Annex 4.5
Socialisation of Costs: Access SCR and Net Zero Service Upgrades

Northern Powergrid: our business plan 2023-28

Contents

This annex sets out our view of how policy changes in respect of connection charges (as a result of the Access Significant Code Review (SCR) minded to position) and charges related to the socialisation of net zero costs related to service upgrades may impact our costs over the next five years. It is split into two parts; Part A – Access SCR and Part B – Net Zero Service Upgrades.

Part A - Access SCR

The Access SCR decision has the potential to significantly impact the volume, type and location of connections, and in turn, the amount of network reinforcement triggered.

In June 2021, Ofgem published a consultation on its minded to position on the Access and Forward-looking Charges Significant Code review ('Access SCR').[1] The aim of Ofgem's review and of any potential reforms to the charging rules has been to encourage optimal investment in the generation mix in reaching net zero. We do not believe the proposals will be good for customers as they remove price signals that help direct connections towards areas of our network where there is already capacity available. Removing these signals will lead to an inefficient system.

The scope of the Access SCR broadly includes a review of:

- the distribution connection charging boundary;
- the definition and choice of access rights for transmission and distribution users;
- Distribution Use of System (DUoS) charges; and
- Transmission Network Use of System (TNUoS) charges.

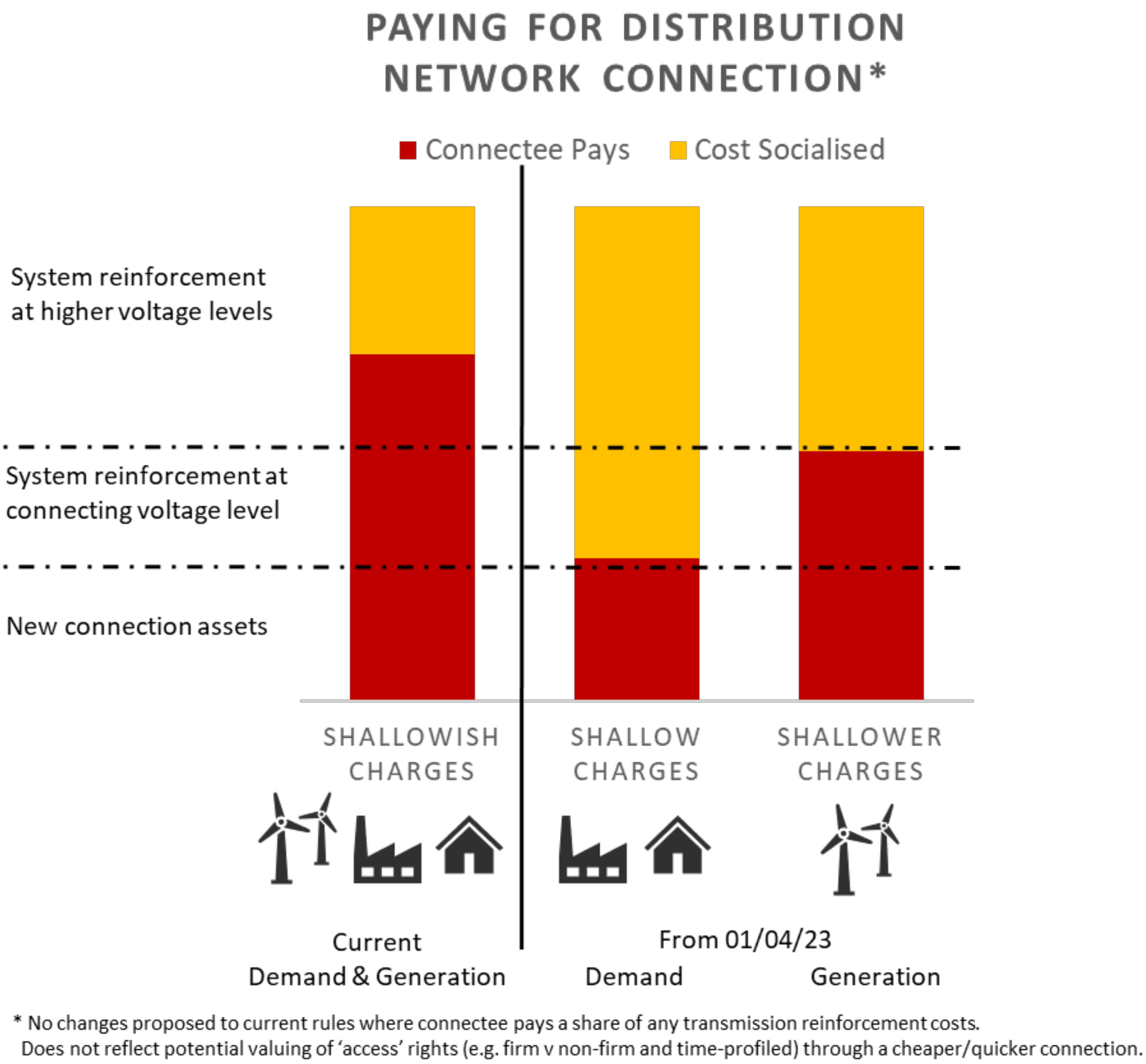
This annex focusses on the first of these aspects of the review, regarding the distribution connection charging boundary.

Under the current charging arrangements, both demand and generation customers face 'shallowish' charges, contributing to the cost of any reinforcement needed for a new connection at both the voltage level at which they are connecting, as well as at one voltage level up.

Ofgem's minded to position has proposed the following changes with respect to distribution network connection charges, applicable from April 2023:

- Demand customers will face 'shallow' charges – they will no longer contribute to reinforcement costs for new connections, i.e. the costs for reinforcement will become fully DUoS funded. This will apply to any reinforcement required at the voltage level at which demand is connecting, as well as at one voltage level up.
- Generation customers will face 'shallower' charges – they will continue to contribute to reinforcement costs for new connections at the voltage level at which they connect. They will however no longer contribute to any costs of reinforcement required at one voltage level up.

[1] https://www.ofgem.gov.uk/sites/default/files/2021-06/%281%29%20Ofgem%20Access%20SCR%20-%20Consultation%20on%20Minded%20to%20Positions.pdf



Source: Northern Powergrid, based on Ofgem Access SCR minded to position consultation

Ofgem's proposals on connection charges will impact Northern Powergrid's reinforcement costs in two ways:

- First, they will have a mechanistic impact whereby the proportion of reinforcement costs that was previously expected to be customer-funded will now be funded by Northern Powergrid (either in full or in part, as described).
- Second, they will impact customer behaviour, due to the reduction in the overall cost of connecting to the network and the dampening of a locational signal. Specifically, we would expect this behavioural impact to lead to an increased volume of connections, an increased average size of connections and some shifting of connections into more congested areas with greater reinforcement requirements.

We have assessed the potential impact of the Access SCR minded to position, in line with Ofgem's business plan requirements

Ofgem's BPDT guidance requires distribution network operators (DNOs) to submit three types of SCR impact forecast – a Low, High and 'Best View' estimate – to reflect the combined materiality of the expected impacts of the Access SCR minded to position. We have followed this guidance to develop the following three scenarios:

- Low SCR Impact – This reflects our view on the lowest credible impact of the Access SCR decision.
- Best View SCR Impact – This reflects our best view of the expected impacts of the Access SCR decision.
- High SCR Impact – This reflects our view on the highest credible impact of the Access SCR decision.

To inform these scenarios we have analysed available historical connection application data to draw any possible inferences about how future behaviour may change based on evidence of past behaviour.

However, we note that this analysis has proven challenging:

- First, the flow of connections triggering reinforcement over time has been relatively small, but even a single large connection can trigger material reinforcement cost in some cases. As a result, reinforcement costs triggered by new connections have been volatile in our data, dependent on the specifics of the portfolio of connections made.
- Second, our aim was to use historical data to assess past behaviour, in order to understand how sensitive customers are to costs and project this behaviour forward under the proposed charging rules. However, it is possible that the historical behaviour we observe could change under the proposed charging rules, and this could be further exacerbated if some developers choose to hold projects back until the rules change. There is no good way to predict the extent of these changes.

For these reasons, any inferences we have made can only be considered broadly indicative of potential future costs. The impact could be even greater than we have set out under High SCR Impact view.

This annex presents our analysis and findings on the potential impact of the Access SCR minded to position.In it, we present the analysis that we have carried out to estimate the materiality of the impact that we expect the Access SCR minded to position to have on the reinforcement costs that are funded through the DUoS charge.

The remainder of this annex is structured as follows:

- first, we set out our high-level approach to assessing the potential impacts of the Access SCR decision;
- we then present the results of this analysis; and
- finally, we summarise the key outputs of the analysis and our conclusions on the need for an uncertainty mechanism.

Overview of our approach

We have adopted a three-step process to assessing the potential impacts of the Access SCR decision.

