to provide a highly-resilient transmission network for the UK.

VIP – Stakeholder-led visual impact mitigation projects that are forecast to be initiated in the T1 period but, because they are long duration projects, have a greater annual average spend in the T2 period than in T1 causing an apparent increase.

Energy Scenario – Lower volumes of customer connections and network reinforcements than in the T1 period to align with the lower end of the Common Energy Scenario (explained in Part 1 of the business plan).

Efficiency – We have committed to delivering some future capital efficiencies as a result of external benchmarking, innovation and productivity improvements to reduce the costs of the work we

deliver. These are summarised in section 8 of this chapter.

4. Our approach to testing cost efficiency

Overall, our approach has been to collect a wide variety of evidence to support our costs.

At the highest level, almost our entire current cost base has either been market tested via competitive tender or benchmarked over the last six years.

We have also used external independent specialists or independent studies to benchmark and assure our costs and forecasting processes wherever we can. We include such evidence for network capital and maintenance costs, business support function costs, IT investment and operating costs and staff pay rates.

We have also analysed our historic costs (internal benchmarks) to identify trends. Some of the results are presented later in this chapter with more detail in annexes NGET_A14.17 Total Opex and NGET_A14.09 Internal Benchmarking of Capex unit costs.

This approach and associated body of evidence should give stakeholders high confidence in the robustness of our cost forecasts, and Ofgem the necessary evidence to continue to adopt strong incentivisation of cost efficiency in the T2 period to stimulate innovation.

The tools available to test efficiency depend on the nature of spend

Figure 14.8 indicates the relative scale of categories of spend as they will be discussed in the following sections. The categories reflect the different ways in which we incur costs, e.g. contracted out vs using our own staff. We have used * to indicate where we have partial coverage, e.g. some direct opex costs are procured competitively.

Figure 14.8 Benchmarking coverage of categories of spend

Spend area		T2 total	Stakeholder scrutiny	Competitive procurement	Internal benchmarks	External benchmarks
CAPEX	Network-related (Contracted out)	£4.1bn	✓	✓	✓	✓
	Network-related (NGET)	£1.2bn	✓	n/a*	✓	✓
	Non-Operational (mainly Information Technology)	£0.4bn	✓	✓	✓	✓
OPEX	Direct Opex	£0.5bn	✓	✓*	✓	✓
	Indirect Opex	£0.4bn	✓	n/a*	✓	✓
	Business Support	£0.5bn	✓	✓*	✓	✓



5. Our network-related capital expenditure has been tested for efficiency

To connect customers, reinforce our network to enable the economic flow of electricity from generators to demand, and retain a safe and reliable network, we need to invest in network assets. Capital investments mainly consist of building new assets and replacing or refurbishing existing assets. These activities make up 80% of our spend over the last decade and a similar proportion of our business plan; therefore, it is essential that we apply the right effort to understanding and managing these costs.

The efficiency of our network-related investment costs is evidenced by a combination of the following:

- Market testing of our externally-contracted costs
- Informed cost estimation and evaluation
- Internal and external benchmarking of our unit costs to deliver projects
- Cost-benefit analysis
- Robust processes, controls and governance to manage and deliver investments

Driving efficiency through 'native' competition

From 2007, we adopted an Alliance-based capex delivery model to ensure contractor delivery capacity was there to meet rising customer-related investment needs and to address poor contractor safety performance. Partnering with leading engineering firms across a range of sectors offered access to scarce engineering skills, along with the scalability to deliver future investment levels, at the same time as improving safety performance.

As we entered the T1 period in 2013 and customer requirements changed, it became clear that this level of delivery capacity was no longer required and that the core costs of Alliances were not economic against a reducing portfolio of work. We therefore ramped down the Alliances as we introduced a new suite of competitively-tendered, multiple-tier frameworks to ensure fit-for-purpose contracting across all sizes of project. These flexible frameworks are designed to enable a blend of purchasing options to match the different delivery and programme requirements of our many projects. They allow us to choose from equipment supply, install only and supply & install (Engineer, Procure, Construct or EPC) options, facilitating a flexible approach to driving commercial value. Flexibility is important because we work on a live network; our planned work evolves over time to accommodate the changing needs of our customers and in response to system operation constraints.

We have also retained the option of direct competitive tendering where we think this will drive extra value, for example for larger programmes of work. For smaller works, we have developed our in-house delivery capability with our operational staff delivering minor

capex projects alongside repairs, etc. Resources permitting, ET Operations are able to deliver works such as targeted overhead line fittings replacement, refurbishment of bay equipment and replacement of single assets such as instrument transformers; doing so maximises the utilisation of our field force, retains critical skills in the workforce and avoids the need to pay contractor overheads and fees.

We have also increased supply base competition during the T1 period through broadening our sourcing strategy to include countries such as South Korea and China. We have a Group Procurement function that supports both our UK and US businesses to allow us to leverage our worldwide buying powers. We share learning between our UK and US, gas and electricity, and transmission and distribution businesses to continuously develop our procurement activities to ensure we are sourcing and negotiating the right products at the best price from around the globe. The activities of our Global Procurement function are described in annex NGET_A14.06 Delivering competitive value through Procurement.

This commercial and contracting approach is reflected in our native competition plan, which is summarised at the end of this chapter.

Market testing through competitive tender is a key method used to achieve value for money over time. It offers the opportunity to test the market for the latest techniques and prices, as well as giving us access to wider expertise. We also understand that, to get the best prices, we need to be an informed buyer.

Informed cost estimation and evaluation

Understanding what equipment and activities should cost is crucial to ensuring that we are delivering work efficiently. To do this for capital investments, we established a team of in-house expert cost estimators in the E-Hub (Estimating Hub) at the start of the T1 period. They maintain an internal cost reference database which is used to build detailed cost estimates to ensure that we are an informed client, understanding what a fair price would be when tendering works to contractors. This detailed cost estimate is built bottom-up based on the physical scope of works, delivery programme, anticipated project risks and market benchmarking of costs. It is used to sanction projects before we go out to tender and move into delivery.

To build our knowledge of the market, all supplier tender returns are forensically analysed to ensure costing elements used are reflective of external market conditions. With this information, we can challenge and negotiate with suppliers to secure the optimum quotes for projects. This process also allows us to update our internal cost reference database with tendered data to improve our initial plan entries and increases confidence in forecasting.



Following scheme completion, the final costs of each project are further analysed to understand what risks materialised and what variations were paid for during delivery, so that again we can update our cost database and improve our processes. A benefit of this analysis is the opportunity to understand trends in delivered costs over time.

This same cost database is used to maintain unit costs to build our cost estimates at the beginning of the investment process based on standard work scope. These groupings are held in a 'Cost Book' which is employed to set the budgetary estimates during the early pre-construction phases. These are a proportionate way to create estimates for future projects which, while there will ultimately be site-by-site variation, will be right on average.

Some of our expenditure in the T2 period will already have tendered costs or be in delivery (i.e. contract awarded). In addition, for projects where we do not have established unit costs, we have used detailed E-Hub estimates to create forecast costs for our business plan submission.

We have third-party independent assurance (from TNEI in June 2019) to support the robustness of our process for periodically refreshing our cost book. The underlying elements of our Cost Book (assumptions, inclusions and exclusions) have been assessed and updated to reflect the current scope and market prices to define a repeatable unit cost. Key cost drivers have been identified, allowing for removal of outliers to create a well-defined sample for the analysis. The Cost Book unit costs have been updated in our core systems to reflect the output of this assessment.

This cycle of continuous improvement (delivering value and driving down the unit cost, then re-baselining this unit cost for future projects) has kept our costs efficient over the T1 period and means that our T2 submission will systematically include the efficiency we have delivered historically.

Internal capex benchmarking (historic trends)

As indicated by the above process, the main evidence to support our cost estimates for T2 period investments comes from analysis of projects delivered in the T1 period. Investment Decision Packs contain more detailed analysis of costs and volumes for both historic and forecast projects; this section shares some examples from major capex spend areas. These focus on non-load related investment because load-related projects are much less homogeneous (they contain a varying mix of asset types) but load-related projects are made up of the same fundamental building blocks and are appraised using the same Cost Book and cost estimation process.

In each case, the table shows the total cost in each category and the total volume delivered in each price

control period (all years). Dividing one by the other gives a top-down average cost per unit that can be used to simply compare the T1 period with the T2 period (before future capex efficiency commitments).

Transformers. We have delivered a 3% reduction in the average cost of transformer replacement over the T1 period compared to allowances.

Transformers (excluding spares)	T1 allowed	T1 (all years)	T2 forecast
Total cost (£m)	764	444	273
Volume	█	█	█
Cost per unit (£m)	█	█	█

This experience has been reflected in our T2 plan, and the cost per unit has reduced further because we have no off-line replacements (which is a major cost driver) in our forecast.

Overhead line conductor. Over the T1 period, we have delivered a greater volume of work than originally envisaged at a lower cost than we were allowed.

Conductor	T1 allowed	T1 (all years)	T2 forecast
Total cost (£m)	578	533	624
Volume	█	█	█
Cost per km (£m)	█	█	█
Cost per km (£m)	Excluding Tyne Crossing		█

The average cost per km in the T2 period is distorted by a major project to address the Tyne Crossing. When this is excluded, it can be seen that the T2 average cost per unit is 11% lower than that achieved in the T1 period.

Overhead line fittings. As described in Chapter 9 *We will provide a safe and reliable network*, there has been a material decrease in the cost per km of replacing fittings due to the introduction of a novel targeted approach during the T1 period.

Fittings	T1 allowed	T1 (all years)	T2 forecast
Total cost (£m)	222	54	83
Volume	█	█	█
Cost per km (£m)	█	█	█

The T2 forecast plan has a higher average cost per km than we have achieved in the T1 period; this is due to the forecast mix of routes and an increased scope of intervention.

Protection and Control. Over the T1 period, we have innovated to introduce targeted interventions which



mean that we are forecasting to complete delivery at a lower cost per unit than we were allowed.

Protection & Control	T1 allowed	T1 (all years)	T2 forecast
Total cost (£m)	478	246	489
Volume	■	■	■
Cost per unit (£m)	■	■	■

As described in Chapter 9 *We will provide a safe and reliable network*, these new approaches have been built into our T2 submission.

Cables and tunnels. It is not appropriate to undertake simple cost per unit length analysis for cable projects because each is bespoke and highly dependent on scope, e.g. whether the cable is direct-buried or in a new or existing tunnel, and physical location. The majority of our planned investment over the T2 period is associated with London Power Tunnels 2 (in south London); the main tunnelling work is currently out to tender, and we will be letting contracts and starting work in the T1 period. Our current cost estimates have taken account of detailed learning from the London Power Tunnels 1 project (in north London) which was similar in scope.

External capex benchmarking

To provide additional evidence to validate our internal approach and use of unit costs for the T2 period, we have commissioned an external benchmarking exercise from TNEI. TNEI is an independent specialist energy consultancy providing technical, environmental, strategic and consenting advice to organisations operating within the conventional and renewable energy sectors. TNEI's report can be found in annex NGET_A14.02 TNEI Asset Unit Cost Methodology Review.

In summary, TNEI have assured our approach to historical unit cost analysis by:

- validating our approach to tracking and using unit costs for capital investments
- verifying the findings of our historical unit cost analysis
- comparing our unit costs with anonymised external benchmarks.

The report covers 40 of the major 'building blocks' which make up our capital investment plan (including transformers, reactors, overhead lines, cross-site cables, switchgear, protection and control systems). This required us to align the scope of our units with their data to make sure that they were comparable. We provided our final, delivered costs for the installation of new assets (mostly in situ, but some off line). These costs included our capitalised 'on costs' for developing, delivering and managing projects through to commissioning and closure. This means that total costs will be comparable regardless of the chosen

delivery model; for example, internal project management costs can vary depending on whether a company chooses to contract a Tier 1 supplier to manage all subcontractors, or whether the company manages such interfaces themselves.

TNEI used industry mean costs as a valid comparator because across their international dataset there are variations in standards (e.g. around safety) and approach to whole-life asset management (such as maintenance requirements and operational longevity).

Their findings were that, for more than half of the 40 units reviewed, our costs were below the industry mean. For the remainder, our costs were between the industry mean and maximum. Overall the benchmarked costs in our T2 plan were £100m cheaper than the industry mean. However, we have committed to taking an efficiency challenge on ourselves to reduce all of the above-mean unit costs in our plan to TNEI's industry mean. This equates to a further reduction in forecast capex for the T2 period of £44m.

In addition, we are committing to a further efficiency challenge of a productivity improvement of 1.1% year-on-year (for the proportion of capitalised costs associated with our employees). This is described later in this chapter but equates to an additional efficiency challenge (and therefore cost reduction commitment) of £37m.

Sharing best practice across the infrastructure and energy sectors

By participating in external groups (such as the British Tunnelling Society, Association of Cost Engineers and Society for Cost Analysis & Forecasting), we learn about estimating and cost forecasting best practice, understanding how different sectors manage uncertainty and risk. Where we are able to identify market rates for generic activities (e.g. tunnelling rates through different ground conditions), we use these to inform our 'bottom-up' estimating. We use our own information (both on actual projects delivered and from tender returns) to calibrate our subject matter experts' understanding of project costs to ensure they take account of new technologies and remain aligned to current market conditions. Finally, we leverage the benefits of being an international group by sharing learning with our US business.

We have tested our investment plan using cost benefit analysis

We have carried out Cost-Benefit Analysis (CBA) of our proposed projects for the T2 period. Certain areas of our spending are automatically covered by CBA. For example, schemes that deliver wider network capacity are assessed by the Electricity Network Operator's Network Options Assessment (NOA) process. NOA selects the least regret option from a range of alternatives for investing in the transmission network; it uses an extensive CBA process that takes account of



proposed investment and forecast system constraint costs under a range of Future Energy Scenarios.

For projects that are not covered by automatic CBA, we use our own CBA to select preferred options. This is a proportionate approach that allows us to take account of wider benefits to consumers. For example, we assess whether spending more now could save money for consumers in the long term.

A portfolio of Investment Decision Packs, containing CBAs, has been produced to support our business plan. These will be reviewed by Ofgem as part of their assessment process.

Our investment processes, governance and controls are robust

We have a lean, standardised end-to-end investment process with gates to control the quality of projects as they move from inception through to approval, delivery and closure. Supporting this, we have a framework of governance and assurance which includes mandatory and voluntary financial controls in conjunction with internal and external audit activities. Finally, we have annual regulatory reporting requirements which involve us submitting performance reports and data to Ofgem each year. These processes and controls are described in detail in annex NGET_A14.05 How we contract and deliver efficiently.

Our process for tracking, updating and challenging unit costs for estimating the cost of future capital projects was specifically reviewed by TNEI. They found that “NGET applies a broad range of differing estimating methodologies to ensure that the final unit cost is aligned to the most probable outturn cost, and the techniques used are logical and aligned to good industry practice & guidelines. The use of different estimation methodologies results in a range of estimated costs updated on a yearly basis, which enables our estimator to question any significant differences leading to more accurate estimates”. Details of their review are contained in annex NGET_A14.02 TNEI Asset Unit Cost Methodology Review.

6. Justification and efficiency of our Information Technology investment

Information Technology (IT) underpins the safe and reliable operation of our transmission system and enables our business to function efficiently, delivering value for money for our customers. We have spent above our IT allowances in the T1 period to ensure our workforce have the tools to stay productive and to enable lower operating costs and better controls in our business support functions. Our increasing reliance on IT, together with the requirement to replace applications and infrastructure as they reach end of life and respond to a growing cyber threat, is driving an increase in baseline IT investment in the T2 period.

Our IT Investment in the T1 period

At the start of the T1 period, we responded to the efficiency challenge by extending the technical lives of our IT infrastructure assets, accepting higher levels of risk whilst maintaining levels of availability. However, as we continued through the T1 period, our employees fed back that IT was becoming a significant blocker to their effectiveness at work. Over the same period, the increasing rate of change of technology and the escalating threat of cyber-attack on our IT systems meant that we had to look again at how we managed our infrastructure so that we could proactively monitor and remediate cyber threats. In light of this, we have revised our IT asset health policies, which have been reviewed by independent IT experts Gartner, who confirmed that they are in line with industry practice.

We have recently implemented a series of investments in new systems to support our HR, purchasing and financial transactional processes in response to analysis that showed that we had more manual process steps than “world class” functions. These investments will support better controls and lower costs of function as we start the T2 period.

Our proposed IT Investments for the T2 period

Our IT investment portfolio for the T2 period continues the work we have begun in the T1 period to bring our IT infrastructure assets in line with asset health policies, so that our people have the right tools and equipment to work effectively, and we can share data securely and effectively to promote cross-sector collaboration. The forecast cost of our IT investment plan for the T2 period is £148m, including £48m of investment costs to support future application implementations and upgrades on behalf of our business support functions. These costs are in addition to the IT expenditure driven directly by the Electricity Transmission business and those that are needed to keep our network cyber resilient, which we have included in our key stakeholder priority chapters.

The key areas of investment for shared systems are in Enterprise Networks, Hosting, End User Computing (Modern Workspace), IT Operations and Tooling and Business Services. In each case, investments have been subject to broad ranging optioneering and cost benefit analysis.

Enterprise Networks comprises the wide area network or ‘WAN’ (connections between sites) and the local area network or ‘LAN’ (network within sites including wireless networks) that support data and voice communication services that are essential for the safe, reliable and secure operation of our business. Failure of these services will significantly compromise our ability to deliver on our commitments to customers and consumers and the productivity of our workforce.

Following optioneering and detailed analysis, we propose investment of £23m across the T2 period to:

- i) replace 400 WAN routers at 300 sites as they reach end of life



- ii) replace 1,000 LAN switches and 900+ wireless access points
- iii) provide 6,000 user accounts for voice services.

