# Distribution connection boundary – discussion note

**Summary**

This note provides an overview of existing connection charging arrangements and an assessment of the potential options for amending the distribution connection charging boundary.

We note that some users have raised concerns with the current arrangements such as the level of upfront cost associated with obtaining a connection. We are also aware of potential issues that might exist by having different arrangements at distribution and transmission which are influencing investment decisions. Where there is a choice, differences between transmission and distribution arrangements may lead to inefficient decisions to connect at a particular voltage. We think the evidence so far is inconclusive and it could be argued that the current arrangements are working as they are intended to do. An important part of our ongoing work is examining what evidence exists to further test this.

We think there are three categories of options for amending the distribution connection charging boundary:

1. **Shallowish:** the status quo, including potential modifications to the current approach.
2. **Shallower:** still recovering some reinforcement costs through connection charges, but less than now.
3. **Shallow:** no longer recovering any reinforcement costs through connection charges.

This paper represents our initial views on the options. We think there are likely to be trade-offs between different options. For example, while a more shallow connection boundary will reduce costs for the connecting customer, it could mean that overall network costs are higher, with higher costs for customers as a whole.

We will continue to assess the feasibility of amending the current connection charging arrangements and quantify the potential benefits to both customers and network operators of moving to a more shallow connection boundary.

1.1. This note is set out as follows:

- Section 1: A description of the current approach to connecting to electricity distribution and transmission networks.
- Section 2: The potential issues with the current arrangements and our preliminary views on what evidence exists to support the case for change.
- Section 3: An overview of the possible options for change and our initial assessment of these.
- Section 4: Cross-cutting policy considerations and links with other work.
- Section 5: A summary of our preliminary views.

1.2. Users seeking to connect to electricity distribution or transmission networks in Great Britain (GB) are charged in accordance with the relevant network's connection charging methodology. This sets out the charges a customer will face for connecting to the network in a particular location.

1.3. Some stakeholders have told us the current arrangements for distribution may no longer be working in consumers' interests. In particular, some stakeholders are concerned that these arrangements could be detrimental to the roll-out of low carbon technologies such as small-scale renewables generation and electric vehicle (EV) charging infrastructure that are needed to decarbonise our economy. DNOs have also flagged that the current arrangements may not be supportive of the most efficient use and development of the network, including potentially making it harder for them to use flexible technologies to accommodate new connections rather than traditional reinforcement.

1.4. We therefore decided to review the arrangements as part of the Access and Forward-Looking Charges Significant Code Review (Access SCR) and consider whether there was a case for recovering less costs through up-front connection charges. An important part of our analysis will be to examine in greater detail the evidence that the current arrangements cause, or will cause, customer detriment.

1.5. The current arrangements can however provide strong signals about the impact of connecting to the distribution network in different locations. In launching our review, we said that any decision to make changes to these arrangements will depend on the extent to which we consider that other changes in this review, in particular improved locational signals through Distribution Use of System (DUoS) charges, can offset any risks to consumers.

1.6. We set up a subgroup under our Delivery Group[1] to help define and understand the impact of different options to change the connection charging arrangements.[2] This document sets out our initial views on those options.

# Section 1 – Current approach

**Distribution**

1.7. When a customer seeks a connection to the distribution network, the Distribution Network Operator (DNO) in that region will consider what works will be needed to connect them. That will generally require some work to extend the existing network to the customer ("extension assets"). In some cases, it will also require the DNO to upgrade or expand the capacity of the existing network ("reinforcement works"). DNOs follow an approved common connection charging methodology, with Independent DNOs' (IDNOs) methodologies also being approved by us.[3]

1.8. Connection charges are the costs associated with these works that are paid by the connecting customer. Connecting customers are usually required to pay connection charges in advance, before their connection is made live; staged payments in line with the planned construction programme will typically be available for larger projects. Remaining DNO costs are recovered from customers more generally through DUoS charges. The split between the amount paid by the connecting party and wider consumers is called the connection charging boundary. The connection charging boundary for a particular voltage is then described in terms of its depth.