In order to attempt to quantify the potential impacts of the Access SCR minded to position, we have used a three-stage methodology. We started with a baseline forecast of reinforcement costs, and then made the following three adjustments to reflect different potential 'impacts':

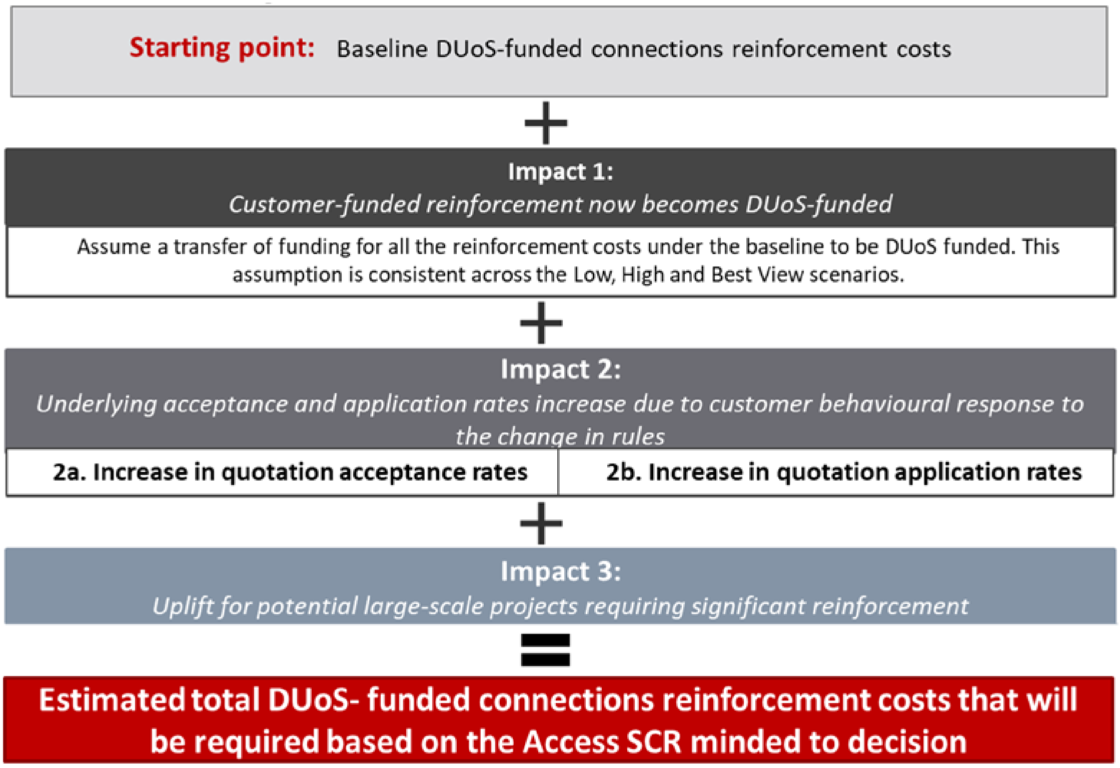
a) **Impact 1** - Reinforcement costs that were previously expected to be customer funded will now be funded by the DNO, leading to a mechanistic increase in expected reinforcement costs for Northern Powergrid.

b) **Impact 2** - We have analysed available historical data on connection applications to attempt to infer to what extent customers' behaviours may change in response to the Access SCR proposals. Specifically, we have attempted to infer scaling factors that we can apply to the baseline reinforcement cost forecasts:

- An increase in the rate of *acceptance for connections* quotations relative to historical levels. We would expect that all else being equal, customers who apply for connections will be more willing to accept quotes for connections, particularly in areas with higher reinforcement costs, given that they will no longer bear these costs.

- An increase in the rate of *applications for connections* quotations relative to historical levels. We would expect that all else being equal, Northern Powergrid will receive more connection applications, particularly in more congested areas with higher reinforcement costs given that customers will no longer bear these costs.

c) **Impact 3** - We have also attempted to quantify the potential impact of new large-scale connections that would not previously have connected in congested areas due to cost signals, but could now drive significant levels of reinforcement.



In applying this approach, our analysis has relied on the following information:

- Our baseline forecasts of connection costs over 2023-28, based on expected run rates as set out in our costs in detail
- Historical data on application for connections quotes, and acceptances of those quotes by customers over the period 2015-2021. Our historical dataset is derived from our internal quote management system, which records all formal quotation requests that we receive. It does not capture any informal discussions that we might have with customers prior to them submitting a quotation request and therefore does not necessarily fully capture a customer's behaviours or decision process. The dataset includes information on the location of the requested connection, whether the application came from a demand or generation customer, whether it was at the LV, HV or EHV voltage level, the quote given, and whether the customer accepted or rejected the quote.
- Case studies on the potential impact of new large-scale connections.
- Stakeholder engagement with medium and large scale connections customers.

For our analysis of the impacts of Access SCR, we have distinguished between the following customer groups. This allows us (to the extent possible based on the data available) to isolate and capture any differences in the behaviour of different groups of customers. For example, we might expect a generator to be more flexible with regard to its location to avoid high connection costs than a commercial load such as a supermarket, where other product market conditions may be more important than minimising network costs to the final investment decision.

- LV Demand
- HV Demand
- EHV Demand
- LV Generation
- HV Generation
- EHV Generation

We discuss our approach to assessing and forecasting each of the three potential impacts identified in turn below.

Impact 1: Customer-funded reinforcement will become DUoS funded

We have used our baseline estimates for connections reinforcement costs (as set out in our costs in detail) as the starting point for our analysis. This includes both customer-funded and DUoS-funded reinforcement.

We then assume a simple transfer of the reinforcement costs previously expected to be funded by customers, to now be funded by Northern Powergrid through DUoS, reflecting the revised charging rules.

This step is consistent across the Low, Best View and High scenarios.

Impact 2: Underlying acceptance and applications rates increase due to customer behavioural responses to the change in rules

Before explaining our analysis, it is important to note that there are some limitations in the data that limit our ability to fully isolate the reinforcement costs as a driver of customers' decisions to apply for and accept connections quotations across our network:

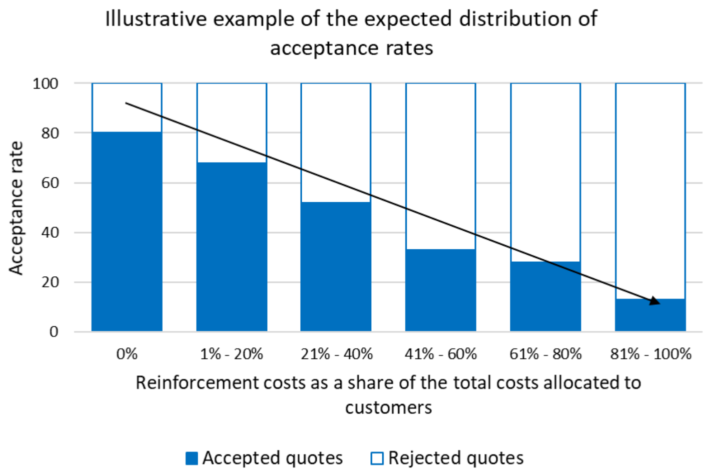
- The analysis relies on historical data and therefore it reflects current drivers of customer behaviour. However, customer behaviour is expected to change in response to the new rules and therefore past behaviour may only partially inform how customers might be expected to respond to the proposed charging rule changes.
- The historical dataset does not capture more informal discussions with customers prior to them submitting a formal application. These conversations are not recorded in Northern Powergrid's application data and therefore the dataset is not able to capture the full range of customer behavioural responses.
- The dataset is limited by small sample sizes when cutting the data across demand and generation customers, and across different voltage levels. The sample of projects triggering large-scale reinforcement in the historical data is also small, limiting the amount of relevant information we can rely on.
- In addition to the introduction of the application fee mentioned above, the historical data also captures the effects of other factors which we are not able to isolate, such as the impact of Covid-19 in the most recent data, but also other policy changes, such as the reduction to subsidies for solar generation.
- Prevalence of reinforcement in the historical data may not reflect future prevalence of reinforcement if DNO networks are becoming increasingly capacity constrained.
- A decision for different types of customers to connect will be driven by a wealth of factors, not just reinforcement cost. These factors cannot be fully identified or isolated within the available dataset and we are therefore not able to control from these.

Impact 3: An increase in quote acceptance rates due to customer behavioural response

We carried out analysis using our historical dataset on connection applications, to attempt to infer how acceptance rates might be impacted by a change in the reinforcement costs faced by customers. We carried out this analysis in two steps.

First, we assessed whether the data shows a relationship between the proportion of reinforcement costs included within quotations, and the resulting acceptance rates. We would expect acceptance rates to be lower in cases where the proportion of reinforcement costs is higher.

In testing this, we first calculated reinforcement costs as a share of the total quotation[2] (which also includes the costs of installing the connection assets) and categorised the connection applications into bands based on these shares (see illustrative example below). We then looked at the acceptance rates of quotes in each of these cost bands, to determine whether acceptance rates declined as the share of reinforcement costs increased, as we would expect.



[2] We assessed this as a share of total costs rather than the absolute level of reinforcement costs as this allowed us to focus on how relevant reinforcement costs are with respect to the total connection costs allocated to the customer.

Assuming that the above pattern holds, one potential impact of the Access SCR proposals (in removing most reinforcement costs for customers) would be to increase all quotation acceptance rates in line with those observed for quotes with zero reinforcement costs.

Based on this expectation, we took two approaches to estimate the potential impact of the Access SCR proposals on acceptance rates under Low, High and Best View scenarios:

Under the first approach, we assumed that under the proposed charging rules, the acceptance rate of quotes with non-zero reinforcement costs would change to match the acceptance rate of quotes with zero reinforcement costs; and

Under the second approach, we first calculated the average between the acceptance rate of quotes triggering reinforcement costs and the acceptance rate of quotes without reinforcement costs. Then, we assumed that under the proposed charging rules, this average acceptance rate would change to match the acceptance rate of quotes with zero reinforcement costs.

It is worth noting that in 2018, we introduced a fee for connection quotations. We expect that this would have impacted customers' behaviour, such that customers are less inclined to submit 'speculative' applications following the introduction of the fee. This has resulted in a reduction in application numbers received since 2018 (see Figure 1).

We would expect that quotes recorded from 2018 onwards are more likely to be from customers highly motivated to connect, and potentially with a good prior understanding of the costs they expect to face. Their decisions to accept or reject quotes are therefore more likely to be driven by elements other than reinforcement costs. For this reason, we have focused our analysis on quotes submitted between 2015 and 2017 (before the introduction of the quotation fee) to avoid confounding the impact of the quotation fee with other potential drivers of customer behaviour.