Implementation of a modern, cyber-secure WAN/LAN architecture is essential to support the adoption of cloud-based services and drive increased workforce efficiency.

Hosting is the generic terminology used to cover several technologies such as Storage and Compute. These technologies may be hosted in a physical data centre owned and operated by National Grid or by a third party and may be hosted remotely in either public or private cloud. These environments, together with the Enterprise Network, provide the overall infrastructure that is essential to the day-to-day operation of our business.

One of our key learnings from the T1 period is that perceived savings from extending core IT asset life can prove to be a false economy in the longer term. The impact on productivity, efficiency and customer satisfaction of poorly performing IT infrastructure is felt across the whole organisation. We have identified and evaluated a range of options to meet our hosting requirements and concluded that a hybrid cloud approach is the most effective and economically-efficient approach, blending the security of private cloud, where it is necessary, with cost-effective public services at a cost of £20m across the T2 period.

End User Compute (Modern Workspace) comprises computing devices (laptops and tablets), managed printing and the new digital workplace which are needed to provide fast, frictionless, and end user-focussed services.

Investment of £15m is required across the T2 period to maintain currency and appropriate performance levels for end user devices. We intend replacing devices every three years (3,000 devices per annum) as a continuous programme of work, and an Enterprise Mobility Management solution will be deployed to manage tablets, mobiles and laptops on a common platform ensuring Windows 10 and O365 security patches are applied rigorously to mitigate the increasing cyber threat. A three-yearly replacement policy for end user devices recognises the increasing rate of change of technology and associated operating systems and is consistent with the Gartner benchmark.

IT Operations & Tooling refers to the operations and service management capabilities that are required to deliver excellent operational performance of the IT services and infrastructure that support the core business.

Our current IT operations are adversely affected by factors including limited visibility of real end user

experience; inadequate real-time data on end-to-end application performance; and manual and labour-intensive application management, which is both inefficient and leads to a poor end user experience.

Our investment of £23m across the T2 period will establish cloud aware cost transparency for all IT costs across the business enabling effective prioritisation and decision-making, and we will implement tools and automation to streamline our processes so that the IT estate can be managed as cost efficiently as possible across planning, build, provision and maintenance activities. We will also invest in the consolidation and automation of the network operations centre to ensure optimised network operations.

Automation will enable us to balance efficiency and the need for rapid change as we continue to invest in the people, tools and processes needed to execute and manage the business of IT optimally.

Collectively these investments will rationalise and modernise our IT infrastructure, providing a reliable, cyber secure environment that is flexible for the future, and will provide a foundation for us to digitally transform our business to meet the needs of our customers and stakeholders.

Business Services are delivered through a shared services model with support functions providing the efficient delivery of common services such as HR, Finance, IT, Legal and Procurement to our businesses.

Investment of £48m is required across the T2 period to refresh and maintain our core back-office systems. This will make sure the investments made in the T1 period do not become outdated, inefficient and non-compliant with legislation and regulations. It will also ensure that our systems and data are not exposed to increased levels of cyber risk and operational failure.

Overall ET IT Investment is outlined in annex NGET_A14.07 ET IT Investment, and the over-arching IT Strategy is included as annex NGET_A14.08 IT Strategy. Investment Decision Packs are included as annexes NGET_A14.03 Hosting, NGET_A14.15 Business Services, NGET_A14.18 Enterprise Network Refresh, NGET_A14.19 End User Compute, and NGET_A14.20 IT Operations & Tooling. Our Cyber Strategy is included as NGET_A10.03. We have separately published our Digitalisation Strategy on our website and provided a hyperlink to Ofgem. This strategy outlines how we will use technology and data to digitally transform our business and includes some initial thoughts on our response to the recommendations of the Energy Data Taskforce report on 'A Strategy for a Modern, Digitalised Energy System'.

Our IT investments are in line with external benchmarks

We have submitted our IT investment plans, including those investments relating to Electricity Transmission



applications, for independent review by Gartner – a recognised IT benchmarking organisation. They found that the mix of investment areas, the individual project costs and our project rate cards were all in line with their expectations, formed from their knowledge of IT investments made by other utility companies.

7. Justification and efficiency of our operating costs

Our operating costs are the costs we incur on an ongoing basis to run and maintain the network, provide customer service and operate our business. As such, they contribute to all the stakeholder priorities in our T2 plan.

Collectively, our total operating costs are forecast to be £1,410m and make up 20% of our totex expenditure for the T2 period. On average our operating costs are £282m per year. 39% of these costs are spent on activities that directly impact our assets, such as maintenance activities and asset inspections. 30% is spent on customer-related and work and asset management activities and 31% on business support functions such as IT, HR and finance.

Evolution of our operating cost base through the T1 period

The mix of our operating cost base has changed over time as the result of business decisions to invest in support activities to reduce costs elsewhere and the need to respond to external challenges. Therefore, it is important to consider the total operating cost base as a whole. As we entered the T1 period, we were facing growing maintenance requirements from a more diverse and ageing asset base with coincident challenges in the supply and demand of adequately trained workforce.

In response, we reset our operating model at the start of the T1 period and restructured our business to realign accountabilities, introducing lean continuous improvement capabilities and optimising our support functions for additional operational workload. This allowed us to mitigate some of the upward pressures in workload and reduce our workforce by over 100 roles. As our asset base has grown through the period, we have invested in IT systems to automate the monitoring of our assets and understand more about their condition. This delivered savings in our direct maintenance costs and additionally enabled us to minimise capital requirements in the period.

In terms of business support costs, IT costs increased because of the IT systems we invested in to support our asset maintenance and additionally as we developed our capability in identifying and managing the increasing cyber threat to our operations. We also needed to increase the scope of our financial control activities to respond to new and increasing compliance requirements. The benchmarks that set our allowances did not take these increased activities into account and we were not able to contain these costs within our

allowances. We take these lessons and others into our T2 business plan.

We are forecasting to bring our total opex costs below allowances by the end of the T1 period but will have cumulatively overspent due in part to business support allowances being set using overly simplistic benchmarks.

Building on the experiences and capabilities we developed in the first half of the T1 period, we are currently undertaking an ambitious, UK-wide bottom-up transformation of our business (called Performance Excellence Value, PEx) which enables us to bring in new skills and capabilities to reflect the changing needs of our customers and reduce costs. We have identified a suite of co-ordinated initiatives which we believe will deliver savings including realigning processes using lean techniques, replacing our financial systems to improve and streamline controls and introducing more flexible field force arrangements which will be implemented over the remaining years of the T1 period.

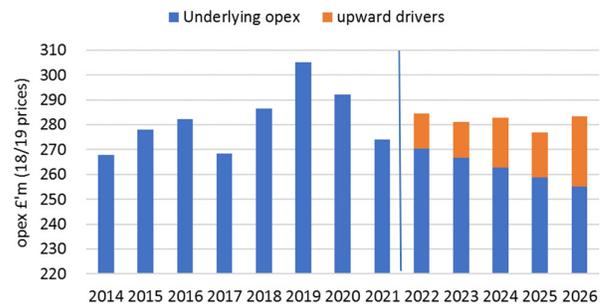
Commitment to reducing our cost base by £40m a year

The resulting re-shaped organisation and cost base will make us fit for delivering new challenges in the T2 period. We are forecasting to deliver annual opex savings of £40m by March 2021 (from a baseline of 2018/19 outturn costs) and we are committing to achieving and sustaining these future efficiencies for the T2 period, making a T2 saving of £200m. Later in this chapter we demonstrate that our pay is comparable with peer companies and that savings bring our business support costs in line with or better than benchmarks.

Commitment to £47m productivity improvement

On top of these savings, we are challenging ourselves to find more efficiencies in the T2 period. We are committing to a stretching productivity improvement of 1.1% per annum which is nearly three times the current UK trend for productivity. Our T2 opex plan therefore reflects a commitment to re-set the cost base and a commitment on productivity improvement, both which have been embedded. The figure below shows the impacts of these on our underlying cost base.

Figure 14.9 Reductions in underlying opex



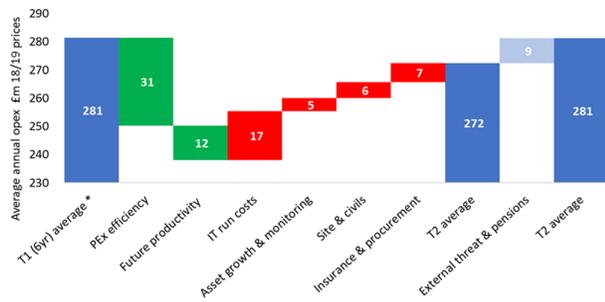


However, we are also forecasting a number of upward cost of pressures (orange bars). Changes from the T1 period are shown in Figure 14.10.

Cost driver changes from the T1 to the T2 period

In the following waterfall chart, we have converted our efficiency commitments to be consistent with a T1 average outturn comparator. We also identify four key upward cost drivers between the periods:

Figure 14.10 Changes in Average Annual Opex between the T1 and T2 period



*T1 6-year average outturn based on 2013/14 to 2018/19 actual spend, adjusted for change in tower painting cost treatment in T1

IT run costs +£17m

The costs of supporting our IT systems has grown through T1 as we have made investments in asset data management systems and built our capability to respond to an escalating cyber risk. Average spend for the early part of T1 was £33m per annum, however our IT costs are forecast to reach £49m by the end of T1 as we expand our cyber resilience activities and support investments we are making to make our transactional business support functions more cost efficient. Independent benchmarking experts Gartner have confirmed that our IT operating costs are efficient as we enter the T2 period.

IT operating costs fall throughout the T2 period, as the cumulating impact of our 1.1% per annum future productivity improvements offsets the incremental cost of supporting further investments to support key business processes, deliver our IT cyber plans and modernize shared IT infrastructure and hosting capabilities. Overall, this results in IT operating costs for the T2 period that are on average £17m per year higher than the first six years of T1. We give more detail on the drivers for this transformation in annex NGET_A14.08 IT strategy.

Asset growth and condition monitoring +£5m

We are forecasting cost increases in asset maintenance costs due to the newly-commissioned Western HVDC Link, a forecast 2% growth over the T2 period in the network asset base and an increase in condition monitoring installation. The WHVDC link will minimise total costs to consumers by reducing system constraint costs, and condition monitoring will help us better-target asset interventions.

Operational site costs and carbon offsetting +£6m

We are anticipating increased costs on our sites including our operational rents and vegetation management. Operational property rents relate to leases for sites such as substation leases which will need to be renegotiated over the T2 period. Whilst we work hard to manage the impact of a general trend in rising market rents we will not be able to offset the full impact of these sites. We have challenged ourselves to retain 50% of the risk of rental increases limiting the impact to an increase of £1m in direct opex by the end of the T2 period. We will also spend £1m per annum more than in the T1 period on maintaining the physical security of our PSUP sites, two more of which will be commissioned in the T2 period.



Our stakeholders want us to continue our work from the T1 period on reducing our capital carbon from construction with the ambition to achieve net-zero carbon construction by the last year of the T2 period. A value of £2.5m has been estimated in the final year to offset the residual unavoidable carbon impact of our T2 construction plans, which is represented as an average of £0.5m per annum increase to our indirect opex costs. For more information see annex NGET_A14.17 Total Opex.

Insurance & procurement +£7m

Sustained losses due to events such as natural catastrophes, wildfires, etc, are driving increases in insurance premiums globally. Whilst we insure our businesses via a captive insurer arrangement (where National Grid effectively self-insures), this arrangement can only mitigate some of the external pressures from the commercial insurance market. These pressures will drive an increase in insurance premiums of £3m on average through our T2 plan, compared with the T1 average costs; despite this increase, in the next section we demonstrate that our costs are 30% below market rates.

As part of our PEx efficiency programme, we moved contract management expertise that had previously been spread across the business into our procurement function, reducing overall cost but increasing the procurement function cost by £3m per annum relative to the T1 period.

Despite these upward pressures, the average baseline operating costs for the T2 period will reduce by £9m per annum compared to T1 average outturn. The cost of our opex activities in 2019 will decrease by £31m by the end of the T2 period.

Other structural changes

In addition to these drivers, we anticipate an average increase of £7m per year in costs relating to



enhancements to external threat protection at our operational sites. Whilst we have high confidence in the efficiency of these costs, changes in Government requirements may lead to future scope changes. We anticipate these costs will be covered by a “use it or lose it” uncertainty mechanism, meaning we will only be funded for the work that is needed at the time and so we have shown them separately to our other baseline opex costs. More information on these activities can be found in Chapter 10 *We will protect the network from external threats*.

In its RII0-2 Sector Specific Methodology Decision, Ofgem confirmed the reclassification of Pension Protection Fund levy and pension admin costs from pass-through costs to be totex costs for the T2 period. We therefore show an additional £2m per annum of cost because of this reclassification.

Our operating costs have been tested for efficiency

In testing the efficiency of our operating costs, we used a variety of approaches depending on how the cost was incurred. When we procure goods and services from third parties, we follow rigorous OJEU procurement guidance ensuring that we robustly test the market for prices. This enables us to give external assurance on our procured costs. Where our costs relate to our own people and processes, we have looked to external and internal benchmarking evidence to provide this assurance. Figure 14.8 summarises how we have used efficiency evidence to test our opex plan and we discuss each area of evidence in more detail below.

We benchmark our maintenance activities internally

Our direct opex costs are a function of our asset inventory, for example, types of equipment, their age and condition, and our maintenance policies. We review our maintenance policies on an ongoing basis using the latest condition and performance information in order to enable assets to achieve their anticipated asset life and reduce the potential for unplanned disruption. Drivers for changes to policy include the identification of new defects, or legislative changes such as the Pressure System Safety Regulations 2000 which increased the time it takes to complete tasks.

We have standard costs for each plant type and activity including routine non-outage inspections, basic maintenance activities and planned major maintenances. These all have a frequency associated with them, allowing us to build a forecast plan in our work management system. This plan indicates a demand for labour and materials. Therefore, asset inventory multiplied by maintenance policy equals work. Each work item has a standard job with resources and associated cost to facilitate estimating.

As work is delivered, actual costs for standard jobs are analysed, outliers removed, and updated costs reflected in the core system. A reporting tool known as Tableau has been introduced during the T1 period to help

visualise the data. Tableau reports help team leaders highlight variances from the standard; where the variance is due to new ways of working, which reduce costs, the practice is shared nationally. Our T2 submission will be based on our latest forecast of efficient direct opex costs, supplemented by estimates for new cost areas such as an increasing need for cyber security measures.

We are also able to share best practice with our US business. We have an Asset Management and Engineering business management standard which sets out minimum requirements across the whole National Grid Group. This standard establishes the terms of reference for the Engineering Assurance Committee, and a key activity of this committee is sharing best practice across the group. Examples of sharing include peer reviews which are focussed on a particular topic (e.g. risk management, cyber threats) and sharing of asset management maturity assessment results. In addition to organised exchanges, regular interaction has fostered a culture where opposite numbers will contact each other on an ad hoc basis to ask questions and gain insights.

Our maintenance activities are benchmarked externally

Since 1994, we've also been engaging in external benchmarking activities, comparing our costs and maintenance activities with organisations across the globe. Benchmarking is a licence obligation and the use of benchmarking to support continuous improvement is a feature in ISO 55001 “Asset Management”, against which we hold accreditation.

Our direct opex is benchmarked via ITOMS (International Transmission Operational Maintenance Study), a closed confidential forum of more than 31 companies representing 25% of electricity transmitted across the globe. The participants operate in diverse environments (regulatory, economic, environmental, etc); this diversity serves to benefit the group, as different companies bring different ideas and practices to the table which can be beneficial to all.

The ITOMS benchmarking study is a consultancy-led biennial exercise. ITOMS benchmarks ~50% of our expenditure on inspection and maintenance activities, covering all of our major plant types with the exception of cables as most other participants have small populations.

The most recent ITOMS study was undertaken in 2018 based on 2017 data (i.e. before the restructuring work, we are currently undertaking and excluding the productivity assumptions included in our plan). In summary, the study shows that, while we had higher than average opex costs for most maintenance activities, we also have higher than average performance. For example, we consistently have higher than average reliability (being one of the best in the



study for energy not served) and better than average safety performance. The results indicate that have one of the oldest asset bases in the study, and that the cost of care is expected to increase as equipment approaches end of life. We present more details on the latest study in annex NGET_A14.17 Total Opex.

Our pay benchmarks in line with our peer group

We test our pay deals against our peer group and regularly benchmark our employee remuneration to ensure it remains in line with the market. Our annual pay awards are benchmarked against those of network companies and other competitors in the skills market. We ensure that any deal we put in place with our trade unions or annual pay rise for managers is in line with our peers so that we do not fall out of step with the market, but equally so that we do not become a higher-than-market payer.

To more effectively control costs and remain competitive in the labour market, we have also made adjustments in recent pay deals to reduce long-term staff workforce costs including:

- changes to the performance pay matrix that aligns individual pay awards to market practice
- the annual settlement figure setting base pay awards moving away from an RPI formula to a more rounded consideration of wider factors.

From a benchmark perspective, we undertake regular pay and benefits reviews, with the latest study completed in 2018 by Korn Ferry (a people and organisational consultancy). We adopt a single pay framework across our UK regulated businesses. This means that all of our employees' (both direct and support function) costs have been recently benchmarked. In summary, total cash remuneration was in line with median pay for a comparator of 130 entities in the Utilities, Oil & Gas and Chemical sectors.

Our business support costs benchmark efficiently

We regularly use benchmarking exercises to test the value that our business support functions deliver. In preparation for our business plan submission, we commissioned studies to test the efficiency of our HR, Finance, Audit and Regulation, Procurement, Property Management, CEO & Group Management and Business support IT costs. We did not include health and safety costs or insurance costs, as the varying levels of risk between businesses means comparisons are limited in these areas.