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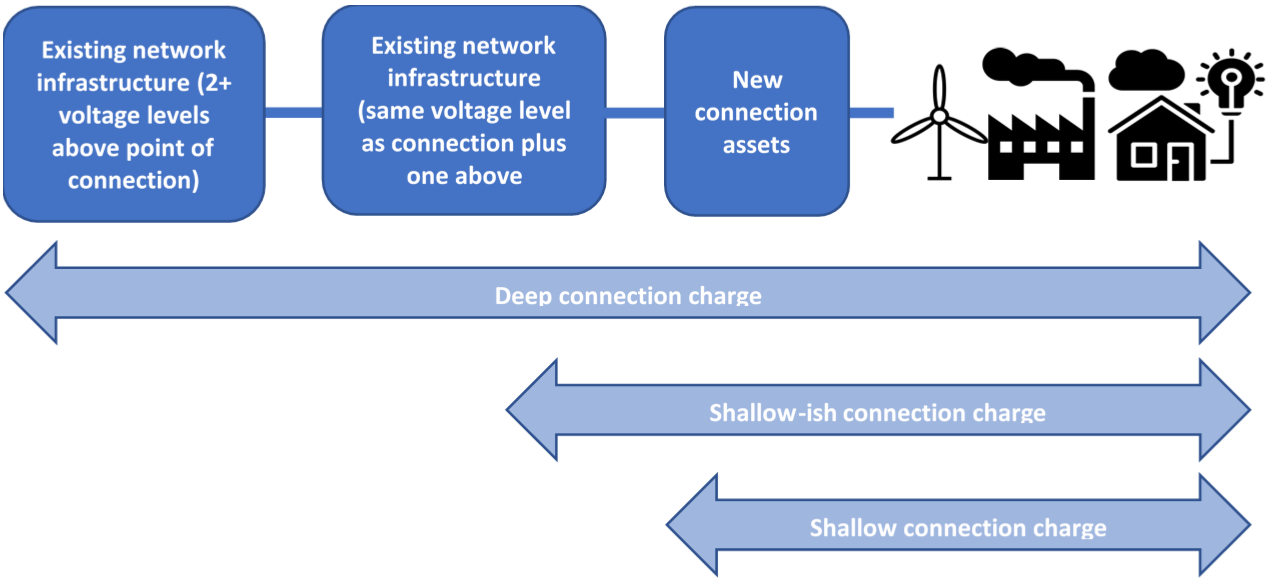
[1] See our note on "Stakeholder inputs to our Work" that accompanies this note for more detail on how we have drawn on external engagement through this SCR.
[2] The connection boundary subgroup will publish its report on the Charging Futures website (www.chargingfutures.com).
[3] IDNOs own and operate smaller networks located within the areas covered by the DNOs. IDNO networks are mainly extensions to the DNO networks serving new housing and commercial developments.

1.9. In simple terms, a "**shallow**" connection boundary involves the recovery of the costs of connection assets through an up-front connection charge, and the recovery of all reinforcement costs through use of system charges. This differs from a "**deep**" connection boundary which involves the recovery of the total costs that will be incurred as a result of connecting new load or generation to the system, including all costs of network reinforcement, through an up-front connection charge.

*Figure 1: different connection charges faced by connecting users*[4]




1.10. Currently, customers connecting to the distribution network face a "**shallow-ish**" connection boundary, which is between shallow and deep. This means that in general, the connecting customer pays:

- for their connection assets (referred to as "extension assets"), and
- a contribution to any reinforcement, with the rest being recovered from all consumers in the relevant DNO's area through use of system charges.

1.11. The connecting customer's contribution to reinforcement is calculated using rules that are set out in the DNO's connection charging methodology. These are common rules that apply to all DNOs. For example, connecting customers are required to pay a proportion of the

[4] Customers facing a shallow-ish connection charge pay a contribution (rather than the full amount) towards reinforcement of existing network infrastructure at the same voltage level as the point of connection, plus the one above.

cost of reinforcement at the same voltage level as their connection, plus a proportion of any reinforcement at the level above. The cost of any reinforcement at two voltages level and above the point of connection is recovered from all customers within the relevant licensed area through DUoS charges. This represents the wider benefits such reinforcement is expected to provide. This is referred to as the "voltage rule".

1.12. The proportion that the connecting party pays towards reinforcement is calculated using one of two Cost Apportionment Factors (CAFs), dependent upon the factor that is driving the requirement for reinforcement. They are: (i) a security apportionment rule, which covers situations where network reinforcement is required due to thermal or voltage criteria; and (ii) a fault level apportionment rule, which is used to cover situations where reinforcement is required due to equipment fault level ratings being exceeded. In both cases, where reinforcement is necessary due to a party connecting to the network, the connectee pays a share of the costs associated with the reinforcement. Their share is dependent on their capacity compared to the network capacity post-reinforcement.

1.13. At the time of developing the apportionment rules it was recognised that it was important to minimise the risk of free rider problems. In response, the DNOs' methodologies include a charge for a contribution to existing reinforcement assets. The ability to recover these costs within a connection charge is provided for by the Electricity (Connection Charges) Regulations, albeit constrained to a prescribed period of five years.[5] In this case, there must be a first comer who has triggered the reinforcement to the DNO's network. However, due to the incremental nature of the reinforcement, or a DNO choosing to oversize a network when accommodating a new connection, it may be that additional capacity is created. It is this subsequent headroom that may be used by a second connectee and recharged proportionately to them. This set of regulations is also known as the "second comer" rule.