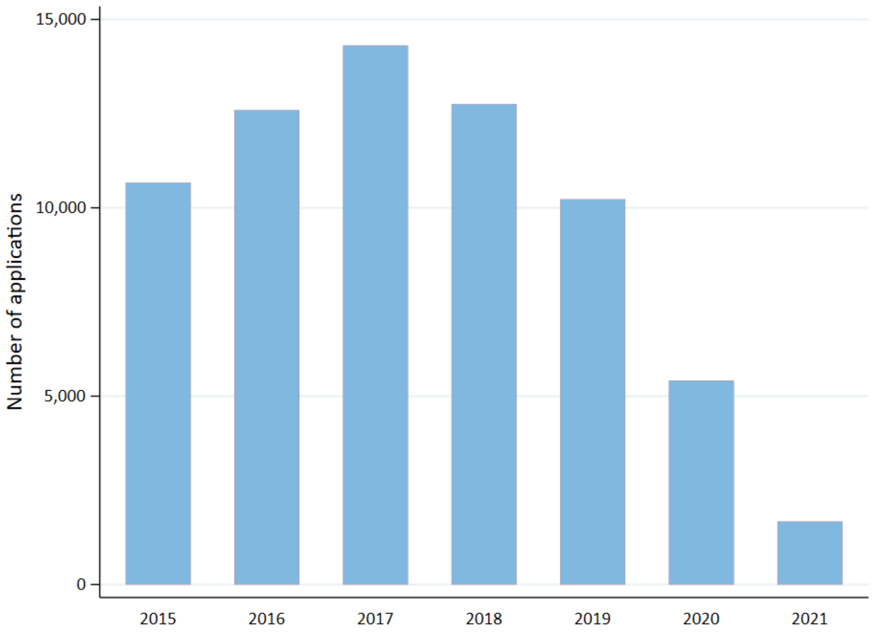


Figure 1: Total connections quote applications, 2015-2021

Source: Northern Powergrid historical data (note: 2021 data only contains the quotes submitted before 30 March 2021)

Lastly, as mentioned, the historical data on which we based this analysis has some limitations that should be taken into consideration. In particular, this dataset does not capture more informal conversations that customers have with Northern Powergrid before deciding to submit a quote as well as the many other drivers that affect a customer's decision to accept the connection quote they receive.

An increase in quote application rates due to customer behavioural response

We analysed the available historical data on connection applications, to attempt to infer how the application rate for quotations might be affected by a change in the reinforcement costs faced by customers. In particular we focused on how application rates might increase in areas that are constrained i.e. where customers currently face reinforcement costs, but would face less of these costs in future.

Our approach was to assess the historical rate of applications in more constrained versus less constrained areas of the network, to determine whether (and by how much) the application rate is lower in more constrained areas (since customers will anticipate that they will face higher reinforcement costs in those areas). If this holds, we could then infer that application rates in constrained areas may increase once customers no longer face reinforcement costs.

The first step of our analysis was to determine, for each connection application, the level of network congestion at the connection location. Our connections dataset includes the postcode of each connection application. We therefore needed to match each postcode to information about network congestion.

We make available to customers up-to-date 'heat maps' on the HV and EHV networks that show how congested different parts of the network are, and therefore whether a connection at a specific location is likely to trigger any reinforcement. Customers are able to view this information, and use it to help decide whether to connect on a particular part of the network.[3]

While such heat maps provide a useful tool for understanding the level of congestion (and therefore the level of reinforcement that may be required for new connections) on different parts of the network, we have not been able to rely on this data in carrying out our analysis for the following reasons:

- Heat map data is only available for the HV and EHV networks, and therefore cannot be used to analyse the impacts on customer behaviours on the LV network.
- In carrying out the analysis, we require postcode-level data to be able to map connection applications at specific sites to specific areas on the heat maps. However, postcode level data is not available in the heat maps dataset.

Given this, we instead attempted to find a proxy for network congestion based on information in our connections dataset. We did this in two steps.

- First, we grouped connection applications by location, based on the outward code (the first part of the postcode) of each application.
- Within each location, we calculated the share of quotes in that area that triggered reinforcement costs. Based on this share, we categorised each network location as follows:
  - White: Areas in which no quotes triggered reinforcement;
  - Green: Areas in which less than 25% of all quotes triggered reinforcement;
  - Amber: Areas in which 25% to 50% of quotes triggered reinforcement;
  - Red: Areas in which 50% to 75% of quotes triggered reinforcement; and
  - Black: Areas in which more than 75% of quotes triggered reinforcement costs.

Once that we could match each connection application to a congestion level, the second step of our analysis was to determine whether fewer applications were made in more congested areas. To address issues around sample size and to

[3] While this information is not available on the LV network, customers are still able to contact us for information on the level of congestion in the area they are interested in connecting to understand whether any reinforcement may be required

simplify the results, we aggregated the congestion categorisations above to define just two areas, a more congested and less congested area. We did this in two ways to test the sensitivity of our results: first using a threshold of 25% of quotes triggering reinforcement (where areas above this threshold are defined as more congested, and areas below are less congested), and second using a threshold of 50% (as set out below).

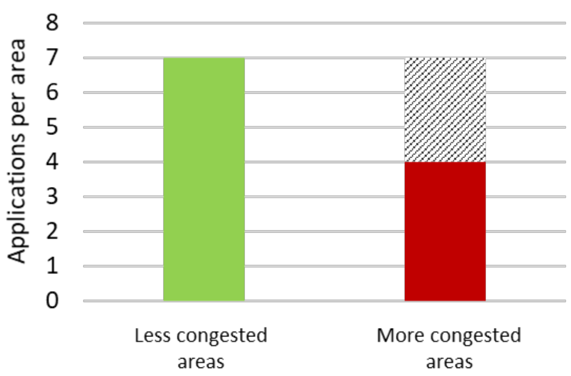
	25% cut-off	50% cut-off
No applications triggered reinforcement costs	Less congested areas	Less congested areas
Less than 25% of applications triggered reinforcement costs		
25% - 50% of applications triggered reinforcement costs	More congested areas	
50% - 75% of applications triggered reinforcement costs		Less congested areas
More than 75% of applications triggered reinforcement costs		

Finally, assuming that we do observe fewer applications in more congested areas, we further assumed that under the proposed Access SCR charging rules, this gap in application rates would close. I.e. because they no longer face reinforcement costs, customers will no longer avoid applying in more congested areas, and application rates in different areas will equalise.[4]

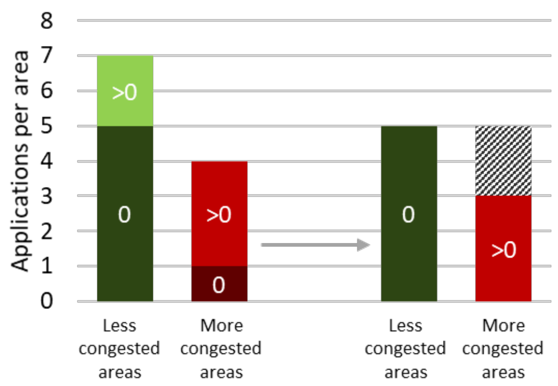
We used this approach to develop our Low, Best View and High scenarios of the Access SCR impact. To improve the reliability of our results, we applied two different approaches to equalising application rates:

- Under the first approach, we assumed that we would expect that under the proposed changes to the charging rules, customers would become indifferent between applying in different areas based on the level of reinforcement required (i.e. on the level of congestion), and therefore the application rates in more congested areas would increase to equal the current application rate in less congested areas (increase represented by the grey area in the figure below).
- Given that less congested areas include some quotes with non-zero reinforcement costs and more congested areas include some quotes that did not trigger reinforcement costs, we recognised that customers may however continue to choose to locate in similar locations as before. Under the second approach, we therefore assessed the application rates of non-zero reinforcement quotes in more congested areas and the application rate of zero reinforcement quotes in less congested areas. In particular, we assumed that under the proposed charging rules, the application rates in the former group would increase to equal to those in the latter. This is illustrated in the second chart below.

Approach 1



Approach 2



[4] To conduct this analysis we look at the average number of applications per area rather than the total number of applications made in each of group of areas as this is a comparable metric and allows to control for the size of each category.

Impact 3: An increase in the number of large-scale connection requests in congested areas that require significant reinforcement costs

We have attempted to quantify the impact of new large-scale connections that would not previously have connected in congested areas due to cost signals, but could now drive significant levels of reinforcement.

We therefore layered on a further adjustment to account for the impact of these new types of connections. We developed the following three case studies to form a view of the potential reinforcement costs where, due to the lack of cost signal as a result of the Access SCR, customers may apply for connections which would have otherwise potentially been uneconomic:

- **New EHV generator** – A developer wants to connect a 49.9MW solar farm at 66kV to Driffield supply point. The site is close to the supply point and would have sole use costs of approximately £2.5m. This would trigger a £35m upstream reinforcement to create a second 132kV feeder from Creyke Beck GSP.

- **New HV demand** – A customer wishes to connect a 200kVA EV charger at Oughterslaw in the Yorkshire Dales. The customer would contribute £25k for a new pole mounted transformer to connect to the existing line. This would trigger a P2 HV reinforcement scheme on the existing HV infeed and would require 19km of new HV cable costing £2.9m.

- **Existing customers with an existing active network management (ANM) connection request 'firm access'** – The existing generation customers on our distribution ANM schemes request firm access (non-constrained) following the rule changes. This triggers significant upstream EHV and 132kV reinforcement at Roos, Seal Sands and Driffield with a total reinforcement cost of £102m. The existing customers would not fund any of the reinforcement.

In each of the case studies, customers would previously have borne a significant proportion of the reinforcement costs and would have likely made the projects unviable. In the case of ANM customers, the efficient response was to accept a more limited connection which the existing network could provide at much lower costs – helping to make the project viable or more profitable (because the project itself doesn't justify the firm access network costs). Under the proposed charging rule changes, the full cost of reinforcement will be DUoS funded, representing a significant cost reduction for connecting parties.