We invited The Hackett Group, a global business benchmarking organisation, to perform a high-level benchmarking assessment for our combined business support costs for electricity transmission, gas transmission and electricity system operator businesses. For our IT costs, we also engaged Gartner (an industry-recognised specialist in IT benchmarking) to perform a more detailed analysis of our operational and non-operational IT costs, comparing costs for each

key activity (e.g. application support, networks, storage, end-user computing) with those of other companies in their database, adjusting for workload (i.e. number of applications, number of services, number of users). We did this because simplistic comparisons of total IT costs between companies do not account for factors such as the number and level of availability of business applications supported.

As a result of this analysis, we have reduced the costs of our CEO and Group management activities in our plan by £13m over the T2 period to align with the upper quartile benchmark. In all other areas, the benchmarking analyses showed that our costs were in line with upper quartile efficient level after accounting for additional activities to non-regulated businesses (such as regulatory activities), and our obligations as operators of Critical National Infrastructure Sites, or in line with peers (the recommended level for effective operation of IT) for IT function costs. These studies and their findings are presented in more detail in annex NGET_A14.17 Total Opex.

Our insurance costs are 30% lower than commercial market premiums

We insure our businesses through our captive insurance company, wherever it is efficient to do so. Under this arrangement, insurance is provided by a licenced insurance company owned by the group, set up specifically to underwrite the insurable risks of our business operations. We periodically use external consultants to review the premiums considered achievable in the commercial market for our risks, and to compare these against the premiums charged and forecast by the captive. We last did this in 2019, using Aon Global Risk Consulting and RKH Speciality, who estimated the commercial market premiums would be over 30% more than our proposed premiums for the T2 period. This equates to over £10m of savings to consumers for the five years.

8. Summary of our total future cost efficiency commitments

Throughout this section, we have outlined future efficiency improvements that we are committing to seek to achieve which reduce the costs of our T2 totex plan by a total £383m. These are summarised below:

- We are committed to delivering and sustaining the benefits of our stretching UK efficiency programme. This is an efficiency commitment of £200m.
- Independent specialist consultants have benchmarked our capital investment unit costs against similar international companies. While the benchmarking showed our plan is £100m cheaper overall than industry mean costs, we are committing to moving all the above-mean unit costs in our plan to the industry mean or lower. This is an efficiency commitment of £43m.



- We are making a stretching commitment to improve the productivity of our operating costs and the costs in our capital plan that relate to our people by 1.1% per year, almost three times the current UK productivity increase forecast. This is an efficiency commitment of £84m.
- We have benchmarked our business support costs. We will move all our support function costs to be upper quartile. This is an efficiency commitment of £29m.
- We commit to seeking to extend the application of innovative T1 solutions to address the life-limiting components of other protection and control systems. even though we do not know yet whether this is possible. We will continue to work closely with our supply chain to achieve this. This is an efficiency commitment of £27m.

These efficiencies are included in our baseline plan costs of £7,104m in two ways. We have embedded opex efficiency commitments in our bottom-up opex costs. For capital costs, we have treated them as overlays to our underlying expenditure forecast.

9. Proposals for managing price uncertainty

Protecting consumers from forecast price error

Real Price Effects (RPEs) occur where input prices are anticipated to move differently to the inflation measure by which our allowances adjust annually. This is because the mix of goods and services in the inflation calculation differs from the goods and services we purchase. The main areas where this applies are labour costs and the materials we use in our capital works, such as copper or steel.

Independent forecasts and long-term trends highlight that both labour costs and capex material costs are forecast to grow at a quicker rate than inflation over the T2 period. RPEs have a material impact on the costs we incur with 89% of our totex plan impacted by price changes that show sustained deviation from CPIH. We will therefore be exposed to above-inflation RPEs in our plan. Whilst both are anticipated to grow, the level of control we have differs, as does the potential volatility in the annual price movements.

Our staff costs track the directional trend of the relevant indices but do not fluctuate with short-term changes due to our long-term pay deals and longer-term approach to workforce resilience. The underlying indices are also less volatile than those related to commodities. Following the RIIO principle of aligning risk to the party best placed to manage it, we are therefore proposing a fixed allowance for labour RPEs based on independent forecasts of 0.3% above RPI (1.3% above CPIH). We have managed the risk of labour RPEs in the T1 period by locking in long-term pay deals.

In contrast, we have limited ability to control how capex material prices impact our cost base. Changes in input prices will be factored into all goods we purchase, and the related indices aligned to these costs are inherently more volatile than labour with, for example 20% annual cost swings in the last ten years. Although these impacts can be partially mitigated through contracting strategy, we cannot control the risk and underlying cost trend. We are therefore proposing to index our capex material costs to an industry-recognised index linked to the cost of copper which will ensure our customers and consumers pay no more or less than the relevant market based indices for these costs. In preparing our business plan, we have made a baseline assumption of 1% above RPI (2% above CPIH), based on the historic long-run average.

Our current forecasts of the impact of RPEs over and above CPIH is shown in figure 14.11 and totals £325m against our baseline T2 plan, of which £137m is subject to indexation. Moving from RPI to CPIH indexation makes the impact of RPEs more pronounced (as CPIH is typically 1% lower than RPI). Overall, after accounting for both RPEs and productivity growth, our opex input prices will still reduce by 0.6% over the T2 period (1.6% reduction RPI-equivalent). Capex input prices will increase by 3% (2% RPI-equivalent), of which 2% is based on the current view of copper prices and subject to indexation.

Figure 14.11 Our proposal to manage the risks of real price effects in the T2 period

Consideration	Plant, materials & equipment costs	Labour costs
Extent of potential price volatility	High, particularly on materials	Lower in the long term
Network's ability to mitigate RPE effects	Limited ability with outputs to deliver, procuring at market rates	More controllable through salaries
Risk of variance to forecast	High due to volatility	Lower due to duration of pay deals
	Our Proposal	Our Proposal
Approach to RPE related allowance uplift	Baseline allowance based on forecast that varies up or down with relevant indices	Ex-ante fixed allowance based on forecast with upper and lower thresholds
Forecast RPE uplift across T2 period	Capex £133m	Capex £138m
	Opex £4m	Opex £50m

We describe our assessment of Real Price Effects in more detail and provide evidence to support our approach in annex NGET_ A14.14 RPEs and ongoing efficiency.



Defining our output commitments

An important part of providing value for money is spelling out exactly what our stakeholders will receive for the money. We are making clear output commitments for as many of our costs as we can. Outputs are measurable, consumer-facing outcomes that network companies can deliver. These include meeting licence obligations and government standards. They also include service quality improvements that consumers are willing to pay for.

The benefit of defining outputs to consumers is that they are transparent. We can be held to account to deliver them. If we do not deliver an output, we expect to see consequences through our regulatory contract. By focusing on outputs, we can look for more cost-effective and innovative ways to achieve them. When we do that, we give consumers what they want at a lower cost and share any savings with them.

Adjusting our allowances appropriately through uncertainty mechanisms

Throughout this document, we have explained the uncertainties the energy sector faces over the T2 period. If we fix allowances at the start of the T2 period, there is a risk we would have too much – or too little – funding to provide what our customers and consumers want.

Our stakeholders only want us to be funded for the activities we carry out. We have therefore proposed more uncertainty mechanisms and set out how to improve the existing uncertainty mechanisms to make them more accurate. This is described in more detail in annex NGET_ET.12 Uncertainty mechanisms.

We are consulting on our uncertainty mechanism proposals with stakeholders. Ofgem will also scrutinise them when it carries out its assessment.

10. How our plan offers value for money

This baseline plan delivers more investment for the future which delivers value to consumers by ensuring a safe, reliability and resilient network as society becomes increasingly reliant on electricity in the transition to a net zero energy system. We are able to deliver this increased investment without increasing our part of the energy bill for household and business consumers alike.

We have used external benchmarks to test the efficiency of our capital unit costs, the costs of organisational functions, our IT investment costs and our staff pay, and demonstrated they are in line with or better than relevant comparators. Where they aren't, we have taken on the efficiency challenge and reduced them.

We have built into this plan the benefits of all our past successful engineering and asset management innovations that have benefitted consumers already in

the T1 period, measurably reducing the costs of this plan by £707m.

Our forecast network capital costs are largely market tested as they are based on competitive procurement and result from a robust forecasting methodology and process which have been independently verified and assured. We have committed to a 'native competition' plan (on the next page) to continue to ensure we drive competition to get the best value from suppliers and contractors.

In Chapter 7 *We will enable the ongoing transition to the energy system of the future* and Chapter 8 *We will make it easier for you to connect to and use the network*, we also highlight certain projects where an alternative competitive model to NGET delivery might create value for consumers.

To ensure our customers and end consumers get the outputs they expect from these efficient costs, we are proposing a range of outputs that means we can be held to account for delivery. In Part 1 of the business plan, we also set out our consumer value proposition which outlines where we believe the proposals in our business plan deliver 'added value' for consumers that can be quantified.

We have protected consumers from errors in forecasts for the future by proposing a range of uncertainty mechanisms to ensure the price control flexes as things change in the T2 period. This ensures that our allowances and associated outputs are able to vary from this baseline plan as the needs of customers and stakeholders change going forward, and changes in external markets are reflected in our allowances.

Finally, recognising the pressure on energy bills for all our business customers and end consumers, we are stretching ourselves to commit to future efficiency improvements totalling £383m in the T2 period to keep our part of energy bills as low as possible.



OUR NATIVE COMPETITION PLAN

We utilise competitive processes for all procurements and projects, except where the potential benefits of doing so are outweighed by the costs

- We comply with the European Utilities Contracts Regulations 2016 (UCR) which require the use of competitive processes for the purchase of goods and services above a financial threshold (currently ~£363k for Goods and Services and ~£4.55m for Works).
- A competitive process is followed for purchases over £20k, with any exceptions to be authorised through appropriate delegations of authority. For all purchases greater than £100k, we follow a more defined sourcing and tendering process. This is lower than the legal threshold set by the UCR; we choose to do this because we believe we can drive more value.

Our competitive process is robust, transparent and provides equal treatment of potential bidders and protects information appropriately

- We treat all bidders fairly and with the appropriate level of transparency. Bidders need to trust us not to reveal confidential information to the market before they make their best submission and share innovations.
- We ensure confidential information is handled appropriately.
- We offer fair payment terms and participate in the Prompt Payment Code, encouraging our direct contractors to cascade these principles through all levels of the supply chain. This protects the cash flow of all parties, but particularly helps smaller businesses.
- We drive performance in our contracts by ensuring they contain appropriate measures (Key Performance Indicators) to incentivise suppliers. We measure supplier performance on a quarterly basis and the outcomes affect future workload allocation.

The complexity of the competitive process used is proportionate to the value and time-sensitivity of the project or system need in question

- Our Strategic Sourcing Process enables us to identify the optimum way to contract work taking into account the value, risk and urgency of the work. We seek opportunities to benefit from our global buying power.
- We have set up frameworks to speed up the commercial process, reduce tendering costs, drive optimal designs, leverage volume and introduce innovation. Our framework agreements allow enough flexibility to ensure that suppliers are able to introduce innovation and optimise designs whilst we remain able to leverage our volume through the workload allocation processes.
- For complex, high-value, bespoke or unusual projects where we believe we can drive additional value, we retain the option to spot tender and can allow a longer period for tender receipt than the legal minimum.

Information is provided equally to all parties, and any conflicts of interest are managed

- We will continue to provide early visibility of the work plan through quarterly webinars and issuing project briefs to enable our supply chain partners to plan more effectively. We have already shared our T2 plan through our ongoing six-monthly senior engagement forums with our key framework suppliers.
- We have appropriate checks in place to identify and manage any conflicts of interest.

We are agnostic to technology and bidder type

- We continue to drive competition into our supply chain by introducing new suppliers. We are open to innovative solutions and remain technology agnostic (where practicable).
- Our frameworks are expanding to include more options for installation-only contractors, to increase technology agnosticism by decreasing our reliance on equipment manufacturers.

Competition is structured to generate outcomes in the interests of current and future consumers

- We constantly work to increase efficiency, mitigate risks and optimise whole-life costs. We have a lead role in the Institution of Civil Engineers Infrastructure Client Group; as part of this, we are an early adopter of Project 13 principles for our LPT2 project which emphasises the importance of delivering broader outcomes to benefit the local community and consumers.
- We leverage value by being a better client, regularly seeking feedback from our supply chain as to how we can help them be more efficient, which in turn leads to lower costs and better outcomes for customers and consumers.



15. How our plan should be financed

What this chapter is about

An appropriately balanced financial framework is key to current and future consumers being fairly charged for the networks they use and the services they receive. This chapter explains the principles we adopt to ensure a balance is struck between consumers benefitting from sustainably low bills and incentivising continued investment in long term assets which provide benefits over many years.

What you have told us so far

You have told us that the balancing charges between current and future customers is important. You have also told us that it is important that adequate funding is available in T2 for the potential investment required. Investors have told us they consider the risk of investing in UK regulated utilities has increased compared to earlier in the T1 period. Investors have also told us that Ofgem's working assumption for the level of return in the T2 period does not reflect our underlying business risks.

What we will deliver

We work hard to deliver sustainable financing, reducing long term costs for stakeholders.

This requires a return which reflects the risks involved in running an electricity transmission business and allocates risks to the parties best placed to manage them.

With the move towards net zero by 2050 and the related investment required we need to ensure we have adequate financial capacity and resilience. We show that Ofgem's package is not financeable at the same investment grade used in the T1 period without making artificial adjustments which break the regulatory principles underpinning our approach.

What you can find in this chapter

1. Our sustainable approach to financing
2. Regulatory principles underpinning our approach for RIIO-2
3. Financeability assessment of Ofgem and National Grid packages
4. Bill impacts

The financial package we propose enables us to raise the finance we need to deliver consumers'

and our stakeholders' key priorities on a sustainable basis. The right level of return is positive for consumers and customers as it enables the investment and incentivisation needed to facilitate the transition to a low carbon economy.

Our plan with both Ofgem's and our financial package will reduce customer and consumer bills when compared to T1 averages.



Introduction

We have worked with our stakeholders to build a business plan that reflects their expectations and delivers the services they want. This involves infrastructure investment which will be funded through a combination of debt and equity. In line with the RIIO-2 business plan guidance, we provide detailed analysis and evidence around the financial package in NGET_A15.01 Finance Annex. In this chapter, we focus on:

- our sustainable approach to financing;
- the strong regulatory principles which guide our approach;
- setting out our definition of financeability to assess the proposed financial package.

1. Sustainable approach to financing

We have a demonstrable and consistent track record in efficiently financing our activities

National Grid Electricity Transmission (NGET) forms part of the National Grid plc group, a publicly owned FTSE 100 utility company. The company is owned by our equity investors, a diverse range of largely long-term investors which reflects the broader UK market, including pension funds and individual retail investors, some of whom have held shareholdings for over 20 years.

Management operate the business on behalf of our equity investors in line with the NGET licence and supported by the regulatory model, investing in assets which will provide benefits to energy consumers over many years. We have a long track record of funding investment in regulated energy infrastructure. Our scale and the strength of our balance sheet enables us to access a diverse range of financial markets, ensuring that investment can be funded on behalf of consumers, even in periods of macro-economic distress.

Being part of a listed group requires a very high level of transparency of ownership, governance and financial disclosures. We continue to adopt best practice in our disclosures, for example, we have included additional transparency on our economic performance throughout the T1 period in our statutory accounts and are a member of the accounting for sustainability network which aims to integrate financial and environmental decision making.

NGET financing strategy is cost efficient for consumers

Based on our business plan submission, around 20% of our annual totex will be funded by customers via in-year revenues and 80% is funded by the company, to be recovered from future customers. This transfers risk from customers to the company, spreading the cost of the long-term investments we make over multiple generations, fairly matching the cost with those that use the network over time.

To optimise the efficiency of raising debt finance, the company funds around 40% of its share of totex from equity investors and 60% from debt investors. This is consistent with management's view of the optimal capital structure to minimise the weighted average cost of capital. It is also consistent with Ofgem's RIIO-2 working assumptions.

Funding sources include:

- reinvestment of profits attributable to equity investors;
- reinvestment of scrip dividends; last year just under 40% of NG plc's shareholders elected to reinvest dividends totalling around £600m;
- issuance of new equity, e.g. our £3.2bn rights issue in May 2010; and
- raising financing efficiently from debt investors.

Both debt and equity investors provide funding in anticipation of earning a return that is commensurate with the risk they are taking. Risk arises due to the uncertainty as to whether the future cash flows generated by the company will fully refund the investment and return expected by investors. Whilst our regulatory agreements reduce this risk, its five-year timeframe is much shorter than the current holding period of many of our investors and the regulatory asset life of 45 years. Therefore, investors' assessment of the attractiveness of investing in UK regulated energy networks will include a judgement about the long-term quality and stability of the UK regulatory regime and the certainty of recovery of the RAV which represents money due to investors. If investors perceive the risk is too high compared to the return, they will move their money elsewhere, making raising new equity and debt more costly, increasing costs to consumers.

We add value to consumers by accessing efficient sources of debt financing to fund large scale investment over the long term

Our business plan assumes that NGET expects to issue ~£3bn of long-term debt over the T2 period, both to fund capital expenditure and to refinance maturing debt.

Our scale enables access to the debt capital markets which tend to provide the most efficient source of debt financing. The vast majority of our debt is raised in this way and we work hard to ensure debt is issued as efficiently as possible in line with the incentives under the RIIO-1 framework. For example, we can issue debt in any one of multiple currencies, using derivatives to manage the ultimate liability into sterling ensuring we have access to the best value funding available. We have also used a variety of debt products to find new and innovative ways to issue debt including Retail Price Index (RPI) retail bonds.