We applied different combinations of these case studies in our Low, High and Best View scenarios.

Based on this approach, we have attempted to quantify the potential impacts of the Access SCR under our Low, Best View and High scenarios

Using the data and analysis described above, we have derived assumptions for the potential impacts of the Access SCR minded to position. In some cases, our analysis gave counterintuitive results that did not align with expected customer behaviour, meaning we were not able to draw assumptions from these results. In those cases, we placed a greater reliance on judgement in developing our assumptions. We have used different assumptions to develop our Low, High and Best View scenarios.

The figure below provides a high-level overview of our approach to estimating each of the three potential Access SCR impacts identified for the Low, Best View and High scenarios.

	Low View	Best View	High View
Impact 1 – Customer-funded reinforcement becomes DUoS funded	Same across scenarios: previously customer funded reinforcement now DUoS funded		
Impact 2 – Behavioural scaling factor	Low increases in acceptance and application rates	Medium increases in acceptance and application rates	High increase in acceptance and application rates
Impact 3 – Large-scale connections	Single large-scale HV demand and single large-scale EHV generation connection over RIIO-ED2	Existing ANM customers wishing to remove constraints at EHV, plus a single new large-scale EHV generation and HV demand connection over RIIO-ED2	Existing ANM customers wishing to remove constraints at EHV, plus five HV large-scale demand connections and a single large-scale EHV generation connection per year

Our assumptions are applied as follows:

- For impact 1, the mechanistic impact of reallocating some reinforcement costs from customers to DUoS, we simply take the absolute reinforcement costs that were previously customer funded, and add this to our baseline reinforcement costs;
- For impact 2, the behavioural impacts, our assumptions are in the form of a percentage uplift to the baseline level of reinforcement costs. We can apply this uplift directly to the new level of reinforcement costs because an increase in acceptance rate will directly and proportionally increase reinforcement costs, as will an increase in the number of connection applications being made in areas that require reinforcement;
- For impact 3, we add on the £m cost associated with the case studies we have developed.

Stakeholder engagement

In total, 15 customers were interviewed – with a mix of generation and demand connections customers.

In addition to these interviews, the topic was approached with domestic customers in the Citizens Panel and covered in the cross-utility workshop and an industrial customer workshop.

A summary of the feedback from the 15 customer interviews is as follows:

- Overall, the majority of demand and generation connections customers stated that the number of connections per year would stay the same or increase based on current connection charges.
- For those who felt there would be an increase, this was primarily as a result of an increased demand for renewable generation or EV charging.
- Overall, Ofgem’s minded-to position was not expected to change connections behaviours in the next year, although some customers stated that it could lead to certain applications being delayed until this point.
- More than half of demand and generation customers stated that Ofgem’s minded-to position would encourage more connections applications after April 2023.
- Customers expected the proposed changes to connections charging would lead to more projects and applications being viable to go ahead from a commercial standpoint.

Results

In the sub-sections below, we set out the results for each of the three potential impacts of the Access SCR minded to position, based on the analysis described above.

For each impact we set out:

- The findings of our analysis and how this compared to our expectations; and
- How we have used the results of the analysis to derive our final assumptions for our Low, Best View and High scenarios of the potential impacts of the Access SCR minded to position.

We first forecast our total baseline reinforcement costs over RIIO-ED2

We used as our starting point our baseline forecasts of the total reinforcement costs for new connections over RIIO-ED2. This reflects our costs in detail. We identified these costs at each of the LV, HV and EHV voltage levels and by demand and generation customers.

As set out below, we forecast total DUoS-funded baseline reinforcement costs of £64.1m over the RIIO-ED2 period, with an average annual cost of £12.8m over the five years.

Voltage level	Customer type	Average annual cost (£m)	ED2 total (£m)
LV	Demand	0.4	2.2
	Generation	0.0	0.1
HV	Demand	7.6	38.2
	Generation	0.5	2.4
EHV	Demand	0.5	2.5
	Generation	3.8	18.8
Total reinforcement costs over RIIO-ED2		**12.8**	**64.1**

Table 1: Baseline reinforcement costs in RIIO-ED2

Impact 1: Customer-funded reinforcement will become DUoS funded

Based on the baseline forecasts above, we then assume that all reinforcement costs that were previously customer-funded are now socialised.[5] Holding all else equal, this increases the reinforcement costs funded through DUoS by £12.2m over RIIO-ED2.

Customer type	Average annual cost	RIIO-ED2 total
Previously DUoS funded	12.1	60.4
DUoS-funded under Access SCR	14.1	70.5
Estimate of Impact 1	**+ 2.0**	**+ 10.1**

Table 2: Impact 1 estimate

Impact 2: Underlying acceptance and applications rates increase due to customer behavioural responses to the change in rules

In the sections below, we present the results from our analysis on the acceptance and application rates of connection quotes in turn. For each set of analysis, we set out the results for demand and generation connections in turn, and split by the voltage level of the connection requested (LV, HV and EHV).

We note that, based on the splits between demand and generation and by voltage level, the sample sizes for some splits were limited, and consequently in some cases the conclusions we were able to draw were limited.

An increase in quote acceptance rates due to customer behavioural response

As set out in the previous section, to estimate the impact of a potential increase in the rate of acceptance for connection quotations due to the Access SCR minded to position, we assumed that customers' acceptance rates would no longer depend on the level of reinforcement cost required for connecting to the network. For this reason, we first investigated whether the data showed a relationship between acceptance rates and reinforcement costs, expecting that acceptance rates would be lower for quotes with a higher proportion of reinforcement costs.

We then estimated by how much the acceptance rate of quotes that triggered reinforcement costs would have to increase in order to equalise with the acceptance rates for quotes with zero reinforcement costs.

[5] The only exception to this is £1.4m of customer funded reinforcement on accepted EHV schemes, assuming 50% to go ahead as accepted under the current rules.

Demand connections

The figure below sets out the percentage of acceptances of connection quotes, based on the percentage share that reinforcement costs made up of the total quotation. We split the analysis over two periods as explained previously: 2015-2017 and 2018-2021. We note that:

a) For LV and HV demand connections:

– The 2015 - 2017 data indicates that the acceptance rate of LV and, to a lesser extent, HV demand customers tends to be lower for quotations with a higher proportion of reinforcement costs, as expected.

– However, over the period 2018 - 2021, we are not able to identify a similar pattern between the acceptance rate and the level of reinforcement costs. This is likely to be partially explained by the introduction of the quotation fee in 2018. This also highlights that the decision by demand customers to accept a quote will also have been driven by other factors other than the cost of reinforcement.

b) Given that the sample of EHV demand connections is small (only 160 applications were submitted over the period 2015-2021, of which only 19 triggered reinforcement costs), we are not able to separately identify whether reinforcement costs were a key driver for customers to accept or reject a quote.

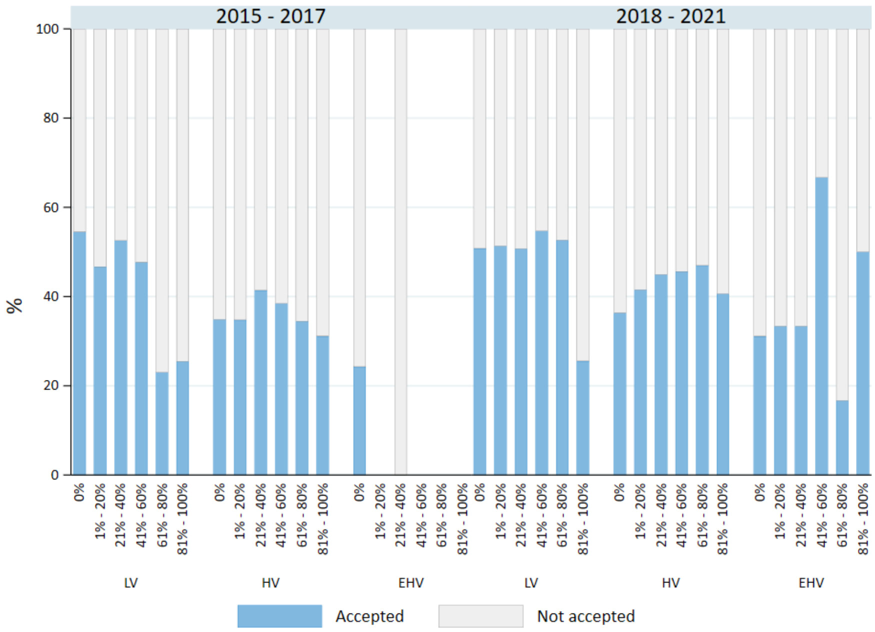


Figure 2: Acceptance rates for demand connections quotes relative to share of reinforcement costs

Source: Northern Powergrid historical data

As a second step, we calculated acceptance rates for demand connection quotes based on whether these triggered any reinforcement costs or not.

The table below sets out the percentage of quotes for demand connections across quotes with and without reinforcement costs.

Customer type	Acceptance rate of demand quotes with zero reinforcement costs	Acceptance rate of demand quotes with non-zero reinforcement costs
2015 – 2017		
LV Demand	54%	39%
HV Demand	35%	36%
EHV Demand	24%	very small sample (only 1 application)
2018 – 2021		
LV Demand	51%	49%
HV Demand	36%	44%
EHV Demand	32%	33%

Table 3: Acceptance rates for quotes for demand connections
Source: Northern Powergrid historical data

In some cases the data did not support our assumption that acceptance rates would be higher for quotes with zero reinforcement costs compared to the quotes that triggered reinforcement costs, for example, in the 2018-2021 period, the acceptance rate for HV demand quotes with zero reinforcement costs was 36%, but the acceptance rate for quotes with non-zero reinforcement costs was actually higher than this at 44%.