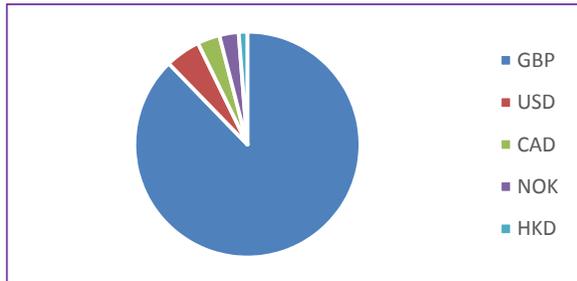
We are a well-known issuer with a clear and distinctive debt investor proposition, reflecting our world-class safety and reliability performance as well as our strong credit rating and financial ratios. Efficient debt funding is incentivised by the regulatory framework and the



resulting lower interest rates feed into future revenue allowances for all networks.

We seek to minimise the total interest rate charges to NGET, whilst managing liquidity risk and maintaining a balanced maturity profile of debt issued that appropriately manages refinancing risk.

Figure 15.1 £7.2bn of debt (pre derivatives) at 31 March 2019, by currency



A strong credit rating minimises our borrowing costs and ensures financial resilience to enable investment to deliver net zero

From a debt funding perspective, we aim to retain an A3/A- credit rating for NGET (for the actual company) as this ensures access to a wide range of debt instruments and capital markets at an efficient interest rate. This rating is supported through targeting a Baa1/BBB+ credit rating for the notional company.

We currently support the higher actual company rating through working hard across the capital markets to raise debt at lower interest rates than the regulatory benchmark and through delivering stakeholder outputs at lower totex levels to allowances. These outcomes are incentivised by the regulatory framework because the resulting lower interest rates and totex levels feed into future revenue allowances. With interest rates predicted to increase and lower incentivisation in the RIIO-2 framework, we recognise there is greater risk around achieving A3/A- under this approach in the future, but we are maintaining our target of Baa1/BBB+ for the notional company.

The purpose of targeting a Baa1/BBB+ credit rating for the notional company is both to enable access to an efficient cost of debt and ensure that we are

appropriately resilient to future financial shocks, which is important given our role as owners and operators of critical national infrastructure. For example, at a Baa2/BBB rating (one notch below our target rating), a change in RPI to CPI wedge to 50bps would reduce our interest cover nearly to sub investment grade, severely restricting the ability of the notional company to efficiently raise further debt funding. An illustration of the resilience a strong credit rating brings is that during the 2008 global financial crisis the company was able to maintain debt market access. Following the Lehmann Brothers collapse in September 2008, NGET was still able to issue a new syndicated €600m five-year bond on 1 December 2008.

A Baa1/BBB+ credit rating is also consistent with recognised regulatory practice: Ofwat targets Baa1, Ofgem have previously targeted Baa1. It is consistent with the cost of debt allowance (which is an average of A and BBB corporate bonds) and consistent with the vast majority of our peers, with currently only one utility entity in the UK rated BBB or lower. Reducing credit ratings for the energy network would also add additional risk at a time when networks are being asked to invest to meet the governments net-zero targets and when much of the industry is on negative outlook.

The lowest cost of investment comes from an equity proposition that appropriately reflects the risks of investing in transmission

To create a framework that attracts low cost funding to deliver consumer investments it is important to understand how equity investors will assess the attractiveness of the sector, these will include analysis of:

- the risk reward balance in light of a lower risk-free rate but higher political and regulatory risks when compared with the T1 period;
- the relative attractiveness of the risk reward balance compared to similar regimes in other jurisdictions (e.g. USA, EU and Australia);
- the ability of the company to maintain an efficient capital structure over the long term, without the use of short-term financing levers; and the ability for the company to maintain its financeability in a range of macroeconomic and operational scenarios.



Figure 15.2 Impact of misaligning the risk reward balance

Case Study: PR99 regulatory agreement

PR99 was a review of water companies' price limits for the period 2000/01 to 2004/05. Ofwat imposed a significant reduction in allowed rate of return compared to the previous price control.

PR99 is remembered for precipitating a 'flight from equity'. There was a sense that the price control put off investment that would have benefited customers and the owner of one company in financial distress was forced to sell up at a discount to the regulated capital value.

The House of Commons Public Accounts Committee, Pipes and Wires, stated in 2002:

"The market valuation of companies in the water industry has fallen below that estimated by Ofwat, suggesting that it might in 1999 have set the cost of capital too low"

We generate value for our investors through a combination of dividend yield and asset growth. However, equity investors do not place equal prominence on each element of the equity offering. In our latest equity shareholder survey, all respondents stated that our National Grid plc dividend policy "to grow the ordinary dividend per share at least in line with the rate of RPI inflation each year for the foreseeable future" was an important part of their investment decision. This demonstrates the fact that the level of dividend pay-out is closely monitored by our shareholders and the wider investment community to assess its sustainability and relative attractiveness within our peer group and relative to the wider equity market. To help achieve this plc level dividend policy we have an NGET dividend policy to maintain gearing at 60%, transferring any additional cash up to plc level. This maintains the efficient financing position for the operating company.

The measures that are commonly used to assess the appropriateness of the dividend pay-out are the dividend yield and dividend cover.

Over the last decade, listed utilities in the UK have averaged a 5.3% dividend yield with the FTSE above 4%. Changes to the regulatory model that increase cash generation at the expense of asset growth, such as the move from RPI to CPIH inflation, lead to investors expecting a higher dividend yield in the T2 period.

The prominence of the dividend policy in regulated utilities is explained by the long asset lives relative to other UK listed peers, as well as the regulatory price controls that set their revenues. A consistent dividend policy, both in terms of yield and cover, therefore,

provides confidence to investors of the regulatory commitment to allow equity investors to recover their initial investment and earn a stable return over the long term.

Any significant change in the level of yield would cause equity investors to question the place of National Grid as a yield stock within their portfolio and reallocate capital elsewhere in the FTSE or to regulated utilities in other jurisdictions and may lead to a 'flight from equity' such as that experienced after the PR99 regulatory agreement in the water sector.

Investors will also be aware of the wider political environment in the UK, for example since the vote to leave the European Union in June 2016 there have been net outflows from UK equities of around 10%, this move from UK equities has been reflected within the regulated energy sector with a reduction in share prices of National Grid (9%), Centrica (65%), and SSE (17%) over the same period

Shareholders also earn a return through asset growth. For example, we expect to deliver asset growth of 4% per annum on average during the T2 period based on the baseline plan. The value that investors place on asset growth is dependent on the future dividend capacity attributable to the asset growth. Our asset growth can also be compared to the higher asset growth of the FTSE100 of 8%, further underlining the prominence of the dividend within our investor proposition and the importance of differentiating the level of dividend yield at 5% within our plans, compared to that of the FTSE100.

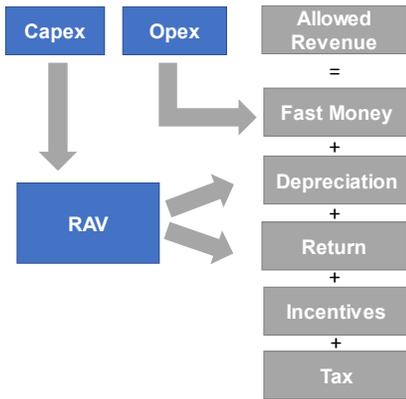
We therefore target a 5% dividend yield, consistent with the T1 period consistent with historic precedent.

2. Regulatory principles

An appropriately balanced financial framework is key to current and future consumers being fairly charged for the networks they use and the services they receive. This is because we pay for investment as we incur it but we recover the cost of that investment for as long as it provides a consumer benefit, which is currently over many decades. This timing creates a cash flow gap which we bridge through debt and equity investment



Figure 15.3 The building blocks model of regulation



The RIIO framework is based on the ‘building blocks’ model of regulation. In this model, allowed revenue should be sufficient to recover the efficient costs the network incurs in providing its services.

Those costs being:

- Fast money: the operating expenses associated running the business.

- Depreciation – the annual expense that is based on spreading the cost of investment over its useful economic life.
- Return on RAV – the cost of financing investment, i.e. paying a fair return to debt and equity investors.

As part of the regulatory framework we are allowed to recover the efficient costs of paying interest and dividends to investors. In this context, efficient means we need to balance lower consumer bills now with a funding platform which will help us to keep financing costs sustainably low by maintaining credit ratings and equity investor returns. Without this return, we would not be able to fund investments over a long time period and current consumers would bear all the cost of investments undertaken even though they would not receive all the benefit. An out of balance risk and return mix would not keep financing costs sustainably low, creating a much bigger consumer bill increase in the future when the balance is returned.

A balance between current and future consumer bills is achieved by using a regulatory framework which

Table 15.4 Required attributes of the regulatory framework

1	<p>Balances risk and reward: by ensuring risks best managed by network are not passed on to consumers</p> <p>A key attribute of the regulatory framework must be a transparent and fair balance of risk and reward between consumers and networks. Removing risks for networks can reduce the cost of capital, and therefore short-term consumer bills. However, the risks removed will still exist only now they will sit with consumers. This creates little incentive or financial capacity for the networks to control costs because of the limited opportunity to be retained from any reductions. This will ultimately drive higher and more variable long-term consumer bills.</p>
2	<p>Demonstrates regulatory commitment and a stable regime: to keep financing costs low for consumers</p> <p>Our costs of borrowing will depend on how our credit rating is assessed. If our credit rating deteriorates, then borrowing costs will go up. Furthermore, it is reasonable for equity investors to expect returns which are broadly stable over time so that returns which were considered appropriate at the time of investment would still be considered appropriate now and in the future. Unpredictability increases risk perception placing upward pressure on the cost of capital. Only by maintaining a consistent approach will the financial framework allow network companies to attract the required investment and keep bills as low as possible for consumers.</p>
3	<p>Takes a long-term sustainable approach: to ensure investment is recovered fairly from both current and future consumers</p> <p>Financeability is not just a consideration of short-term liquidity ratios but considers the long-term sustainability of the company’s financial position which is important in safeguarding future investment. We consider trends across several price controls. This helps us to avoid short-term fixes to address immediate cashflow issues that might create financeability problems in the future.</p>
4	<p>Provides strong incentives: so the networks demonstrably strive to deliver benefits for consumers</p> <p>An effective incentive framework ensures delivery of services at the price and levels consumers are willing to pay by aligning their interests with those of investors. Networks are encouraged to seek out lower costs, through the potential to share benefits, whilst still being held to account for delivering the outcomes they have committed to with clear consequences of non-delivery. Outcomes should be measured and monitored against targets set at the start of the price control providing the transparency which is important for maintaining consumer confidence.</p>



3. Financeability

3.1 Approach to the financeability assessment

The majority of our investment is added to the RAV with the regulatory framework allowing recovery through depreciation and a return on investment. The cost to consumers is spread over the life of the asset and requires us to finance the initial investment from debt or equity investors. Ofgem have a duty to have regard to our financeability by allowing us to recover revenues that are sufficient to pay interest and dividends to our finance providers. We also have a financeability duty by ensuring that we can maintain an investment grade credit rating.

It is in consumers' interests that we fulfil our financing duties efficiently, so the return and interest costs funded by consumers are as low as reasonably possible. Maintaining a strong credit rating and providing confidence to investors that their investment is secure minimises financing costs. We also retain sufficient financial capacity and flexibility to continue operations and investment programmes in the event of economic downturn and outturn of downside risk. At its very basic level, the financeability assessment is a review of the projected levels of financial ratios, which test this financial capacity against target levels. Our network is financeable if we can meet the expectations of both our debt and equity investors. Within this context, we have adopted the following approach to assess financeability:

Table 15.5 Our approach to assessing financeability

1	Focus first on the notional company	Assess financeability for a notionally efficient company with a capital structure consistent with that used to determine the weighted average cost of capital. This ensures companies and their shareholders bear the risk of their capital structure and financing, not customers.
2	Target a strong credit rating	Use a target rating of Baa1/BBB+ to ensure financial resilience and consistency with the index used to set cost of debt allowances.
3	Consider a range of financial ratios for debt and equity investors	Follow methodologies and focus on key metrics used by credit ratings agencies to aid transparency and consistency. For equity metrics, we target a dividend policy consistent with investor expectations and review trends for dividends and earnings profiles. Table 15.6 summarises the ratios targeted.
4	Assess resilience within and beyond the RIIO-2 period	Consider trends across several price controls to assess the long-term sustainability of the financial package, stress test financial resilience through the application of a range of sensitivities and alternative scenarios. This helps us to avoid short-term fixes which would increase overall costs.

Table 15.6 Target thresholds for key financial ratios

	Ratio	Threshold	Rationale
Debt	Adjusted interest cover ratio (AICR) measures how many times a company can cover its interest payments using available cash	1.5	Based on Moody's methodology AICR – mid-point of Moody's range
	Net debt/RAV (Gearing) ensures we maintain an efficient financing structure	60%	Gearing – notional gearing assumption
	FFO/Net debt measures the ability of a company to pay off its debt using available cash	10%	Based on S&P's methodology Mid-point of 9-11% range
Equity	Dividend yield enables investors to measure how much they could earn in dividends by investing in stock	5%	Consistent with the RIIO-1 framework, in line with UK utility peers and reflective of growth / yield mix versus FTSE.

We use the scorecard methodology adopted by Moody's (Moody's Grid) and core metrics applied by Moody's and Standard and Poor's (S&P) as our primary tools to assess financeability from a debt investor's perspective.

We have applied the Moody's approach in line with how Moody's themselves apply the methodology for the overall Grid rating. This involves putting an additional focus on the core metrics: AICR and net debt/RAV.

We have also focussed on FFO/net debt as the core ratio used by S&P in their rating assessment.



Engagement with S&P, review of their rating methodology and consideration of peers' ratings leads to the interpretation of 9–11% as a BBB+ threshold.

Our assessment considers credit metrics as being achieved when the mid-point of the relevant thresholds is met. This is for two reasons.

Firstly, it is in line with credit rating agencies practice, where it is expected that metrics will have a buffer above the threshold for the relevant rating to apply. If we were to achieve only minimum thresholds throughout the period, the potential for downside risks would result in a network with weak financial resilience, increasing the likelihood of downgrade or being placed on negative watch. This should not be the case for a “notionally efficient” company which we are modelling.

Secondly, Moody's has the majority of UK water companies on negative outlook, reflecting concerns over Ofwat's PR19 determinations. Given the rise in the perception of regulatory intervention through items such as the performance wedge it is credible that this could be applied to energy networks.

Recently, both Moody's and Fitch assessed that the water sector has become riskier and therefore increased the ratio headroom required for AICR by 10bps. We have assumed that the thresholds applied to energy networks do not change from where they are today with this risk partially reflected in our targeting the mid-point of the thresholds ranges for key ratios.

For the context of this chapter, we concentrate on key financial ratios in line with the rating agency methodologies and include a wider range of metrics, including those set out by Ofgem's guidance, in NGET_A15.01 Finance Annex.

Given energy transition and the uncertainty inherent in proposed investment for the T2 period, the network needs to be financeable at different funded levels of totex and we stress test the financial package using Ofgem's proposed scenarios. The impact of downside risk is assessed through:

- totex ranges, including credible outturn scenarios and contestable projects;
- interest rate scenarios based on -1% compared to forward implied rates as per the base case in each year
- inflation rate scenario based on +1% in each year
- RPI – CPI divergence scenario based on -0.5% movement from assumed wedge
- 10% totex overspend
- proportion of index linked debt issued -5% lower than assumed in the base case.

3.2 Financeability assessment of Ofgem's working assumptions

We test the financeability of the notional company in the first instance using the following assumptions set by Ofgem:

Table 15.7 Ofgem's working assumptions including incentives performance

Parameter	Ofgem assumptions
Allowed equity return	4.3% post-application of the 0.5% outperformance wedge
Incentives performance	0.5% equivalent = £35m p.a.
Dividend yield	3%
Gearing	60%, set at beginning of RIIO-2 and maintained throughout the period
Allowed debt funding	Full indexation, 11-15 year trombone
Debt profile	25% inflation linked debt throughout the period with RPI debt switched to CPIH
Inflation indexation	Immediate transition to CPIH, CPIH assumed to be 2% per annum
Depreciation	45 years, straight line
Capitalisation rate	Natural rate

Our baseline plan has annual totex ranges which vary between £1.3bn to £1.6bn, totalling £7.3bn across the 5-year price control, when real price effects are included. However, our plan also shows there are credible scenarios where much higher investment is required. This is particularly the case for facilitating net zero by 2050 and if potentially contestable projects are delivered by ourselves under either the T2 framework or the Competition Proxy Model (CPM). Our high scenario forecasts over £10bn of totex in the T2 period.

The T2 framework must enable our plan to be financeable under all credible scenarios. To do otherwise would risk constraining investment and risk delivery of the net-zero targets. For this reason, whilst we focus our financeability assessment firstly on our baseline plan we also assess higher capital scenarios.

Before setting out the detailed financeability assessment, it is worth outlining why our conclusions from this work are that we do not believe our plan is financeable on a notional basis using Ofgem's working



assumptions and a higher equity return is required to keep consumer costs lower over the longer term:

- Cashflows are close to Baa1 AICR thresholds but only due to the inclusion of highly uncertain incentive performance of c£35m per annum. This revenue would be disregarded by rating agencies and is higher than the likely T2 incentive package so should not be included in any assessment.
- Without the implausible incentive performance adjustment, credit metrics are not consistent with a Baa1 investment grade, reducing the financial capacity to carry the risk of capex uncertainty and bringing a more risk averse approach to investment and innovation.
- Dividend yield and allowed equity return will not attract required investment, particularly to the levels required to deliver net-zero targets.

- CPIH transition is being used as a way of supporting short term financeability and a reduction in allowed equity returns. This is a short-term fix which will require compensating adjustments to the price control in future periods.
- Economic and totex sensitivities show cashflows reducing to near sub investment grade e.g. if the CPI to RPI wedge was 0.5% rather than 1% and totex was overspent by 10%.
- If we were required to deliver potentially contestable projects, then cashflows would only be consistent with a low Baa2 rating with use of the CPM reducing cashflows to sub investment grade.