Given that the results of this analysis produced some counterintuitive results, we were not able to clearly identify to what extent we might expect demand customers to increase their acceptance of quotes with the removal of the reinforcement costs that they bear. The only customer group for which we were able to identify any clear and intuitive relationship between the acceptance rates and the level of reinforcement costs was LV demand connections. We therefore based our assumptions on the increase in the rate of acceptance for demand connections in general on the results for LV demand connections submitted between 2015 and 2017 as follows:

- We estimated that the acceptance rate of quotes with non-zero reinforcement costs would need to be 41% higher to be equal to the acceptance rate of quotes with zero reinforcement costs (i.e. the percentage increase between 39% and 54% in the table above). From this figure, we derived the High scenario assumption of a 50% increase in acceptance rate.

- We first calculated the average acceptance rate between (a) the acceptance rate of quotes triggering reinforcement costs, and (b) the acceptance rate of quotes without reinforcement costs (which amounts to 47%). Then, we estimated that this average would need to be 17% higher to match the acceptance rate of quotes without reinforcement costs (i.e. increasing from 47% to 54%). From this figure we derived the Low and Best view scenario assumptions of 10%.

The table below summarises, the percentage by which we assumed that the acceptance rate of quotes for demand connections would increase under the Low, High and Best View scenarios.

	Low View	Best View	High view
LV Demand	10%	30%	50%
HV Demand	10%	30%	50%
EHV Demand	10%	30%	50%

Table 4: Assumed percentage increases in acceptance rates of demand connections quotes due to the proposed charging rule changes
Source: Northern Powergrid historical data

Generation connections

Similarly to the analysis for demand connections above, the figure below shows the percentage of acceptances of quotes for generation connections over 2015-2017, and 2018-2021, based on the share of reinforcement costs within the quotation. The results do not show any clear relationship between acceptance rates and reinforcement cost share.

These counterintuitive results are partly driven by the small sample sizes at each of the voltage levels for generation connections. Another factor that could be driving this might be that generation customers already tend to have a good understanding of the costs they will face when they submit a connection application (e.g. through prior information discussions with us, or from past experience). This would mean that their decision to accept or reject a quote would not be significantly affected by the level of reinforcement costs within that quote.

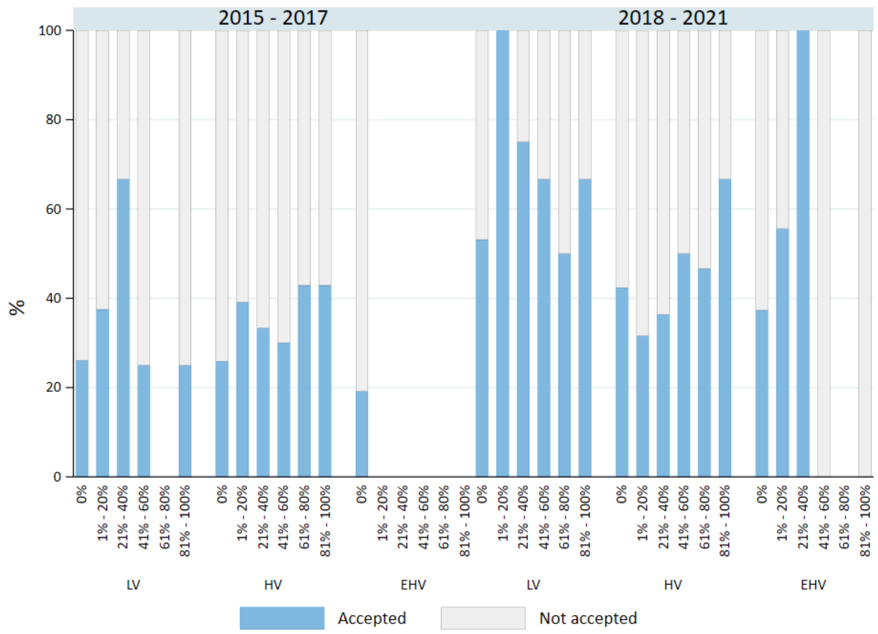


Figure 3: Acceptance rates for generation connections quotes relative to share of reinforcement costs
Source: Northern Powergrid historical data

Table 5 sets out the percentage of quotes for generation connections across quotes with and without reinforcement costs.

Customer type	Acceptance rate of demand quotes with zero reinforcement costs	Acceptance rate of demand quotes with non-zero reinforcement costs
2015 – 2017		
LV Generation	26%	42%
HV Generation	26%	39%
EHV Generation	19%	No applications
2018 – 2021		
LV Generation	53%	67%
HV Generation	43%	42%
EHV Generation	37%	55%

Table 5: Acceptance rates of generation connection quotes
Source: Northern Powergrid historical data

Given these limitations, we have assumed the following:

– Under the Low and Best view scenarios we have assumed that the Access SCR minded to position would not affect the level at which generation customers accept connection quotes that would require reinforcement costs. The rationale for this assumption is that generation customers already have a good understanding of the reinforcement costs they will face when they apply for a connection. Therefore the behavioural impact for generation customers may instead manifest through changes in application rates (rather than changes in quotation acceptance rates).

– Under the High scenario, we have simply made a high-level assumption that customers would accept 20% more of the quotes triggering reinforcement costs.

The table below summarises, the percentage by which we assumed that the acceptance rate of Generation quotes would increase under the Low, High and Best View scenarios.

	Low View	Best View	High view
LV Generation	0%	10%	20%
HV Generation	0%	10%	20%
EHV Generation	0%	10%	20%

Table 6: Assumed percentage increase in acceptance rates of generation connections quotes due to the proposed charging rule changes

Source: Northern Powergrid historical data

An increase in quote application rates due to customer behavioural response

To estimate the impact of a potential increase in the rate of connection applications due to the Access SCR minded to position, we assumed that customers' applications would no longer vary based on the level of congestion in a given area, since the reinforcement that may be triggered by a new connection in a congested area would no longer be charged to the connecting party[6], reducing a cost signal that may have dissuaded parties from trying to connect in areas where it was costly hitherto. In the following sub-sections we set out our findings on (a) whether there appears to be a relationship between the number of applications in a given area and the congestion level of that area, and (b) by how much the application rate in more congested areas would increase if application rates were to equalise with less congested areas, as a result of Access SCR (see the Approach section).

Demand connections

Similarly to our analysis of acceptance rates for generation connections, the small sample size for applications for EHV demand connections limited the extent that we can carry out or infer any meaningful results from the analysis for these connection types.

We therefore largely focussed our analysis on LV and HV customers. However, for completeness in the figures below we also illustrate the results for EHV demand customers.

The data shows that the majority of LV demand customers submitted applications in White and Green zones (i.e. where at most 25% of applications triggered reinforcement costs) and the few applications submitted in more congested zones are mostly concentrated in Amber areas.

On the other hand, HV Demand customers were mostly requesting to connect to Green, Amber and Red zones. We believe that this finding is in line with the fact that HV Demand quotes are usually connection requests submitted by supermarkets, hospitals or schools, which often need to be located in more densely populated (and therefore more likely to be congested) areas so that their services are more readily available to the population. These types of customers are also less likely to be flexible in terms of their connection location, and to respond to reinforcement price signals as a result.

[6] Noting that generation customers may still face some exposure to reinforcement costs.

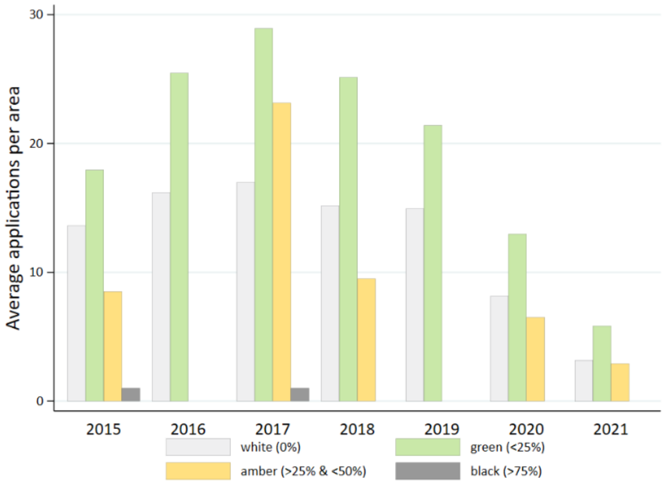


Figure 4: Average application per area for LV demand customers, 2015-2021

Source: Northern Powergrid historical data

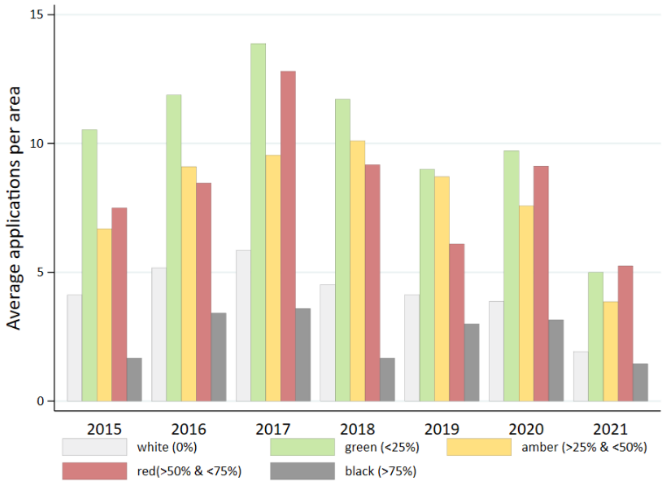


Figure 5: Average application per area for HV Demand customers, 2015-2021

Source: Northern Powergrid historical data

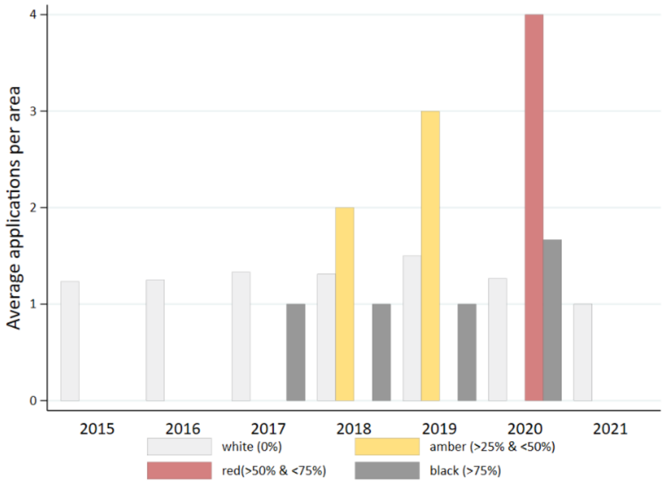


Figure 6: Average application per area for EHV demand customers, 2015-2021

Source: Northern Powergrid historical data

The second step of our analysis was to group applications into just two location categories 'less congested' and 'more congested' areas, using the two different cut-offs mentioned above. We then calculated the average number of applications per area for each of these groups. Finally, we applied the two approaches explained in the section above to estimate by how much the application rate in more congested areas would need to vary to match that of less congested areas. These values are reported in table 7.