These points are explained in more detail through the following sections. We also show the results of analysis using our proposed assumptions.

Table 15.8 Key metrics based on Ofgem’s package including incentives performance

Quantitative Metrics	T1 Final Proposals	T2 period				
	Dividend Yield	5.00%	3.06%	3.10%	3.11%	3.09%
Dividend Cover	2.36	2.95	2.86	2.79	2.76	2.59
Indicated rating from Moody’s Grid	43	Baa1	Baa1	Baa1	Baa1	Baa1
Core Metrics						
AICR	1.64	1.46	1.45	1.45	1.46	1.47
Net Debt / RAV	60%	60.7%	61.2%	61.4%	61.2%	61.1%
S&P : FFO / net debt	11.91%	10.99%	10.53%	10.37%	10.30%	10.15%

Consumer implications

This package leads to higher consumer bills by risking equity investment which will ultimately increase financing costs

Credit metrics are only close to thresholds due to implausible incentives performance

A rating
 Target investment grade
 Below target investment grade

Dividend yield and allowed equity return will not attract required investment

Ofgem’s working assumption is a 3% dividend yield but this does not align with our investor expectation of stable dividend growth and is less than the 4% average of the FTSE 100 and 5% of our peers.

It is not appropriate to resolve debt financeability constraints through assuming lower dividends. Given that energy networks hold greater risk than water companies, investors could see this as an opportunity to invest in an alternative sector where they can earn higher dividends for lower risk. The implication is that Ofgem’s package does not balance risk and reward appropriately or adequately reflect the risks inherent in running a transmission network.

We are competing for funds globally which, when combined with the significant level of investment required in UK infrastructure, means returns must be sufficiently attractive to equity investors. A sustainable and predictably growing dividend is key to accessing funds for investment. Ultimately, if it is not high enough, many investors will cease to hold stock as they see dividends placed at risk through lower revenues and structures which have little headroom to absorb any financial

shocks. This impacts the ability to attract investment, which has implications for raising further financing efficiently. New equity investment will be more expensive to raise and if equity is replaced with higher levels of debt, the risk to debt investors will increase borrowing costs.

Assumed incentives performance is not credible

An assumed 0.5% incentive performance adds c£35m p.a. to revenues and provides significant support for credit metrics in the T2 period. Without this assumption, AICR falls below Baa1 thresholds during the T2 period. The incentives package has not been finalised, but our current view is that ~£30m per annum is the maximum that could be achieved, lower than the assumed performance. It is also incredible to assume we would achieve maximum performance each year of the T2 period given Ofgem’s focus on reducing incentive performance opportunities. Even taking our T1 performance where the maximum reward available is currently c£40m, and our achieved performance averages around £10m shows the implausible nature of the assumption.

The notional company should be financeable without the need to rely on assumed outperformance, which is



in line with how credit rating agencies will undertake their assessment. Moody's have referred to the scope of outperformance being limited by low-powered incentives in transmission and likely challenging cost allowances, meaning they will not include any outperformance in their modelling until a track record has been established. Financeability therefore needs to be assessed without assuming incentives performance.

Sensitivity analysis highlights limited financial resilience

As illustrated in Figure 15.9, sensitivity analysis shows the financial resilience of the network is much more limited than Ofgem's base case would suggest which also needs to be considered in assessing financeability:

Figure 15.9 Sensitivity analysis to assess implications for FFO/net debt and AICR using Ofgem's working assumptions including incentive performance

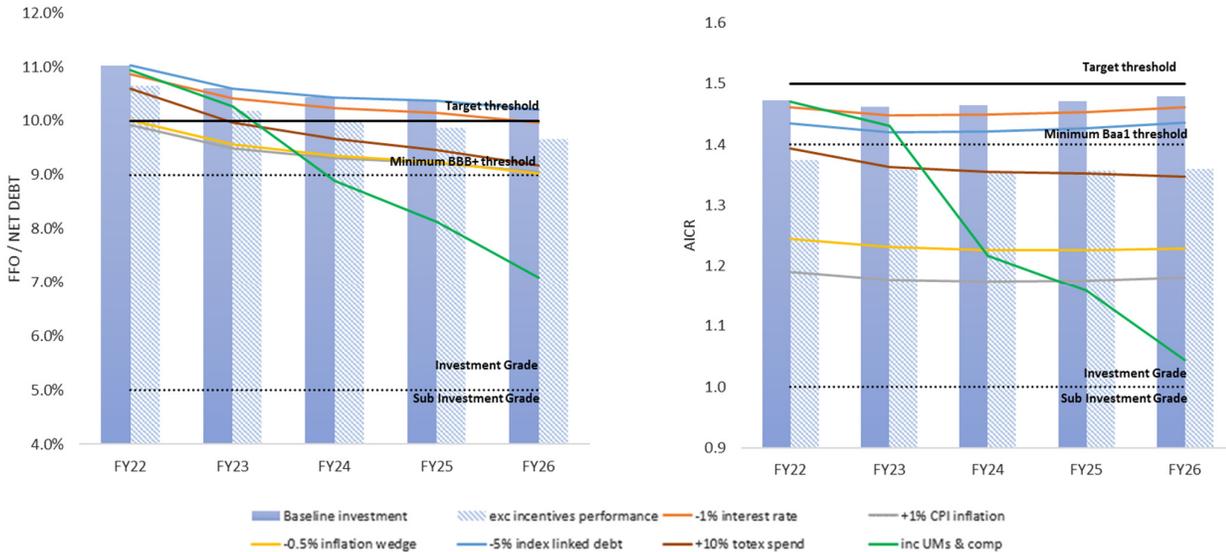


Table 15.10 key metrics based on Ofgem's working assumptions excluding incentive performance

Quantitative Metrics	T1 Final Proposals	T2 period				
Dividend Yield	5.00%	3.07%	3.13%	3.16%	3.16%	3.16%
Dividend Cover	2.36	2.78	2.69	2.61	2.57	2.40
Indicated rating from Moody's Grid	A3	Baa1	Baa2	Baa2	Baa2	Baa2
Core Metrics						
AICR	1.64	1.37	1.34	1.34	1.34	1.35
Net Debt / RAV	60%	60.9%	61.7%	62.0%	62.0%	62.1%
S&P : FFO / net debt	11.91%	10.62%	10.12%	9.91%	9.80%	9.61%

Consumer implications

Limiting investment funds now will **risk our ability to support net zero requirements**

As credit quality deteriorates the **costs of borrowing increase** to reflect increased risk of lending

Capex uncertainty

The network has limited financial capacity even before we have considered the potential impacts of alternative funded totex levels. So far, we have assessed the financial package using our baseline totex plan, this reflects the changing external landscape for transmission in the 2020s but there are elements which are subject to major uncertainty. We are operating against a backdrop of increased uncertainty of supply and demand with the requirements to deliver net zero by 2050 only partially clear. To remain responsive and

proactive to changes in how the network is used we need to ensure financeability in credible scenarios where funded totex outturns higher than the baseline. We also need to consider the potential impacts of competition. At this stage, the competition framework is not sufficiently developed, creating considerable uncertainty for our business plan as to how costs could be incurred and how they would be funded.

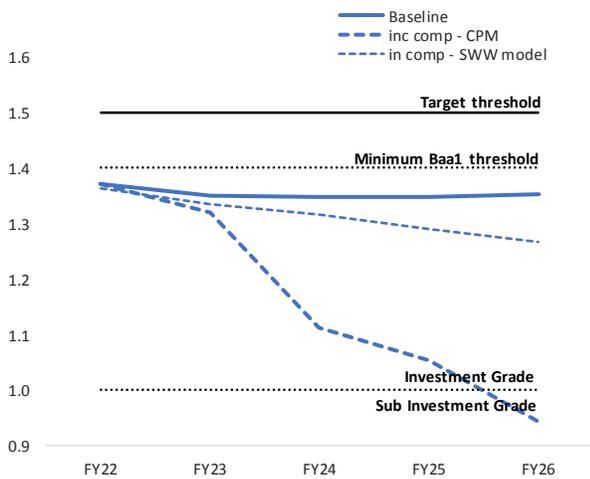
The CPM approach could still be used for the potentially contestable projects which are required in the T2 period so we need to consider the implications. In this



scenario, the construction phase of projects would not be funded for the first five years so we are exposed to the full risk of any additional costs without any allowance certainty during the T2 period.

Including the c£1.6bn of contestable projects in the plan means that by the end of the period the network becomes sub investment grade. Even up to this point there is no capacity to absorb any further shocks or cost over-runs without the network becoming sub investment, as can be shown from the AICR trends. This would severely restrict the ability of the company to be raise further funding efficiently.

Figure 15.11 Impact of potentially contestable projects on AICR



Also shown on the graph is the impact of potentially contestable projects were funded under the Strategic Wider Works model. Although the position would seem like an improvement when compared to a CPM approach, the following table shows metrics are still significantly weakened. However, even this could be considered optimistic as no funding delays have been factored into our analysis.

Table 15.12 Key metrics when including potentially contestable projects funded as SWW

Quantitative Metrics	T1 Final Proposals	T2 period				
		Year 1	Year 2	Year 3	Year 4	Year 5
Dividend Yield	5.00%	3.09%	3.18%	3.32%	3.45%	3.61%
Dividend Cover	2.36	2.76	2.64	2.47	2.37	2.13
Indicated rating from Moody's Grid	A3	Baa1	Baa2	Baa2	Baa2	Baa2
Core Metrics						
AICR	1.64	1.36	1.34	1.32	1.29	1.27
Net Debt / RAV	60%	61.1%	62.2%	63.8%	65.2%	66.7%
S&P : FFO / net debt	11.91%	10.53%	9.88%	9.18%	8.63%	7.99%

Gearing levels increase above 65% by the end of the period which, according the notional thresholds, indicates equity injection would be required to support investment.

With such a constrained financial position it is likely that we would need to be more cautious on investment, needing funding security before beginning any work leading to risks being passed onto consumers. Such an approach in the T1 period would have impacted millions of pounds of infrastructure work where we invested ahead of secured funding in areas of network resilience and renewable generation connections. The impact of these reactions and other unintended consequences would quickly offset any short term bill reductions from the currently proposed levels of return.

Limited financial resilience of the network

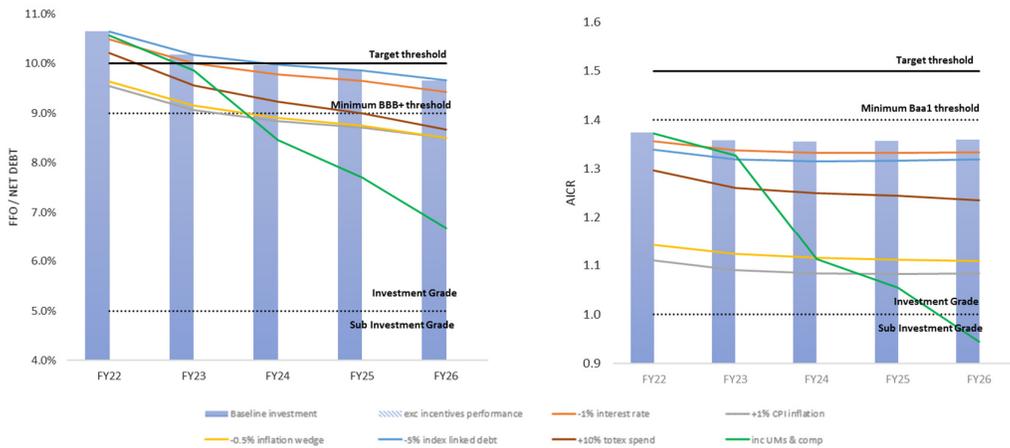
Even without capex uncertainty, Moody's Grid rating falls to Baa2 throughout the majority of the T2 period when incentives performance is excluded, providing only one notch of headroom to achieve an investment grade.

Again, of particular concern is the AICR trend. This metric measures how many times a company can cover its current interest payment with its available earnings. It is important to have headroom in AICR so that the network is still able to meet its interest payments in the event of macroeconomic shocks and outturn of downside risk.

The graphs below show the impacts on key metrics of the sensitivities Ofgem have set out to test the resilience of the financial package



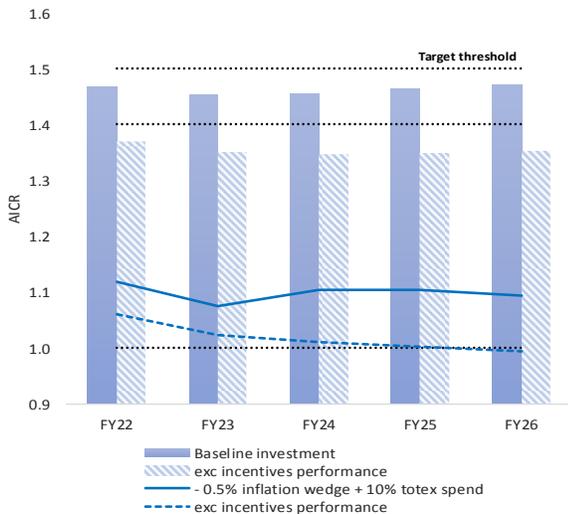
Figure 15.13 Sensitivity analysis to assess implications for FFO/net debt and AICR using Ofgem’s working assumptions excluding incentive performance



The financial package is particularly sensitive to the movement in the macroeconomic environment, where only a 0.5% change in the inflation wedge would mean that AICR deteriorates significantly. Whilst at these levels the network may still be considered investment grade, when combined with a 10% totex overspend we see credit ratings depressed even further and falling below investment grade under credible totex scenarios, indicating significant increase in the risk of lending to the company.

As credit quality deteriorates, a narrowing pool of debt investors combined with increasing costs will ultimately drive higher bills for consumers. Consistent financial ratios are also used by equity investors as a proxy for dividend affordability. Any additional risk faced by the shareholder is likely to place upward pressure on the cost of equity.

Figure 15.14 Combined totex and macroeconomic sensitivity analysis



CPIH transition is being used to alleviate short term financeability concerns

The transition to CPIH should not be used as a lever to address financeability issues that may be caused by setting returns at a level which is too low. We would therefore expect financeability assessments on both a RPI and CPI basis to be able to test value neutrality.

Whilst this combination is modelled based on scenarios set out by Ofgem, we have tested their credibility by assessing further scenarios based on the principal risks identified by our own risk management processes. Through this we have a clear understanding of the events that could impact the delivery of the plan with our analysis supporting a change in inflation wedge with a 10% totex overspend as a severe but plausible scenario. The details of the additional scenarios we have considered in addition to Ofgem’s are set out in Annex 15.01

Figure 15.15 AICR using Ofgem’s working assumptions for 100% CPIH transition and RPI counterfactual

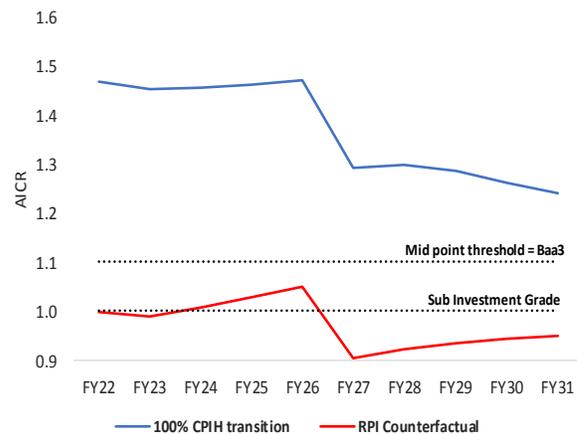


Figure 15.15 illustrates the impact of changing to CPIH on AICR and shows how key financial ratios are being supported by the one-off cash acceleration created by switching to CPIH indexation. If RPI indexation were retained, AICR falls to sub investment grade meaning



that the network is no longer generating sufficient revenue to meet its interest costs.

Short term cash flow increases, whilst supporting metrics in the T2 and T3 periods, will create financeability issues in the longer term. Ensuring NPV neutrality means that initial positive cashflow impacts from the transition will subsequently become negative. This is likely to be exacerbated by other long-term implications, particularly when future funding will reflect CPIH but a significant proportion of costs are likely to remain nominal or RPI linked creating a mismatch between revenue and costs.

As a result, using CPIH transition to support Ofgem’s proposed package will have a detrimental impact on the :

long-term sustainability of the network, which is key to safeguarding future investment and providing confidence that transition is neutral to investors.

3.3 Application of financeability levers

As we have shown, the notional company is not financeable using Ofgem’s working assumptions, the company has limited financial headroom and limited resilience to cost shocks highlighted by weak financial ratios. Ofgem have set out four potential levers (the first four actions set out in Figure 15.16) to address these issues to which we add balancing the risk reward offering through use of the appropriate allowed return

Table 15.16 Financeability levers proposed by Ofgem

Adjust capitalisation rates	Percentage of totex to be added to the RAV is set to balance costs paid by existing and future consumers, considering the proportion of capex costs expected during the price control period.
	Use as financeability lever: The simplest to understand and arguably most economic lever to use. However, use should be limited to marginal changes otherwise the impact of bringing cash forward is unlikely to be sustainable in the long term, will be disregarded by ratings agencies and will create intergenerational mismatches in bills.
Accelerate regulatory depreciation	Set to balance costs paid by existing and future consumers, taking into account expected economic life of assets and uncertainty in their future use.
	Use as financeability lever: Any adjustment to address short term financeability concerns will reduce the transparency of how cost recovery is set to match the benefits consumers receive.
Reduce notional gearing	Demonstrates the financial risk of the company as it measures the level of net debt in the context of the total value of the RAV.
	Use as financeability lever: Lower gearing levels can enable companies to maintain credit metrics under a wide range of market conditions, but only if set to reflect the cashflow risks from the overall business plan submission. Any further reduction should be supported by our current business plan or framework; as any change, purely to enable cashflows to support short-term credit metrics, risks inconsistency with the underlying risk profile of the business and how the weighted average cost of capital has been calculated.
Reduce dividend yield	Dividend yield should be set to align with equity investor expectations.
	Use as financeability lever: The notional company should be financeable based on an appropriately calibrated package and should not therefore require dividends to be cut.
Risk reward balance	There must be a transparent and fair balance of risk and reward between consumers and networks.
	Use as financeability lever: Allowed return needs to be set at a level high enough to not require the use of short-term levers which bring cash forward but also erode future value.