	Based on 25% cut-off	Based on 50% cut-off
LV Demand customers		
Average applications per area		
Less congested areas	11.9	11.8
More congested areas	5.2	0.0
% variation of application rate in more congested areas		
Approach 1	130%	1,708%
Approach 2	549%	1,657%
Average	339%	1,682%
HV Demand customers		
Average applications per area		
Less congested areas	5.3	5.9
More congested areas	7.0	4.7
% variation of applications in more congested areas		
Approach 1	-23%	25%
Approach 2	55%	49%
Average	27%	0%
EHV Demand customers		
Average applications per area		
Less congested areas	1.3	1.3
More congested areas	1.7	1.5
% variation of applications in more congested areas		
Approach 1	-22%	-13%
Approach 2	-8%	-11%
Average	0%	0%

Table 7: Summary of results of application rate increases for demand connections across different Northern Powergrid areas under Approach 1&2

Source: Northern Powergrid historical data (Note: Average is calculated treating negative values as zeroes)

The results for LV demand customers suggest that there is a relationship between decision to apply for a connection and the level of congestion of an area, with significantly more applications in less congested areas. However, LV demand customers do not have visibility of heat maps and, unless they call us to obtain this information, they would not know whether their connection is likely to trigger reinforcement costs.

Moreover, the number of applications by LV demand customers in more congested areas is extremely low, suggesting that there may be other factors at play. Under both of our calculation approaches, the increase required for application rates in more congested areas to match that of less congested areas seems excessively large.

Similarly, data for EHV demand customers is very scarce, limiting the conclusions we can draw from the analysis for EHV demand.

For these reasons, we decided to focus on the results obtained by looking at the quotes submitted by HV demand customers and then applying the final results to all demand customers.

Interestingly, given that there is a high concentration of HV demand applications made in Amber areas, and these fall within a different category using the two cut-offs, the resulting application rates of the 'more congested' groups differs substantially under our two categorisation approaches. In particular, when categorising Amber areas as more congested ones (i.e. using the 50% cut-off), the data shows that the average application rate of HV demand customer is higher in more congested areas.

Given the high sensitivity to the cut-off of the application rates, we used the following method to develop the Low, High and Best View scenarios:

- Given that the data does not show a clear relationship between application rates and congestion levels and some customers often don't have ex ante knowledge of the network's congestion, under the Low and Best View scenario we assumed that the proposed the Access SCR charging rules wouldn't affect the number of applications by Demand customers in areas that would trigger reinforcement costs.

- Under the High scenario, we assumed that the number of applications by demand customers triggering reinforcement costs would increase by 37%. This is based on the average across the two approaches using the 25% cut-off of the HV demand customer data.

The table below shows the extent to which we expect the number of applications for demand connections that would trigger reinforcement costs to increase under the Low, High and Best View scenarios.

	Low View	Best View	High view
LV Demand	0%	18%	37%
HV Demand	0%	18%	37%
EHV Demand	0%	18%	37%

Table 8: Assumed percentage increases in application rates of demand connections quotes due to the proposed charging rule changes

Generation customers

Looking at generation customers, there are only a small number of applications per area submitted by LV and EHV customers. For this reason it was not possible to clearly infer whether there is a relationship between application rates and level of congestion.

On the other hand, the data shows that, in most years, the average application rate of HV generation customers is fairly similar across more and less congested areas.[7]

[7] An exception comes from the applications recorded in 2015 and 2016, where there is a higher average application per area in White and Green areas. These results are probably skewed in this direction as in those years higher solar PV subsidies were in place.

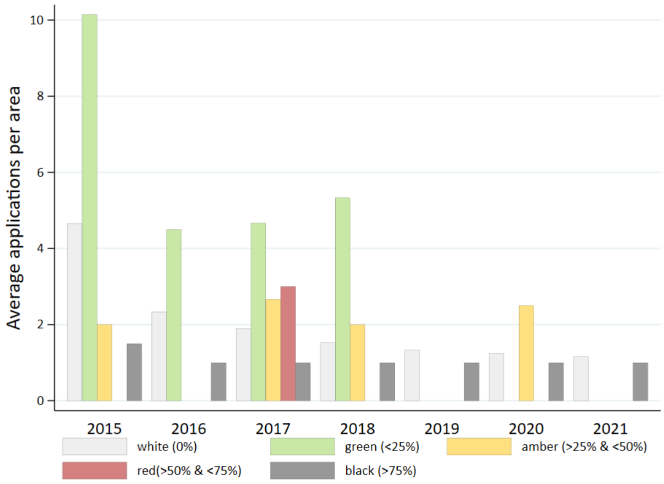


Figure 7: Average application per area for LV generation customers, 2015-2021

Source: Northern Powergrid historical data

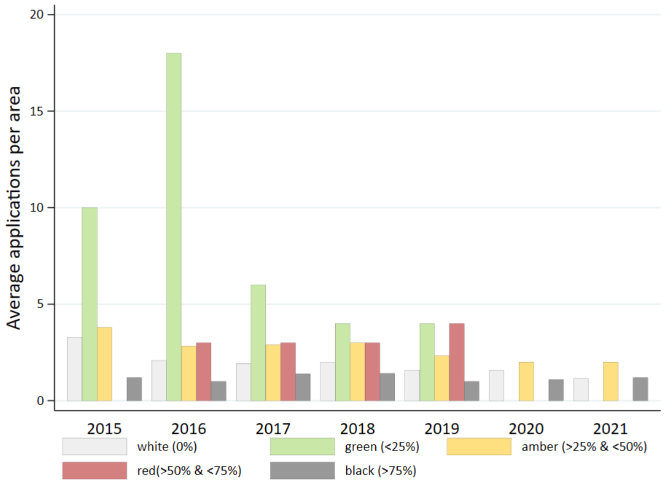


Figure 8: Average application per area for HV Generation customers, 2015-2021

Source: Northern Powergrid historical data

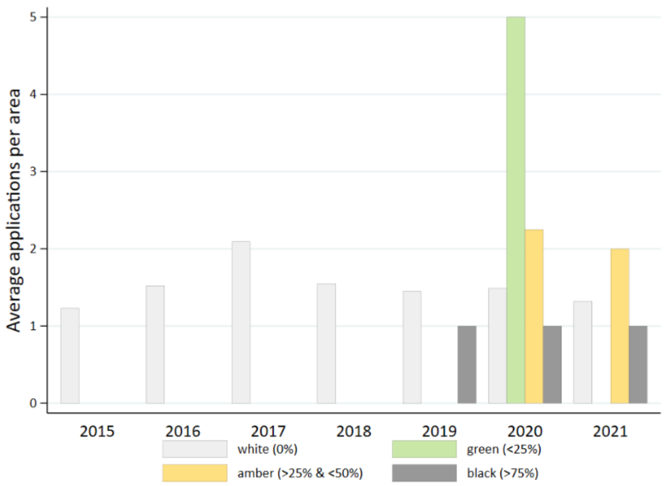


Figure 9: Average application per area for EHV Generation customers, 2015-2021

Source: Northern Powergrid historical data

Similarly to the demand customer data, we categorised areas as 'more congested' and 'less congested' using two different cut-offs and then we used the two approaches explained in the previous section8 to estimate by how much the application rate of more congested areas would need to vary to match the rate in less congested areas (see table 10 below).

	25% cut-off	50% cut-off
LV Generation customers		
Average applications per area		
Less congested areas	1.42	1.43
More congested areas	1.36	1.00
% variation of applications in more congested areas		
Approach 1	4%	41%
Approach 2	41%	43%
Average	23%	42%
HV generation customers		
Average applications per area		
Less congested areas	1.71	1.74
More congested areas	1.69	1.38
% variation of applications in more congested areas		
Approach 1	1%	26%
Approach 2	38%	30%
Average	19%	28%
EHV generation customers		
Average applications per area		
Less congested areas	1.50	1.52
More congested areas	1.55	1.00
% variation of applications in more congested areas		
Approach 1	-3%	49%
Approach 2	52%	49%
Average	25%	50%

Table 9: Summary of results of application rate increases for generation connections across different Northern Powergrid areas under Approach 1&2

Source: Northern Powergrid historical data *(Note: Average is calculated treating negative values as zeroes)*

[8] Under the first approach we assumed that the application rates in more congested areas would be equal to the application rate in less congested areas. Under the second approach we assumed that under the proposed charging rules the application rates of non-zero reinforcement quotes in more congested areas would be equal to the application rate of zero reinforcement quotes in less areas.

Under each cut-off categorisation, we calculated the average percentage variation across the two approaches and then used these values to develop the Low, High and Best View scenarios:

- We used the average values obtained using the 25% cut-off for the Low and Best View scenarios. This implied that the proposed Access SCR charging rule would lead to an increase in applications triggering reinforcement costs of 23%, 19% and 25% for LV, HV and EHV generation customers respectively.

- For the High scenario, we used the average across the two approaches using the 50% cut-off. Under this scenario, applications triggering reinforcement costs would increase by 42%, 28% and 50% for LV, HV and EHV Generation respectively.

The table below shows the extent to which we expect the generation application rates of quotes triggering reinforcement costs would increase under the Low, High and Best View scenarios.

	Low View	Best View	High view
LV Generation	23%	32%	42%
HV Generation	19%	24%	28%
EHV Generation	25%	38%	50%

Table 10: Assumed percentage increases in application rates of generation connections quotes due to the proposed charging rule changes

Source: Northern Powergrid historical data

Impact 3: An increase in the number of large-scale connection requests in congested areas that require significant reinforcement costs

As described above, we have attempted to quantify the impact of new large-scale connections that would not previously have connected in congested areas due to cost signals based on three case studies for a new EHV generator, new HV demand and existing ANM customers requesting 'firm access'.

We have added the potential impact of each of these new-large scale connections to our estimates of impacts 1 and 2 above as set out in table 12.

	Low View	Best View	High View
Scenario Overview	Single large-scale HV demand and single large-scale EHV generation connection over RIIO-ED2	Existing ANM customers wishing to remove constraints at EHV, plus a single new large-scale EHV generation and HV demand connection over RIIO-ED2	Existing ANM customers wishing to remove constraints at EHV, plus five HV large-scale demand connections and a single large-scale EHV generation connection per year
New EHV generator	£37.2m	£37.2m	£185.8m
New HV demand	£3.1m	£3.1m	£77.0m
Existing ANM customer requesting "firm access"	-	£108.2m	£108.2m
Total cost impact	**£40.2m**	**£148.5m**	**£371.0m**

Table 11: Summary of new large-scale connections assumed over 2023-28 business period

Based on the results of the analysis of Impacts 1, 2 and 3 above, we have assumed the following overall impacts of Access SCR across our Low, Best View and High scenarios.

Table 12 sets out the full results of our analysis for each of the Low, Best View and High scenarios.

DUoS funded connections reinforcement (£m) ***annual average unless otherwise stated***	LV			HV			EHV			Total			
	Demand	Generation	Total	Demand	Generation	Total	Demand	Generation	Total	Demand	Generation	Total	Total ED2
Updated baseline for final submission	**1.3**	**0.0**	**1.3**	**7.6**	**0.5**	**8.1**	**0.5**	**3.8**	**4.3**	**9.5**	**4.2**	**13.7**	**68.5**
Access SCR Best View Case													
Work previously assumed to be customer funded is now DUoS funded	0.0	0.0	0.0	1.9	0.0	1.9	0.0	0.1	0.2	2.0	0.2	2.1	10.7
'Medium' scaling assumptions on increase to applications and acceptance rate	0.3	0.0	0.3	7.0	0.2	7.2	0.2	0.9	1.1	7.5	1.2	8.6	43.2
Existing ANM customers wishing to remove constraints at EHV plus a single new large EHV generation project and a large HV demand project over ED2.	-	-	-	0.6	-	0.6	-	29.1	29.1	0.6	29.1	29.7	148.5
Direct cost impact of Access SCR - Best-view Case	**0.3**	**0.0**	**0.4**	**9.5**	**0.3**	**9.7**	**0.2**	**30.2**	**30.4**	**10.0**	**30.5**	**40.5**	**202.5**
Additional Core Closely Associated Indirects - Best-view Case	-	-	-	-	-	-	-	-	-	-	-	4.7	23.6
Total cost impact of SCR - Best-view Case	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**45.2**	**226.1**
Access SCR Low Case													
Work previously assumed to be customer funded is now DUoS funded	0.0	0.0	0.0	1.9	0.0	1.9	0.0	0.1	0.2	2.0	0.2	2.1	10.7
'Low' scaling assumptions on increase to applications and acceptance rate	0.1	0.0	0.1	2.8	0.1	3.0	0.1	0.5	0.6	3.0	0.7	3.7	18.3
Single large HV demand project and single large EHV generation project over ED2	-	-	-	0.6	-	0.6	-	7.4	7.4	0.6	7.4	8.0	40.2
Direct cost impact of Access SCR - Low Case	**0.1**	**0.0**	**0.1**	**5.3**	**0.2**	**5.5**	**0.1**	**8.1**	**8.2**	**5.5**	**8.3**	**13.8**	**69.2**
Additional Core Closely Associated Indirects - Best-view Case	-	-	-	-	-	-	-	-	-	-	-	1.6	8.2
Total cost impact of SCR - Best-view Case	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15.5**	**77.5**
Access SCR High Case													
Work previously assumed to be customer funded is now DUoS funded	0.0	0.0	0.0	1.9	0.0	1.9	0.0	0.1	0.2	2.0	0.2	2.1	10.7
'High' scaling assumptions on increase to applications and acceptance rate	0.5	0.0	0.6	11.9	0.3	12.2	0.3	1.4	1.7	12.7	1.7	14.4	72.1
Existing ANM customers wishing to remove constraints at EHV plus five large HV demand projects and single large EHV generation project per year	-	-	-	15.4	-	15.4	-	58.8	58.8	15.4	58.8	74.2	371.0
Direct cost impact of Access SCR - High Case	**0.6**	**0.0**	**0.6**	**29.1**	**0.4**	**29.5**	**0.4**	**60.3**	**60.7**	**30.1**	**60.7**	**90.8**	**453.9**
Additional Core Closely Associated Indirects - Best-view Case	-	-	-	-	-	-	-	-	-	-	-	11.5	57.7
Total cost impact of SCR - Best-view Case	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**102.3**	**511.5**

Table 12: Summary of results of expected increase in DUoS funded costs as a result of the Access SCR minded to position

Conclusions

Our results suggest that the impact of the Access SCR proposals may be very substantial and subject to a significant degree of uncertainty.

We used historical data on connection applications to attempt to infer how sensitive customers are to reinforcement costs, and therefore how their quotation acceptance and application behaviour might change when reinforcement costs are reduced or removed under the Access SCR minded to position.

However, for many customer segments (i.e. combinations of customer type and connection voltage level) the historical data gave counter-intuitive results, or results of a disproportionately large or small magnitude. For example, some of our results showed higher acceptance rates for quotations including a larger proportion of reinforcement costs (whereas we would expect the opposite). In all likelihood, this reflects the fact that there are many drivers of customer behaviour (some of which might be correlated to reinforcement costs) and it is therefore very difficult to isolate the impact of reinforcement costs alone. This challenge highlights that it is not possible to confidently predict behavioural impacts of a future policy change.

Our stakeholder survey results were mixed, with over half of the demand and generation customers stating there would be either more applications received or more connections would go ahead following the proposed SCR changes. The survey broadly supports the results from the quantitative analysis in this report but also highlights another element of uncertainty that there is not a consensus amongst customers on how they will behave if the rules change.

The table below sets out our estimates of the potential impacts of the Access SCR minded to position.

Scenario	Estimated total DUoS- funded reinforcement that will be required based on the Access SCR minded to decision
Low SCR Impact	£77.5m
Best View SCR Impact	£226.1m
High SCR Impact	£511.5m

Table 13: Estimated impact of the Access SCR minded to decision on DUoS-funded reinforcement

This analysis has proven challenging, and that it is therefore important to treat the results shown above with caution. Our analysis can only be considered broadly indicative of potential future costs, as reflected by the wide range of estimated impact on costs above.

The following list summarises the caveats that make these estimates uncertain:

- A final decision on Access SCR has not yet been taken, and any changes in how it is to be implemented have the potential to change our estimated impacts of customers' behavioural response.
- The historical evidence on connections reflects the behaviour that was encouraged by the current charging rules. As set out above, there is good reason to think that behaviour may change and that the effects may be large, particularly if some developers choose to hold projects back until the rules change. There is no good way to predict the extent of these changes.

- The flow of connections triggering reinforcement over time has been relatively small, but even a single large connections can trigger material reinforcement cost in some cases. As a result, reinforcement costs triggered by new connections have been and will likely remain volatile, dependent on the specifics of the portfolio of connections made.

- The robustness of the results may be limited, given that the historical dataset we have access to is not complete or large. In particular, the dataset does not capture more informal discussions with customers that are not recorded in our application data. It is also limited to our service areas (rather than including national data) and therefore we face a relatively small sample size.

- The historical data captures the effects of other factors which we are not able to isolate, such as the impact of Covid-19 in the most recent data, but also other policy changes, such as the introduction of charges on quotations in 2018 and reduction to subsidies for solar generation.

- The underlying analysis to infer the customer behavioural response in the application and acceptance of connection quotations does not provide intuitive results. This is almost certainly a consequence of the fact that a decision to connect will be driven by a wealth of factors (including those listed above), not just reinforcement cost, such that the results from this underlying analysis have required a large degree of judgement.

- The prevalence of reinforcement in the historical data does not necessarily reflect the future prevalence of reinforcement if networks are becoming increasingly capacity constrained.

- There is uncertainty around timing of the Access SCR impacts, for example connection customers may wait until the rule change are enforced, and then bring forward a glut of applications.

Given the challenges of predicting the impact of Access SCR on customer behaviour, and the significant degree of uncertainty around the cost impacts, an uncertainty mechanism is critical to manage this risk.

Since the Access SCR final decision is yet to be confirmed, we have included our estimated cost impacts only as a sensitivity to illustrate the potential impacts on our business plan for the RIIO-ED2 period.