For the reasons set out in section 1, dividend yield is not a valid lever, leaving depreciation profiles, capitalisation rates and notional gearing as potential levers to address the limitations of Ofgem’s financial package. We also consider the allowed return and what is an appropriate level to reflect the risks of a transmission network and ensure a balanced risk and reward package. AICR, as calculated by Moody’s, is typically our most constrained metric; therefore, we focus on how the levers could be used to achieve financeability based on this ratio.

Adjustment of capitalisation rates

We first consider adjusting the capitalisation rate, using this single element would require fixing the rate to 77% versus a natural rate of 79% to ensure credit metrics achieve target thresholds in the T2 period. A 2% change may seem marginal but as a proportion of totex,

the level of cash brought forward is significant, at circa £250m over the T2 period.

We have assessed what the capitalisation rate would need to be without including the cash equivalent of the performance wedge, as we do not consider it appropriate to assume outperformance in our financeability assessment. However, if the wedge were to be applied, the capitalisation rate required to meet target thresholds would be more marginal, c0.5% equating to c£75m of cash.

The materiality of the cash levels brought forward to correct financial concerns, undermines Ofgem’s primary obligation of ensuring fair charges for existing and future consumers for the services they receive. This is also true when considering the acceleration of regulatory depreciation purely to address financeability concerns.



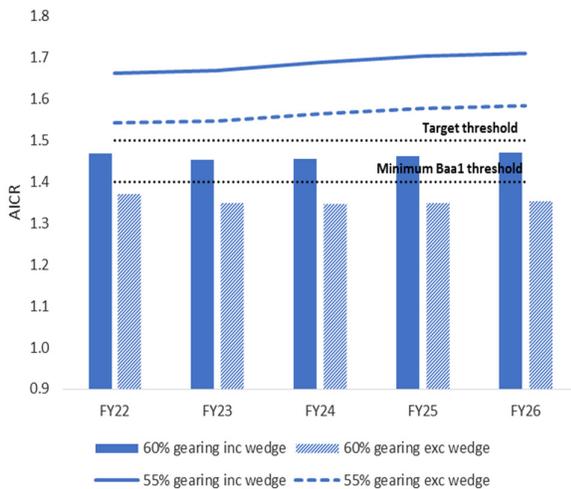
Making companies financeable through levers which bring cash forward and erode future value cannot be sustained in the long term and should not be considered as a substitute for setting allowed equity returns at a high enough level. Particularly, as credit rating agencies disregard changes to capitalisation rate and depreciation profile on the basis that adjustments are NPV neutral.

Reduction in notional gearing

We have also considered the impact of reducing the notional gearing level to 55% as a lever to achieve acceptable debt metrics under Ofgem’s proposed package.

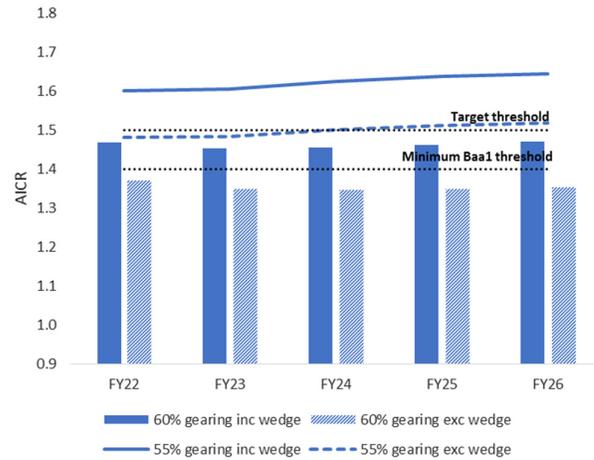
Firstly, we have assumed a view keeping equity return at 4.3% but changing gearing. A change to the notional gearing changes the reference point for equity injections and the absolute level of debt and, therefore, impacts the weighted average cost of capital (WACC) used in revenue calculations. This would imply we are setting an equity return without reference to the change in notional gearing, increasing the WACC.

Figure 15.17 AICR at 60% and 55% notional gearing with allowed returns increasing



The alternative is to reflect the lower gearing levels in the equity return. This would reduce the headline equity return figure which would mean that the allowed WACC has little movement but financeability ratios would still show improvement given the reduction in net debt.

Figure 15.18 AICR at 60% and 55% notional gearing keeping allowed returns aligned



The graphs show that a reduction in notional gearing to 55% could lead to the network being considered financeable. The concern however, is that at these levels, financial structures are not efficient and sustainable in the long term.

At 60%, gearing remains consistent with the market. Whilst levels have been set lower, this has only been considered appropriate for companies undergoing significant RAV growth, a position not aligned with our baseline plan. As the risk profile of the network has also not decreased there seems to be limited justification in adjusting notional gearing simply to address financeability concerns.

Using gearing as a lever to support a return which has been set too low, further deteriorates the investor proposition by transferring additional risk to equity and reducing asset growth.

Dividend policy

The focus so far is on achieving credit metric target thresholds in the T2 period. However, the equity investor proposition is not in line with the feedback from our shareholders or other regulated entities. When we adjust to a 5% dividend yield, Ofgem’s proposed financial package AICR falls even more significantly.



Table 15.19 Key metrics based on Ofgem’s working assumptions with a 5% dividend yield excluding incentive performance

Quantitative Metrics	T1 Final Proposals	T2 period				
Dividend Yield	5.00%	5.23%	5.45%	5.62%	5.76%	5.92%
Dividend Cover	2.36	1.66	1.59	1.53	1.49	1.37
Indicated rating from Moody's Grid	A3	Baa2	Baa2	Baa2	Baa2	Baa2
Core Metrics						
AICR	1.64	1.36	1.32	1.30	1.28	1.27
Net Debt / RAV	60%	61.8%	63.3%	64.4%	65.3%	66.2%
S&P : FFO / net debt	11.91%	10.45%	9.78%	9.42%	9.14%	8.80%

Consumer implications

Dividend policy is not sustainable, as gearing increases above threshold by the end of the period.

Limited ability to facilitate changing consumer requirements.

There is also a deterioration in the debt investor proposition as Moody’s rating grid falls to Baa2 during the period. Using downward changes to the equity investor proposition to address short term concerns for debt metrics is not a substitute for setting base returns

at a high enough level with an appropriately calibrated package.

Neither the reduction of the equity investor offering, nor the use of short-term cash acceleration levers are aligned with regulatory principles:

Figure 15.20 Assessment of Ofgem’s proposed financial package against regulatory principles

Is the regulatory principle met?	Reasoning
Balances risk and reward	Return is insufficient to reflect the risks inherent in running a transmission network and is not aligned with investor expectations or market comparators
Demonstrates regulatory commitment and a stable regime	Ofgem’s assumptions are inconsistent with past regulatory precedent, particularly in relation to setting allowed equity returns. Increasing perceptions of regulatory risk impacts investor confidence leading to increased cost of capital, and therefore bills, in the long term.
Takes a long-term sustainable approach	Short term fixes are required to make Ofgem’s package debt financeable, these can address immediate cashflow problems but only by deferring underlying issues into subsequent price controls and creating an unfair balance of charges between current and future consumers.
Provides strong incentives	There is no financial capacity to compensate networks for assuming more risk for developing new, innovative ways of working which drive lower consumer bills in the long term.

Investors continually trade off risk and return when they evaluate investment opportunities and they need to be rewarded for the risk they take for investing in National Grid. This requires an allowed equity return which is comparable and allows the company to maintain financeability.

In NGET_ A15.01 Finance Annex. we set out in detail our principle-based approach to determining our

financial package. The package we propose can both maintain credit ratings and offer an equity investor package which can attract and retain investment to keep financing costs efficient and as low as possible.

It also provides the capacity to compensate networks for assuming more risk, enabling delivery of the stretching outcomes stakeholders are telling us are important to them.



Table 15.21 Our proposed financial package

Parameter	Our proposed assumption
Allowed equity return	6.5%
Incentives performance	-
Dividend yield	5%
Gearing	60%, set at beginning of RIIO-2 and maintained throughout the period
Allowed debt funding	Full indexation, 15 year index plus 68 basis points additional borrowing costs
Debt profile	25% inflation linked debt throughout the period with RPI debt switched to CPIH
Inflation indexation	Immediate transition to CPIH, CPIH assumed to be 2% per annum
Depreciation	45 years, straight line
Capitalisation rate	Natural rate

Table 15.22 Key metrics based on National Grid's proposed financial package with a 6.5% cost of equity (CPI-stripped) and a 5% dividend yield

Quantitative Metrics	T1 Final Proposals	T2 period				
	Dividend Yield	5.00%	5.12%	5.21%	5.26%	5.26%
Dividend Cover	2.36	2.08	2.01	1.97	1.95	1.85
Indicated rating from Moody's Grid	A3	Baa1	Baa1	Baa1	Baa1	Baa1
Core Metrics						
AICR	1.64	1.56	1.54	1.55	1.58	1.62
Net Debt / RAV	60%	60.9%	61.6%	62.0%	62.0%	62.0%
S&P : FFO / net debt	11.91%	11.96%	11.42%	11.21%	11.11%	10.93%

Consumer implications

Dividend yield is sustainable, and in line with investor expectations

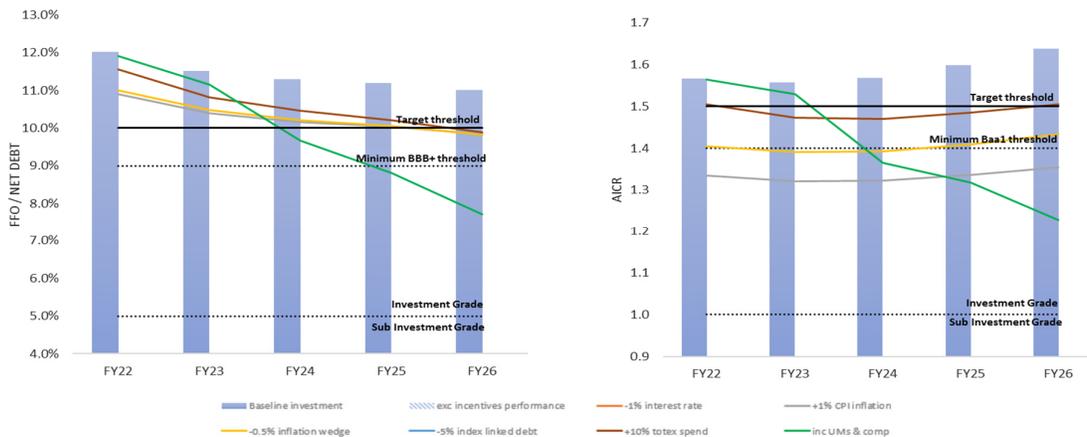
Network is able to borrow more cheaply and can absorb the impact of cost shocks

Network can operate flexibly to facilitate changing consumer requirements

We have tested our package against a range of macroeconomic and operational scenarios to ensure the notional company has sufficient headroom to absorb downside risks.

As the following graphs show, we are able to maintain financeability and remain resilient, a position which is key in safeguarding our future investment, ensuring we have the capacity to facilitate change to a low carbon economy and deliver the energy networks of the future.

Figure 15.23 Sensitivity analysis to assess implications for AICR and FFO/net debt using National Grid's proposed financial package





3.4 Financeability assessment of the actual company

Our assessment so far has focussed on the financeability of the notional company, but we also need to assess financeability of the actual company. The onus for ensuring the financeability of the actual companies lies with networks, but this can only be assured on a sustainable basis if supported by a package which delivers a financeable notional company.

For the actual company, notional gearing is adjusted to actual gearing and actual debt and tax costs are included with other financial parameters remaining at notional values. We also include any cashflows which will be recovered/incurred during the T2 period but are related to the T1 price control. We align our assessment with credit ratings agencies' methodology.

Considering Ofgem's package, including 0.5% of incentive performance, we see an improvement in the results of our financeability assessment when using actual financing. This relates to the debt financing strategy we adopt. We work hard to ensure debt is issued as efficiently as possible to minimise total interest rate charges, but as a consequence tax performance will reduce because of the additional charges incurred.

As already outlined for the notional company, assuming incentive performance at this level is neither a credible assumption nor is it in line with how credit rating agencies will view the network in practice.

Taking out any assumed outperformance shows the significant support the additional revenue provides. We still show an improvement in the credit metric results when compared to the notional focus, but the equity investor proposition remains misaligned with both our peer group and shareholder feedback.

Adjusting to a 5% dividend yield, Moody's Grid is below the A- credit rating we aim to support for the actual company for the whole of the T2 period. We target A- because this ensures access to a wide range of debt instruments and capital markets at an efficient interest rate which is key to supporting our debt financing strategy.

Trends also show a gradual increase in gearing levels, by the end of the period we are very close to the threshold (64.9%), suggesting equity issuance will be required to ensure alignment with an efficient capital structure.

It is unlikely that we would be able to attract additional investment when higher returns can be earned in comparable sectors (e.g. water, tobacco). In reality, it is likely that returns would need to be higher to compensate investors for increasing their exposure to a sector which may be perceived as being riskier because of the political and regulatory uncertainty.

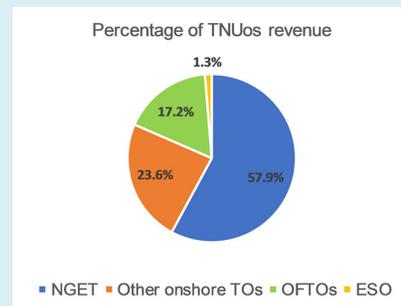
In our assessment, the limiting factor is the notional company, yet in this scenario it is debt and tax performance which is ensuring financeability for the actual company. In assessing an overall package, we shouldn't rely on financing performance which may not be achievable in all credible macroeconomic and totex scenarios, particularly given the low interest rate environment we are currently in and the potential for additional capex spend.

The only sustainable way to support both debt and equity financeability is to set an appropriately calibrated package. The package we propose ensures financeability for both the notional and actual company and allows us to continue efficiently financing our activities whilst supporting sustainably lower consumer bills in the long term

Figure 15.24 revenue proportions of TNUoS tariffs

In March 2019, the ESO published the five-year view of TNUoS tariffs for 2020/21 to 2024/25 including the impact of inflation.

The tariffs are based on the revenues forecasts for onshore and offshore transmission owners and ESO. NGET TO revenues are on average 58% of the total and our revenues do not increase before inflation. The 23% increase in ESO forecasts tariffs from £6.52 in 2020/21 to £8.00 in 2024/25 are due to increases from other factors, inflation and OFTO revenues in particular.



4. Bill impacts

The application of the RII0-2 regulatory framework to our business plan determines the revenues we are allowed to recover through the price control period. The Electricity System Operator (ESO) recovers revenue from transmission network users by applying the

charging methodology in force at the time. The ESO publishes its forecast tariffs, for example through the Forecast of TNUoS tariffs. Our revenues form only part of ESO's published tariffs as the ESO also collects

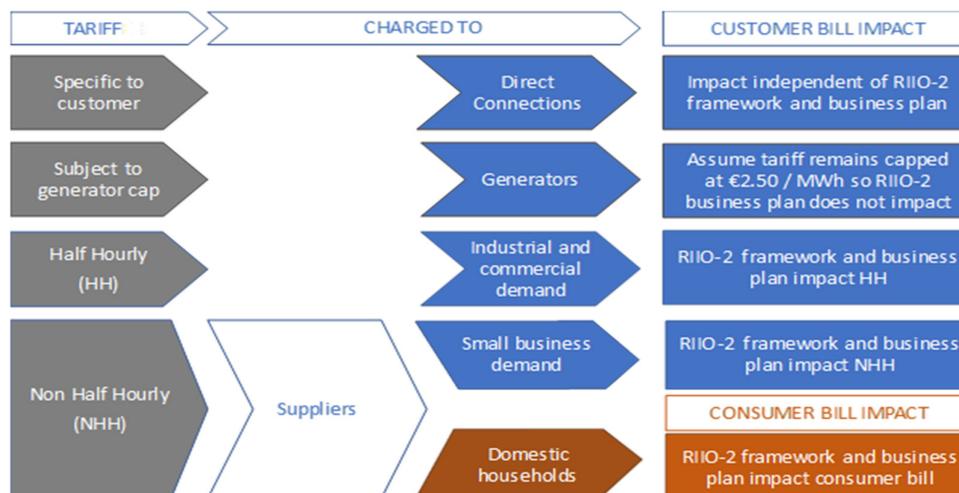
revenues for other onshore and offshore Transmission Owners. Application and engagement on the charging



methodology fall within the ESO's activities. We therefore make the simplifying assumption that the charging methodology will not change from its current form allowing us to quantify the specific impact associated with our business plan and to directly compare T2 period charges with those under the previous price control.

Our revenues are paid for by the customers of the ESO. Customers of the ESO are generators and suppliers. Costs charged to suppliers are passed onto commercial and domestic end users. We consider the impact of our plan both on our customers and the end consumer

Figure 15.25 TNUoS customers and tariffs



4.1 Customer bills

We have built this plan with the help of our customers and have incorporated their views in our proposals.

When we have engaged with our customers on how we can help them understand their bill impacts for the T2 period, they have told us that we should give them visibility of our revenue trends including potential tariff implications. This will allow them to calculate their own

specific bill impacts based on their individual circumstances.