Were the current minded to position to be implemented, it is likely to lead to a higher volume of connections and to customers asking to connect to parts of the network that are more congested and where it is more costly to accommodate new customers. There is a high degree of uncertainty around the materiality and timing of the resulting impacts. An uncertainty mechanism would therefore be needed to manage this risk appropriately, and avoid significant under- or over-remuneration for DNOs, while still maintaining incentives for DNOs to control the overall costs to energy consumers. This is particularly important because new connections are customer-driven, so volume risk cannot be managed by DNOs, but DNOs can take steps to control the cost of the work they do in response to each connection.

If these changes are made, we propose that a volume driver be used to manage this uncertainty, providing a flexible cost allowance based on the number of new connections to the network. The per-connection allowance would need to be differentiated based on factors that typically drive cost differences. For example, a different allowance would be needed for different types of connection (demand or generation), different sizes of connection, and connections at different voltage levels (LV, HV or EHV).

A volume driver based on connection number and type would ensure that funding is provided when it is needed, and that the level of funding provided would closely match the actual costs of the connections being made. The relevant connections data could readily be recorded and reported by DNOs, meaning the mechanism would be simple and transparent to implement without placing a significant burden on either our regulator or us.

A volume driver based on connection volumes would also maintain strong incentives for DNOs to find efficiencies in order to reduce the cost of accommodating new connections onto their networks. This would benefit consumers in both the short term, through the totex incentive mechanism, and in the long term. A reopener could also be used as a backstop to guard against the risk that this uncertainty mechanism might be mis-calibrated, to provide an additional layer of protection from windfall gains to both customers and investors.

Part B – Net Zero Service Upgrades

To support homes on our network becoming net zero ready, we will move to socialise more of the cost for service upgrades while ensuring a just transition

Our current approach to charging for service upgrades is as follows:

- All costs for installing a new fuse up to the standard size, and for upgrading an existing fuse beyond the standard size, are fully borne by the upgrading customer.[9]

- Similarly, the costs for upgrading the service cable (provided it is not shared with another customer) or providing a cut-out are also customer-funded.

In RIIO-ED2 we propose to socialise the costs of any low voltage service upgrade up to 100 amps, including fuse, cut out and service cable[10], therefore the vast majority of customers who are seeking to increase the load at their premises, for LCTs or otherwise, will not face the additional costs of upgrading their service.

We have carried out analysis to estimate the potential impact of Ofgem's proposed guidance on service charges

In the remainder of this annex, we present the analysis that we have carried out to estimate the materiality of the cost impact of socialising more of the service upgrades costs required on our network. The remainder of this annex is structured as follows:

- first, we set out our high-level approach to assessing the potential impacts of a change in our service upgrades charging policy;

- we then present the results of this analysis; and

- finally, we summarise the key outputs of the analysis and our conclusions on the need for an uncertainty mechanism.

Overview of approach

To quantify the materiality of the cost impact of socialising the cost of service upgrades up to a fuse size and service cable rating of 100 amps we looked at our existing run rates of service and fuse replacements and scaled these up in line with our forecasts of LCT volumes over RIIO-ED2.

We have carried out this analysis as follows:

- We first reviewed our historical asset records, and split this to separately identify fuse upgrades, cut-outs upgrade and service cable upgrades;

- We then compared historical volumes of LCT uptake on our network with our forecast LCT volumes over RIIO-ED2, and calculated a scaling factor between the two periods. Our forecasts reflect our DFES planning scenario, as set out in the scenarios and investment planning annex.

- We then used the scaling factor to scale up our existing customer-driven fuse and service upgrades to estimate the volume of service upgrades that we expect will be required over RIIO-ED2.

[9] At present, our standard fuse size is 80 amps for new connections, and 60 amps for legacy connections
[10] But excluding phase upgrades

- Finally, we multiply the estimated volume above by the unit costs for service, cut-out and fuse upgrades, to arrive at an estimate of the total costs for service upgrades over the RIIO-ED2 period.

We note that there are inevitably some limitations in the accuracy of this analysis, given that:

a) We have relied on available data from our service cables records, which reflect a relatively small historical LCT volumes base. It is therefore not certain how these types of service upgrades may need to be scaled up to reflect much larger LCT volumes that are expected over RIIO-ED2.

b) It is unclear how customer behaviour may change as a result of the change in charging policy, i.e. if they no longer face any direct costs for service upgrades that they require. This will likely differ depending on the type of LCT and whether the installer or the customer makes the final decision.

c) Other network impacts which may affect the level of service upgrade required and customer behaviour and demand for service upgrades which are difficult to estimate. This includes the following considerations:

- Requests for 100 amps upgrades will likely be driven by multiple LCTs, e.g. customers connecting both a heat pump and an EV charger. These requests may therefore not be commonplace until 2030 at the earliest, and are likely to be limited to larger properties where such connections are more suitable.

- Demand may also be limited due to the following factors:

  - As demand for energy storage (i.e. batteries) increases, this will likely partially offset customers' import requirements.

  - We are also aware of load limiting devices being installed to limit the overall maximum demand of a property to avoid reinforcement. This is likely to increase as flexibility services on the LV network become more common over ED2.

  - Local Authority action plans are already developing plans for on-street charging units. This has the potential to reduce the number of fuse upgrade requests in residential areas without off-street parking.

Results

Based on the analysis detailed above, we estimate that upgrading services, cut-outs and fuses could have a direct cost impact to Northern Powergrid of £96.8m over ED2. The increasing profile of annual costs reflects our forecasts of how the costs of EVs and heat pumps are likely to reduce over the next five years, and therefore the increase in customer requirements for service upgrades.

The table below sets out our detailed assumptions and calculations used in the analysis and our estimate of the cost estimate over the next five years.

Item	Assumptions	2022	2023	2024	2025	2026	2027	ED2
LCT uptake volumes:								
▪ Heat pump installations		16,449	19,329	20,582	51,814	70,606	88,748	**251,079**
▪ EV charge point installations		52,683	105,160	136,656	173,247	192,333	223,445	**830,841**
▪ Non-LCT Add-loads		785	785	785	785	785	785	**3,925**
Total enquiry volumes		**69,917**	**125,275**	**158,023**	**225,846**	**263,723**	**312,978**	**1,085,845**
Number of affected properties:								
▪ % of heat pump installations coupled with an EV	20.0%	(3,290)	(3,866)	(4,116)	(10,363)	(14,121)	(17,749)	**(50,215)**
▪ % of non-LCT add-loads coupled with an EV	20.0%	(157)	(157)	(157)	(157)	(157)	(157)	**(785)**
▪ % of off-street EV chargers	12.5%	(6,585)	(13,145)	(17,082)	(21,656)	(24,041)	(27,931)	**(103,855)**
Total affected properties		**59,885**	**108,107**	**136,668**	**193,670**	**225,404**	**267,141**	**930,990**
Number of affected properties:								
▪ % of properties on a looped supply	2.0%	(1,198)	(2,162)	(2,733)	(3,873)	(4,508)	(5,343)	(18,619)
▪ % of customers electing to pay for 3ph	4.6%	(2,755)	(4,973)	(6,287)	(8,909)	(10,369)	(12,288)	(42,826)
Total affected properties (non-looped)		**55,932**	**100,972**	**127,648**	**180,888**	**210,527**	**249,510**	**869,545**
Network constraint assumptions								
▪ % of service cable rated for less than 100A	5.0%							
▪ % of cut-outs requiring replacement	3.3%							
▪ % of cut-outs requiring a fuse replacement	40.0%							
Volume of interventions (forecast)								
▪ Service replacement		2,818	5,088	6,432	9,115	10,608	12,572	**43,815**
▪ Cut-out replacement		1,844	3,328	4,208	5,963	6,940	8,225	**28,664**
▪ Fuse replacement		22,373	40,389	51,059	72,355	84,211	99,804	**347,818**
Total "Service Upgrade" Interventions		**27,035**	**48,805**	**61,699**	**87,433**	**101,759**	**120,601**	**420,297**
Unit cost assumptions								
▪ Service Replacements (£)	1,477							
▪ Cut-out replacement (£)	300							
▪ Fuse Replacements (£)	67							
Cost of interventions (forecast)								
▪ Service Replacements (£m)		4.2	7.5	9.5	13.5	15.7	18.6	**64.7**
▪ Cut-out replacement (£)		0.6	1.0	1.3	1.8	2.1	2.5	**8.6**
▪ Fuse Replacements (£m)		1.5	2.7	3.4	4.9	5.7	6.7	**23.4**
Total "Service Upgrade" Intervention Costs (£m)		**6.2**	**11.2**	**14.2**	**20.1**	**23.4**	**27.8**	**96.8**

Table 14: Service upgrade impact analysis

In addition to the direct costs set out above, there is an accompanying indirect cost impact as we invest in our support functions to make sure they're able to cope with these changes. Based on the volumes forecast, we expect to spend £2.0m p.a. (£10m for the period) on indirect costs relating to service upgrades and factor in RPEs of £7.9m for the period.

£m	2024	2025	2026	2027	2028	ED2
Direct Costs	11.2	14.2	20.1	23.4	27.8	96.8
Indirect costs	2.2	2.2	2.2	2.2	2.2	11.0
RPEs	0.5	0.8	1.5	2.1	3.0	7.9
Total	13.9	17.2	23.8	27.7	33.0	115.7

Therefore, in total we estimate the impact of this change is £115.7m for the RIIO-ED2 period, or £23.1m p.a.

However, given the uncertainty around the speed and scale of the uptake of low carbon technology (and therefore the volume of required service upgrades), we propose to only include £15.6m (£3.1m p.a.) in our baseline allowances, which is based on the current rate of LCT uptake on network. However, as we expect uptake to accelerate, we are proposing the use of an uncertainty mechanism to address the risk of over- or under-remunerating DNOs for costs which are driven by factors outside our control.

INTENTIONALLY BLANK

NORTHERN POWERGRID

Visit:
ed2plan.northernpowergrid.com

Follow us on Twitter:
@powergridnews

Follow us on Facebook:
@northernpowergrid

Email us at:
yourpowergrid@northernpowergrid.com