We calculate the impact of our business plan on the half hourly and non-half hourly tariff and therefore on our industrial and commercial and small business and domestic users, respectively. The demand tariff is reflective of revenue. The forecast revenue ranges for our draft business plan submission which are charged to generators and those on Half Hourly (HH) and Non Half Hourly (NHH) tariffs are:

Table 15.26 Revenues charged to generation and demand customers

£m (2018/19 price base)	2021/22	2022/23	2023/24	2024/25	2025/26	T2 average	T1 average
National Grid framework	1847	1929	1801	1747	1704	1806	1769
Ofgem framework	1632	1717	1591	1549	1523	1602	1769

Assuming that forecast demand remains at 2019-20 levels across the T2 period, results in the following forecast impact of our plan on customer tariffs.

Table 15.27 Customer bill impacts

Customer	Impact of our T2 plan on demand tariff	Average customer case study
Industrial / Commercial (HH)	Increase in bills of c.1% 2019-2020 average of £49.9/kW T2 average of £47.2 to £50.6/KW	Half hourly tariff for a 1MW user Change in annual bill of -£2,800 to +£600
Small businesses (NHH)	Increase in bills of c.1% 2019-2020 average of 6.45p/kWh T2 average of 6.09p to 6.53p/kWh	Non-half hourly tariff for an average annual usage of 50kMWh Change in annual bill of -£180 to +£40



We have engaged on this approach through the Independent Stakeholder Group focusing on the impact of our business plan and will continue to engage with individual customers.

described by Ofgem. The consumer bill is expressed as National Grid's element of the TNUoS tariff passed on to households by suppliers. We use the following five step process to forecast the T2 consumer bill:

4.2 Consumer bills

We calculate our consumer bill impact using a simple top-down approach that follows the methodology

Figure 15.28 Methodology for calculating consumer bill impacts



Our approach is based on the charging methodology and inputs from 2019-20, so our forward-looking estimates, such as demand assumptions, do not include potential future changes to these variables.

Using this methodology, on average across the T1 period, National Grid's direct charges to end consumers account for c4% of the average household electricity bill. This is on average around £24 a year.

All values are quoted in the equivalent of 2018-2019 prices. This gives transparency to the impacts expected from our business plan by removing the effects of inflation on bills. We also specifically isolate the impact of our T2 business plan on the T2 bill by separately stating bill effects which are as a result of previous price controls.

Applying Ofgem's proposed financial package, with the capitalisation rate adjustment to ensure that the company remains able to achieve credit metrics at Baa1 grade for the T2 period (section 3.3 in this chapter), results in an average T2 consumer bill of £20.95, an

average reduction in the annual bill of £3.20 compared with the T1 period.

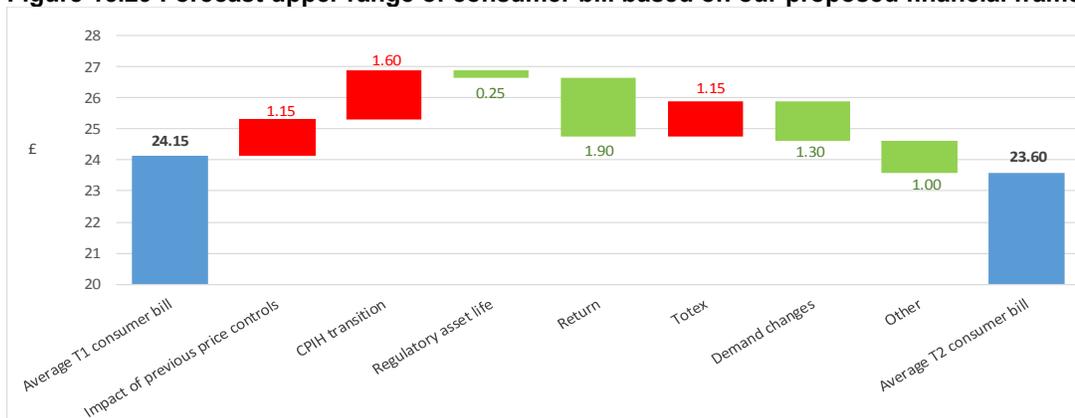
However, by adopting Ofgem's proposed framework, we recognise that there are additional risks for consumers:

- The equity investor offering is reduced and is not in line with that of our peers which limits our ability to make the required investment.
- The short-term fix of amending the capitalisation rate moves away from the principle of matching consumer charges to asset use.

Our proposed financial package mitigates these risks and ensures that charges are set to reflect consumers' use of the electricity transmission network. Under our proposed package, the average T2 consumer bill is £23.60, an average reduction in the annual bill of £0.55 compared with the T1 period.

The drivers which result in the change in the average consumer bill from the T1 to the T2 period can be categorised as follows:

Figure 15.29 Forecast upper range of consumer bill based on our proposed financial framework





- **Previous controls : + £1.15**

The level of RAV additions in the T1 period, and the inclusion of legacy adjustments will flow through to the T2 bill but arise as a result of the previous price control.

- **Framework changes : +£1.35**

The transition to a CPIH indexed price control accelerates cashflow. The continuation of the 45 year regulatory asset life is an increase from the average T1 asset life which delays revenues.

- **Financial package : -£1.90**

This category covers changes to financial parameters; allowed equity return, cost of debt allowances and gearing. Under both our and Ofgem's proposed financial package the cost of capital decreases mainly due to lower allowed equity return when compared with the T1 period.

- **Totex plan : +£1.15**

Our totex plan is driven by what our stakeholders require from the transmission network and the investment needed to deliver a safe, reliable network which will be key to realising the UK's clean growth ambition. We will continue to communicate and test elements of the plan with stakeholders, for example, through the Willingness to Pay exercise.

The upper end of the range representing the impact of Ofgem's package, includes the increased capitalisation rate required to deliver a framework which delivers target credit ratings in the T2 period.

- **Demand projection: -£1.30**

We have continued the 2019-20 charging methodology and demand assumptions through the remainder of the current price control and into subsequent periods.

- **Other movements: -£1.00**

A further reduction is attributable to forecast changes in mainly in pass through costs but also incentive income.

We have engaged with stakeholders on our communications on the consumer bill. In November 2018, we commissioned a study that included awareness of the energy industry amongst the public including the understanding of what makes up the energy bill. Based on the results and feedback we have engaged with stakeholders to explain our portion of the consumer bill and how it is calculated. This information is available at <https://www.nationalgrid.com/about-us/breaking-down-your-bill>. We have also explained how the bill impacts reflect value for the network they use and the services they receive while being fair to current and future generations. This engagement will continue throughout and contribute to development of our plan.



16. We are ready and able to deliver

What you can find in this chapter

1. Our people are key to delivering our plans
2. Learning in T1 makes us fit for the future
3. Our flexible investment delivery model can deliver efficiently against an uncertain future
4. Risks and opportunities in delivery
5. We are taking a whole system approach to system access

We have a strong track record in delivering the outputs our customers want. And we are confident that we have the right plans in place to deliver this plan based on our experience and what we have learnt from the T1 period. Our people are key to delivering our plan. We have a highly skilled, engaged workforce which is encouraged to find better ways to deliver through innovative ways of working. We have long term plans to make sure we have a resilient, diverse, technically skilled and highly engaged workforce that is fit for the future.

We test our plans through regular deliverability checks as a standard part of our business planning processes and have mitigations in place to manage delivery risks. The checks we have made have acknowledged that whilst our business plan is an increase from the T1 period in some areas, it is deliverable.

Our flexible capital delivery model assures us that we can respond to the changing needs of customers that come with the changing energy landscape – it is resilient and adaptable to change. We introduced this model in the T1 period and it continues to be the most appropriate approach to manage uncertainty within our plans. We are confident that we can deliver work at the right time and in the most efficient way, delivering on our outputs, commitments and the consumer value that is expected.

We have a robust supply chain with access to a wide set of markets to buy the goods and services we need and are utilising existing approaches and strategies to deliver efficiently and on time to ensure we are delivering at lowest cost to consumers. We are already preparing ahead for

the start of the T2 period to ensure we have the contracts in place to deliver our outputs.

Increasingly, we will need to take a whole system approach to the way we approach system access needs. This requires greater collaboration across the industry to identify the most beneficial overall outcome for consumers. We propose a whole system optimisation approach and continue to collaborate across the industry with the Electricity System Operator (ESO), Distribution Network Operators (DNOs) and other Transmission Owners (TOs). This considers a whole system approach to system access to ensure we deliver the most optimal consumer outcomes.



1. Our people are key to delivering our plans

Our most important assets are undoubtedly our people because it is our people who create value for our customers and consumers. We have delivered our outputs in the T1 period through innovative designs and approaches for the benefit of consumers. Our success at delivering is built on our sustained ability to attract, recruit, train, motivate, and engage our people. We see workforce resilience as ensuring we have the right number of people, who have the right skills, a healthy mindset, work life balance, and reflecting the communities we serve over a long-term horizon.

We invest heavily in the development of our people to ensure that we have a technically skilled, inclusive and highly engaged workforce who are engaged in what we need to achieve, can thrive and feel enabled to deliver to the best of their abilities. The aim of which is to provide our business with the resilience it needs to deliver for consumers now and in the future. Our employee engagement has been at or near high performing norm levels in the T1 period; on key diversity metrics, we do better than the wider UK engineering sector. We know from our employee and industry stakeholders that we do well in engaging and motivating our people and are leading the industry with our skills training and our safety record.

However, we are not complacent as, like others in the sector, we face significant challenges. Entrants to Science, Technology, Engineering and Mathematics (STEM) careers (from which we would expect to replace our workforce) are becoming increasingly scarce. EU Skills predict a demand over the next decade of 221,000 STEM qualified entrants into the sector, to support the National Infrastructure Plan. In parallel, UK education system changes are having an impact on the number of people who pursue STEM careers. UCAS have reported a drop in university applications by 4.7% in 2017 and another 1% in 2018. At the same time, we are forecasting that 14% of our workforce will retire by the end of the T3 period, and we also expect non-retirement attrition to increase as fewer employees have pension benefits linked to length of service. We will need to work harder than ever to attract and retain people with the skills we need for the future. We also recognise our workforce does not yet represent the full diversity of the communities it serves.

To complement this chapter, we have also submitted annex NGET_A16.02 Workforce Planning. The following sections summarise our key areas of focus.

Workforce capacity

14% of our total workforce is set to retire by 2029 and for our critical roles this is higher at 19%. We forecast peak retirement from critical roles to be in the early years of the T3 period. Since 2016, we have invested in a strategic workforce planning capability. Each year, the team drives a process to forecast our workforce over a 10-year period so that we can understand how workforce changes and the future needs of the business will interact, helping us to plan to ensure we will have enough roles to run a safe and resilient electricity network in the future.

Our ability to deliver relies on the availability of suitably skilled people, particularly in critical roles such as Advanced Commissioning Engineers (ACEs), Senior Authorised Persons (SAPs), Power System Engineers and, with the increasing external threats, cyber expertise. We define the critical workforce as workers in our electrical maintenance & construction and engineering job groups. Out of 1,807 people within Electricity Transmission (excludes Capital Delivery headcount which is included in annex NGET_A14.05 How we contract and deliver efficiently), 1,408 are classified as critical workforce.

We are proposing to recruit and train approximately 165 people into our critical roles to replace retirees and leavers to maintain the resilience of our networks, contribute to the UK STEM talent pool and protect consumers from having to fund premium labour costs in the future. For cyber expertise, there is a challenge on resource competence and capability, as there are not currently enough of them in the market and other sectors are more competitive. We are currently undertaking a recruitment campaign; however, we may have to pay more to acquire this expertise.

We look to minimise the impact of retirement and attrition on our skills base by exploring alternative resourcing models, for example “gig” working for people who are approaching retirement, allowing them to continue working on a part-time basis so that our business can continue to benefit from their experience, mentoring and subject matter expertise. We will expand our current pilot which helps us keep in touch with ex-employees, providing an opportunity to bring skills back into the business within a shorter period than it typically takes to recruit and train up someone who is new to our business.

Workforce capability

We invest in our people because of the strong resulting business benefits, such as improved employee performance, improved morale and satisfaction, increased productivity and reduced employee turnover. In 2018/19, UK employees received an average of 5.3 days’ training. The



opportunity to learn and develop is a key strength in the eyes of our employees as we typically score 5% above the high performing norm in our employee engagement survey.

Our UK academy, based in Eakring, Nottinghamshire delivers operational training to our new and existing workforce. Ofsted have rated our academy 'Outstanding' for the past three inspections and we are the first UK provider of apprenticeships to achieve this milestone. Through our membership of Energy & Utility Skills (EU Skills) and the associated National Skills Academy for Power (NSAP), we collaborate with other networks and suppliers to raise the profile of the utilities sector as a key employer of talent in the UK and share best practice around training the skills needed in our industry.

All our employees are encouraged to have an annual development plan with focus on current role, future career aspirations and key business capabilities that are deemed critical to business performance now and in the future. In addition, strong effective leadership is integral to both individual and company success. We have a carefully defined set of customer-centric leadership qualities that we expect from our leaders, aligned to the purpose, vision and values of our business.

This year, we refreshed our STEM strategy to deliver more focused outcomes: working in the external environment to ensure there is a consistent pipeline of STEM qualified young people and internally ensuring we are attractive and recruit a diverse cohort from this pipeline into our business. We have rationalised the partnerships we sponsor, the key ones being with the Royal Academy of Engineering (RAE) where we have sponsored their "This is engineering" campaign to inform and engage young people in the opportunities offered by a career in engineering. We also partner with Energy and Utility Skills who work across utility companies to ensure a workforce for tomorrow. Additionally, partnering with Smallpiece Trust and Tomorrow's Engineers to deliver an ambition outreach for school STEM days and work experience opportunities.

Workforce culture and engagement

Culture is key to driving our plans forward because it promotes openness and debate, is part of doing good business and something we want to embed within our business. We have started this journey by embracing our values of 'do the right thing; and 'finding a better way'. 'Do the right thing' pulls together our foundational values of keeping each other and the public safe; complying with all the relevant rules, regulation, and policies, respecting our colleagues, customers and communities and saying what we think and challenging constructively. 'Find a better way' challenges us to focus on performance and continuous improvement.

Our board are passionate about this, we want to ensure our people are all driving in the same direction.

We listen to our people. The annual employee engagement survey (conducted by a third party) provides great insight into the areas we need to change and improve to help our people deliver to the best of their ability and have an enhanced sense of their wellbeing. The survey tracks different dimensions of engagement (the intent to perform) and enablement (the ability to perform) and helps us to compare with high performing companies and identify opportunities for improvement, as well as measuring whether we are improving over time. Our survey results show that our workforce engagement is consistently close to or above the high performing norm benchmark for other external organisations. It is from these results that targeted actions are driven out as initiatives – locally or at an enterprise level – to tackle any negative trends. We provide resources that allow action plans to be built and implemented – listening and then acting.

In our last survey, we scored particularly favourably on company values, aligning to company goals and proud to work here. However, we score more negatively on enablement, the barriers people face within their role, sometimes because of IT, tools or support issues. It is from these types of results that targeted actions are driven out as initiatives.

Our short-term bonus plans incentivise the delivery of financial, strategic and customer output measures and the demonstration of our leadership qualities and living our values; measures are subject to change to ensure we reflect the right focus on our priorities. There is a clear line of sight between individual performance and delivery of our business strategy. On an annual basis, every department within our business has a mandate to deliver a set of targets which are focused on what the business must deliver and how they deliver. These are monitored on a quarterly basis to ensure we are on track to deliver both in the short and longer term.

Workforce inclusion & diversity

We value inclusion and diversity as we know this stimulates new ways of working and innovation. There is significant evidence around the benefits of fostering diverse perspectives, such as improved creativity, innovation, problem solving, decision-making, attraction, engagement. In line with our value of 'Doing the right thing' we believe that focusing on improving workforce inclusion and diversity is ethically the right thing to do.

In the last year, we have been recognised as one of the Best UK Employers for Race by Business in the Community (BITC), Top UK Employers for Social Mobility, and The Times Top 50 Employers for Women. We have established Employee Resource Groups which recognise and celebrate people for their faith, race/ethnicity, sexual orientation and



gender. These groups provide valuable feedback that enables us to change policies or practices that serve to unlock the full potential of the workforce. Externally, we collaborate with Stonewall, the Business Disability Forum and Inclusive Employers.

We measure key diversity statistics and report these each year, alongside our financial performance, to be transparent about how our actions are impacting representation of diversity in our workforce. From 2017, we reported our gender pay gap; our latest UK wide data shows that our female employees were paid on average 4.4% less than males, this was significantly lower than the 15% gap reported on average across the utilities sector. Our latest diversity statistics show that here in National Grid (all functions) 13% of the workforce is female and 10% identify as being from Black, Asian and Minority Ethnic (BAME) background. This compares to the UK engineering sector which has under 10% female and 6% ethnic minority.

Our Chief Engineer, who is our diversity and STEM champion, has a stretching ambition to increase gender diversity in STEM and engineering disciplines. We have a multi-disciplined working group established to develop a proposal to achieve this ambition including sharing of best practice such as Royal Academy of Engineering (RAE), working with external organisations, and working much closer with schools and colleges to create a STEM pipeline much earlier.

Our diversity metrics show that we are performing better than the utility industry average, but we still have further to go to truly claim to reflect the communities we serve. We continue to champion our Employee Resource Groups, which have a pivotal role in supporting people with diverse experiences and raising the profile of different groups across our business, helping to attract diverse talent to come and work with us.

We now want to build on these solid foundational achievements, and in a recently established new I&D strategy we have reset our ambition: We will have an inclusive culture and diverse team which is more representative of the communities we serve. The ambition recognises that to date we have focused on diversity representation rather than inclusion and we now aim to be an inclusive employer to appeal to all current and future employees rather than solely focusing on specific diverse groups.

Workforce wellbeing

The wellbeing of our people is important to us, particularly as we operate in more uncertain times. Our immediate risk profile is mental wellbeing, musculoskeletal injury prevention and occupational health risk exposure mitigation. We provide all our

employees with access to a 24-hour employee assistance programme, offering emotional and practical support for work-related or personal issues. And we work with various government bodies on wellbeing, helping us to better understand what we can do to support the wellbeing of our own people, as well as supporting smaller organisations with their own efforts. We are aiming to:

1. Create and embed a culture that enables everyone to perform to the best of their abilities knowing they are cared for and can talk openly about their health and wellbeing.
2. Build a workforce where healthy, engaged and supportive employees can succeed and thrive.
3. Be recognised as an employer that leads in employee wellbeing and will enable us to attract and retain the best talent.

2. Learning in T1 makes us fit for the future

We have carried a deliverability assessment out on our plan, the full detail of which can be found in annex NGET_A16.01 Deliverability. This section covers our main challenges and how we are mitigating these. We also provide an overview of all the changes and efficient ways of working we have implemented in the T1 period that provides confidence that we can deliver our plan.

Planning and resourcing requirements

The annual strategic workforce planning is used within the business to ensure our plans are adequately resourced. Our planning processes have aimed to ensure an even mix of work volumes across each year and in each operational team, supporting deliverability of the plan from both a resource and procurement perspective, ensuring that there are no spikes in volumes that might cause a risk to deliverability. Our engineering resources are also mobile both zonally and nationally. We are forecasting an increase for OHL fittings, protection and control and Optel. We have shared our plans with the ESO and no material concerns have been raised on the plan volumes.

For OHL we have a nationally mobile delivery team to deliver volumes. We are mitigating risks through the new ways of working terms and conditions to maximise daylight working hours and contracting additional resource through our flexible delivery model. For protection and control, more than 90% of the planned works are identified as low or medium complexity for which we have the skillsets and experience. If you look at this work in isolation, we estimate that that we will require 20% more commissioning engineering availability. We have plans in place to address the shortfall through the utilisation of new strategies, optimal bundling of works and alignment of workload. We also have plans to internally grow our commissioning resource.



To deliver the portfolio of Optel works, as well as elements for increased portfolios of protection and cyber works we have calculated we will require an additional 9 telecoms engineers. These are skilled roles, in a competitive market. We have ongoing training and recruitments plans. Other options to meet the shortfall include, training-up of suitable electrically qualified craft-fitters from wider substation resource pool, use of contract staff or partnerships with external telecoms companies.

Our remuneration offering for Cyber professionals is currently below market median in the UK and our approach for recruiting into these roles primarily uses graduate entry and development of existing IT and engineering employees into cyber roles, supplemented by external hire for specific skill-sets (such as risk and vulnerability management). We also have some flexibility to leverage our US resource and potentially outsource some activities. Within ET, cyber resource increases from 14 in 2021 to 25 in 2025 with a focus on operational technology. Roles will be embedded within the existing organisation and filled by developing operations and engineering staff into cyber roles, with clear career pathways put in place to support succession and retention. We are also collaborating across the utility and oil and gas sectors to explore options to address the shortfall in cyber professionals.

Organisational design

In 2018, we made changes to our organisational structure through the PEx (Performance Excellence) Value project. This was a bottom-up review of our business that focused on where we could deliver value for customers, drive efficiencies on all activities and build a structure to deliver in an efficient manner. It put the customer at the heart of our business, to increase the capacity and efficiency of our work delivery. This puts solid foundations in place providing the required level of resource and capability to deliver our plan.

Reduced system access

With the constraints on system access, we have identified ways of optimising our plan to reduce the level of system access required. We have introduced new systems such as Single View of the Plan (SVOP) which provides visibility of all the work being delivered and creates cohesion across the organisation. We have also been identifying the most efficient bundles of works to decrease the overall volume of system access requirements and optimal intervention timescales to ensure we deliver all the works planned. By looking across the T2 period, this has enabled us to identify opportunities to optimise the plan, reduce total outage requirements and minimise the likelihood of non-delivery. We have engaged our operational teams to review the work packages to ensure that the practicalities of multiple works on site are achievable. We have provided the following case study.

Work bundling case study: Amersham – Iver – East Claydon

There are 20 assets on this circuit that need interventions during the T2 period. By reviewing the work requirements at each site across the T2 period, we identified 13 asset interventions that could be bundled into a single outage, reducing the outage requirement from 54 weeks to 16 weeks (70% reduction), enabling delivery of the works within a single outage season. This improves efficiency by reducing mobilisation time, and reducing contractor and outage management costs.

	← Outage Weeks →					
	Transformer Replacement					
Iver	Bay Refurbishment	Bay Refurbishment	CT/VT	CT/VT		
Amersham	Bay Refurbishment	Bay Refurbishment	Bay Refurbishment	CT/VT	CT/VT	
East Claydon	Bay Refurbishment	CT/VT				

Focus on operational productivity

Improving our productivity creates value for consumers by increasing our outputs for the same cost or delivering the same output at a reduced cost. We have focused on identifying initiatives that support our operational teams to drive performance. These include best practice initiatives reducing the variation in our standard job types. We have also introduced a new project lead role that will release ~60% of engineering resource time from non-engineering maintenance activities thereby providing the additional engineering resource required to deliver our T2 plan. We have also introduced new systems, such as Tableau, to drive performance.

New ways of working

This year, changes were made to our operational team’s terms and conditions. The new ways of working agreement includes a seasonal stagger allowing for a 9.5 hour working day during the busy summer period to take advantage of extended daylight working hours. This increases the number of productive working hours.

3. Our flexible investment delivery model can deliver efficiently against an uncertain future

Whilst we have established a baseline investment plan for the T2 period, there remains significant uncertainty in the need for capital investments driven by the needs of our customers, network reinforcements driven by the ESO’s annual Network Options Assessment (NOA) process and potentially new investments required to achieve net zero as pathways become clear. Therefore, adopting an efficient but flexible capital delivery model and a robust supply chain is key to delivering what our customers need from us.

Our investment portfolio is hugely varied, comprising strategic investment programmes, such as London Power Tunnels and Hinkley Point C connection project,



major construction projects, to reinforce and upgrade the network, as well as smaller and single asset capital investment projects.

Our flexible investment delivery model is therefore designed to have a flexible **contracting model**, flexible **operating model and resourcing** approach and robust processes for managing change. We also have a **robust supply chain** through which we procure goods and services. We have applied learning from the T1 period on achieving a balance between flexibility and securing delivery capacity. We have moved towards framework contracts comprising equipment supply only, equipment installation and a combined supply and install option which gives access to both capacity and competitively tendered rates.

Our contracting model and approach to resourcing allows us to be flexible

The flexibility of our contracting model allows us to ramp up and ramp down the work we allocate to contractors depending on customer need and means we can respond when our customers need us to. We have established a suite of competitively-tendered, multiple-tier frameworks to ensure fit-for-purpose contracting across all sizes of project. These flexible frameworks are designed to enable a blend of purchasing options to match the different delivery and programme requirements of our projects.

The frameworks comprise both equipment supply, install only and supply and install options, facilitating a flexible approach to meet the requirements of each project and deliver value. The frameworks are awarded to ensure that we contract with a portfolio of suppliers that can be flexible to meet our needs if customer workload increases. There is, however, no promise of work in these frameworks, this protects consumers if the level of capital investment reduces. We are working with many suppliers as shown in the diagram (in the inner, darker-green ellipse) and are exploring working with others for the T2 period (as shown in the outer, pale-green ellipse). This is on a supply and install basis firstly, and secondly as equipment suppliers or installation contractors (see figure 16.1 and 16.2 below).

Figure 16.1 Equipment constructors

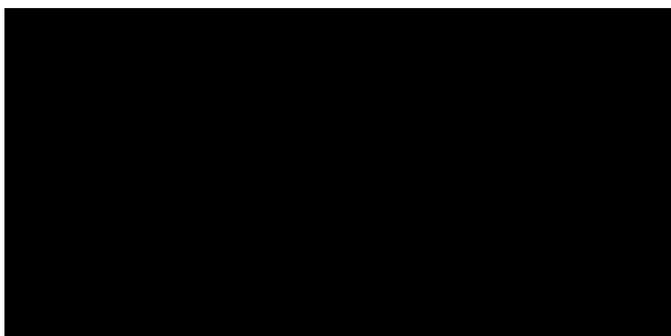
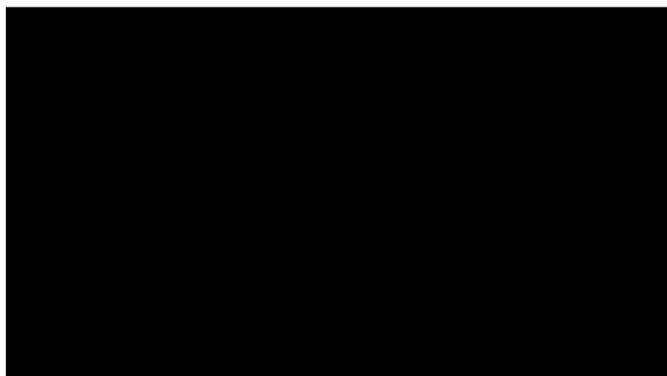


Figure 16.2 Equipment suppliers (and installation)



Flexible operating model and resourcing approach

Major projects, such as the Hinkley project have a dedicated team of resources who can navigate the challenges of getting the relevant consents for the project, co-ordinate multiple contractors during construction to deliver a multi-year programme.

Electricity construction function – during the T1 period we implemented a structure that allocated delivery accountabilities regionally. This enables more local decision-making to support delivery for our customers.

Operations – our field force can deliver small capital projects alongside maintenance, repairs and network events. These types of projects include single asset replacements such as instrument transformers, targeted replacement of overhead line fittings, replacement and refurbishment of circuit breakers.

In deciding which of these routes is the most optimum way to deliver our capital plan, we consider resource availability, capability and lowest cost.

For the flexibility in our operating model, we look to ensure we have the right skilled individuals. Our aim is to be efficient whilst maintaining the flexibility needed. We have managed to achieve this during the T1 period by maintaining a workload/FTE ratio that is within the expected capital industry sector benchmark. There is not a simple correlation between workload and headcount. This is because we may retain a higher ratio than workload would indicate in some years in order that we can develop and then deliver the following years' volumes, due to the long lead times associated with managing capital projects. Some projects also have different project management requirements. Whilst we use contingent labour to smooth peaks in resource demand, there is still a lead time involved with recruiting specialist skilled resource. We plan our resourcing strategy to ensure that we are not a distressed buyer when works increase as this can result in higher costs.



Our optimal regional delivery structure ensures that we do not employ a “one size fits all solution”, however, the delivery approach to low total value, high volumes schemes needs to be considered. The need to manage these small (such as asset replacement), complex projects and still comply with the necessary statutory and regulatory requirements means that the percentage of cost that is linked to delivery costs changes when undertaking a greater proportion of smaller projects.

We have seen an increase in smaller projects through the T1 period which, although smaller in financial value, still have complexity in the engineering and delivery. The trend of the number of smaller projects being the larger proportion of the total capital delivery annual workload is forecast to continue during the T2 period. We have built core construction teams with the necessary skills that can be transferred to manage variability across the regions and commodity types.

Our core employees are complemented with skilled contractors. We have found utilising contractors is a cost-efficient way of managing the variability in the work plan as we can increase and decrease as the workload requires. Although contractors may attract a higher day rate than permanent employees, the costs of recruiting, the ongoing pension costs, sick pay, holiday pay and the potential costs of reassignment/redundancy if there is a reduction in workload means that for peaks in workload, the use of contractors is more economic than appointing permanent employees. This is particularly true for skills we need on a non-enduring basis such as tunnel supervisors that we only need when we undertake infrequent activities.

Using both core employees and contractors, we look to keep our resource broadly in line with the capital plan and can respond quickly if there is an upturn or downturn in customer demand, which allows us to remain efficient and flexible. Whilst we have covered the core elements of our delivery model, you can read further details in annex NGET_A14.05 How we contract and deliver efficiently.

We have a robust, competitive supply chain

Access to a wide market of goods and services is vital in ensuring we can deliver on time and within our forecasted expenditure. We are confident that we have robust processes, strategies and contracts in place that demonstrate we are ready and able to deliver. Our procurement lifecycle has three parts: category strategy framework, strategic sourcing process and contract management.

During the T1 period, our procurement function adopted a more strategic approach through a category strategy framework developing category strategies for the majority of expenditure. The framework

commences with scoping the opportunity and is monitored through to its implementation in a series of stages, which ensure all the value opportunities are sufficiently considered and executed through the strategic sourcing and contract management process.

Annex NGET_A14.06 Delivering competitive value through procurement includes details on our global procurement function and the strategies that enable us to deliver value. Our procurement team undertakes category strategy, strategic sourcing and contract management. One of the key changes we made is in restructuring our global procurement function to drive additional value. We created a global team to identify and develop strategies with global synergy to explore:

- market supplier development opportunities which involved working with the businesses and identify and pursue new supplier opportunities more quickly, enabling us to lower costs whilst ensuring we meet the business needs; and
- supplier relationship management, to use the scale of our collective spend to leverage greater opportunities from key suppliers, improving access to innovation or joint development of products and services.

Significant developments have been made during the T1 period and bring benefit to how we will deliver for the T2 period. These include:

- Development of a capable supplier pool at multiple tiers with direct access to all market disciplines to ensure a ‘fit for purpose’ approach.
- Intelligent contracting that seeks to ensure a tailored efficient delivery approach on a project by project basis by utilising flexible frameworks to enable a blend of call-off options from full competitive tendering, ‘best for task’ and direct allocation to match the delivery and programme requirements of our projects.
- Development of our in-house capability in procurement, estimating, risk management, contract management and project management disciplines.
- Development of forecast driven sourcing plans to inform the supply chain and identify opportunities such as bundling packages of work.

We are preparing for the T2 period by undertaking a series of competitive procurement events, with contract awards expected by the end of 2020. Our contract strategy is designed to be sufficiently flexible to deliver the business plan as it evolves through the challenge and review process, whilst delivering value to the end consumer through application of our key contracting principles. One element to this is the profiling of our workbook to realise efficiencies from the supply chain. The indicative contract award timeframes permit the detailed design works for our projects in time for the build works commencing Spring 2021.



4. Risks and opportunities in delivery

Managing a portfolio of major and small capital investment infrastructure projects with multi-year timelines, changing requirements and complex challenges comes with inherent uncertainties that have the potential to affect cost, schedule and quality. These uncertainties (such as obtaining specialist resources, working next to and around a live network, working in major conurbations and changing customer requirements) drive changes in the workplan. When managing the variability inherent within the plan, we ensure we have a flexible contract model; flexible overall operating model and resourcing approach (all of which we have covered earlier in this chapter); the final aspect is robust processes for managing change.

Robust processes for managing change

Change driven by external factors, such as customer requirements changing, and other events, such as weather or system constraints, have the potential to cause delays and drive additional costs on our projects. To guard against these changes impacting the overall deliverability of our plans, we operate a change control process via the project controls function. The change control process provides the following benefits:

- The programme cannot be changed without going through this process, meaning we get early visibility of issues raised, allowing for timely discussions on potential impacts of change and options to mitigate.
- We get visibility of the issues that are happening on our projects and can prioritise across the whole portfolio to make the best overall decisions.
- These change requests are key inputs into our lessons learnt. We can review the planning and execution of projects, increasing the chances of a positive outcome the next time we undertake a similar project.

Identifying risks and opportunities

We have enhanced our approach by identifying risk earlier in the process, allocating them to the party best placed to manage or mitigate each risk (normally NGET, the main contractor, or the equipment supplier). This enables us to reduce the level of contingency cost across our portfolio of projects, whilst protecting customers and consumers from the potential cost of unforeseen events happening during delivery. In addition, forecast driven sourcing brings a more strategic, forward looking view. It seeks to extract best value from project delivery through:

- early assessment of supplier market capacity and capability
- bundling works by site, region, year for more efficient delivery
- identification of potential innovation through early contractor involvement

- focus on lean asset design, such as the delivery of protection and control equipment with a reduced outage period
- developing and trialling a range of alternative approaches to delivering our projects with a view to reducing delivery times and costs, such as time lapse video trials that monitored and analysed productive time on circuit breaker replacement projects.

5. We are taking a whole system approach to system access

System access is one of the major constraints we have in delivering our plans. We have less control over this as it involves a range of interfaces with the ESO, DNOs and directly connected customers. We are taking a whole system approach (see annex NGET_A7-8.03 Whole systems) and have been collaborating across the industry. For our deliverability assessments with the ESO, we have participated in Joint Planning Committee Operational Assessments (JPCOA). These look at cross party collaboration and co-ordination of outages in conjunction with the ESO. We apply the Network Access Policy (NAP) and share learnings in the NAP forum across all TO's and the ESO which promotes better future planning of outages. Internally to England and Wales we have promoted closer stakeholder relationships across NGET and the NGESO through regular liaison meetings over and above the normal operational requirements.

We have shared our plans with the ESO and no material concerns on the volume or deliverability of our plan have been raised. This allows productive conversations about the larger operability challenges. We have engaged on and are proposing to make a step change through an interface optimisation mechanism to provide the ESO with TO services they can market test to minimise the cost of the transition for consumers. The detail of this mechanism can be found in chapter 7 *We will enable the ongoing transition to the energy system of the future*.

We have shared details of our plans with the DNOs to understand their limitations and network challenges related to our work and, subject to specific preference of each DNO. We have received positive feedback and no material concerns have been raised. We are exploring closer working relationships with the DNOs to improve the chance of success and limit stakeholder impacts. Further engagement is planned with them over November and December 2019 to share more details and gather feedback on our plan.

We are tailoring our approach with our stakeholders and customers to get the best mutual outcome and to work efficiently to each company's needs. Further detail can be found in annex NGET_A16.01 Deliverability.

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