1.14. Generators connecting at distribution also face a "High Cost Cap" (HCC). This requires connecting generators to pay for all reinforcement costs above £200/kW to protect wider customers from particularly high-cost connections.

[5] Electricity (Connection Charges) Regulations 2002 and Electricity (Connection Charges) Regulations 2017.

1.15. DNOs are required to design the connection offer based on the "minimum scheme". The minimum scheme is the solution designed solely to provide the capacity needed for the new connection at the lowest overall capital cost – while still meeting all technical, regulatory and safety requirements. A DNO may design an "enhanced scheme",[6] but the cost to the customer will not exceed that of the minimum scheme. The customer can also request work in excess of the minimum scheme where it thinks this would be more beneficial. For example, it may decide that a more expensive route to the existing network will receive planning permission more easily and is therefore worth paying for. In this case, the customer will need to pay the full cost of this additional work, including the cost of operating and maintaining these additional assets over their lifetime.

1.16. The value of connections completed by DNOs in recent years is summarised below. We note that connections can also be provided by IDNOs and Independent Connection Providers (ICPs). Numbers for IDNO and ICP connections have not been included in the table.[7]

***Table 1: breakdown of total distribution connection and reinforcement costs in 2018 and 2019***

| Year | Extension asset costs – paid by the connecting user | | | Reinforcement costs triggered by new connections | | Other load-related reinforcement |
|---|---|---|---|---|---|---|
| | **Demand** | **Distributed Generation** | **Unmetered** | **Funded by connecting customer (up to one voltage level above connection)** | **Funded by consumers through DNOs' distribution network charges** | |
| 2018 | £431m | £134m | £27m | £34m | £111m | £152m |
| 2019 | £443m | £76m | £24m | £33m | £97m | £128m |

*Source: RIIO-ED1 connections reports and performance data*

1.17. As can be seen from the table above, the total amount paid towards network reinforcement by the connecting customer is a small percentage of total distribution network reinforcement (and an even smaller percentage of total distribution expenditure which was around £3bn in both 2018 and 2019). So while the reinforcement recovered by individual

[6] This could include additional assets to accommodate a larger overall capacity or assets of a different specification which the DNO considers will provide benefits to the general network.
[7] Independent connection providers can compete with DNOs and IDNOs to provide some connections. These are then adopted by a DNO or IDNO upon completion who is responsible for the ongoing ownership and maintenance of the network.

connection charges may seem prohibitive at times, it is a small component of the overall network costs.

1.18. We note that DNOs have introduced an option of flexible connections which allow the customer's access to be curtailed at times of peak demand on the network.[8] This can therefore avoid the need for investment to reinforce the network. The benefit to the customer is that these connections incur a reduced connection charge to reflect the fact that they are not contributing to the need for reinforcement.

**Transmission**

1.19. In 2011, new arrangements were implemented for transmission connections, referred to as "Connect and Manage". The aim of these arrangements was to improve access to the electricity transmission network for generators by offering connection dates ahead of the completion of wider transmission system reinforcements. This allows generators to connect earlier, but may result in additional constraint costs. These arrangements included a shallow connection boundary and "financially firm access rights".[9]

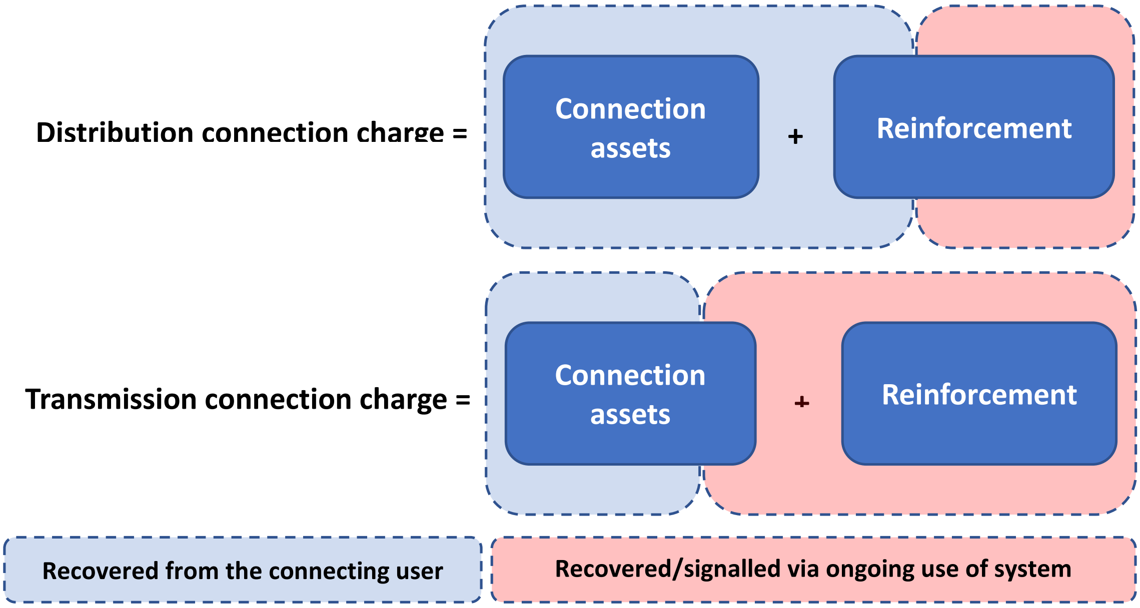
1.20. Transmission connection costs are then recovered through Transmission Network Use of System (TNUoS) charges. TNUoS charges are broken down into:

- wider TNUoS charges which recover the costs of the Main Integrated Transmission System (MITS) and are further broken down into:
    - wider locational TNUoS tariffs; and
    - residual TNUOS tariffs

[8] These is sometimes referred to as "non-firm" access. We discuss firmness in more detail in the description of the current arrangements for transmission connections.
[9] The level of firmness is the extent to which a user's access to the network may be restricted (physical firmness) and their eligibility for compensation if it is restricted (financial firmness). The higher the level of firmness, the less likely a user is to be curtailed. There may be some users that are willing to be curtailed more often (ie a less or non-firm connection), in exchange for a quicker connection or lower charges. Financially firm access rights mean that connectees are compensated via constraint payments from the Electricity System Operator when they are not able to use their connection. These constraint payments are then recovered from transmission users via balancing services charges.

- local TNUoS charges which recover the costs of local circuits and substations required to enable the connection, and are recovered from specific users of those assets.

*Figure 2: simplified breakdown of the current connection charging boundaries*




1.21. Connecting users can choose to pay for the cost of these assets upfront (eg staged payments in line with the planned construction programme or upon energisation), or pay annualised charges over a 40-year period.

1.22. Some transmission connectees are also required to enter into a financial commitment with the network company. For generation users this is called "User Commitment", while for demand users the "Final Sums" methodology is used. This places liabilities on the connecting user, or requires them to provide some form of security against the investment need to connect them, in the event that they cancel or delay their projects. This helps to ensure that the transmission networks have enough information to plan and develop the network economically and efficiently. As a result, this commitment protects consumers' interests. It gives users an incentive to provide accurate and timely information about their needs and ensures some of the risk of stranded assets is held by the parties that are best placed to mitigate and manage such risk. There is no equivalent mechanism in place for distribution connections at this time. This reflects, in part, the fact that distribution connection charges are paid upfront and less of the risk associated with delayed or cancelled projects sits with wider consumers.

1.23. Further information on the current arrangements can be found in our Current Arrangements note which was published in September 2019.[10]

## Section 2 – Potential issues with the current arrangements and the case for change

1.24. As the energy system decentralises and decarbonises, it is increasingly important that the current arrangements do not provide barriers to the uptake of new uses of electricity and new technologies, including Low Carbon Technologies (LCTs) such as EVs and heat pumps. Furthermore, with increasing substitutability and competition between generators at different voltage levels, differences between transmission and distribution should not lead to distortions in investment and operational decisions.

### High cost of connections

1.25. Stakeholders have previously highlighted that one of the issues with the current connection boundary is that it can lead to high upfront costs for those looking to connect new facilities to the network. We think it is important though to understand if this relates to the cost of extension assets, reinforcement or both.

1.26. The table below shows that the element of the connection that is subject to the apportionment rules (that is, reinforcement), and paid for by the connecting customer, is a small proportion of the total cost – 7% of fully accepted offers. It is difficult to draw definitive conclusions without further analysis, but we do note that connecting customer-funded reinforcement is a slightly higher proportion of total costs (11%) in the case of those connections offers which were not accepted. This could indicate that higher reinforcement-related connection charges are a factor in causing some projects not to progress. Please note the table does not include "other charges" meaning that percentages do not sum to 100%.

[10] https://www.ofgem.gov.uk/publications-and-updates/access-and-forward-looking-charges-significant-code-review-summer-2019-working-paper

1.27. We also note the difference in the average cost of accepted and rejected offers below. On one hand, the cost of connections that is sole use-funded by the connecting customer is a significantly greater proportion of connection charges than the charges relating to reinforcement costs, and the average sole use funded charges are also significantly higher in the rejected offers. However, the average cost of reinforcement liable by the connecting user in rejected offers is more than ten times the level of those which have been accepted (as compared to the average cost of the sole use element for rejected offers being more than six times the level of accepted offers). Further work is required to understand which part of the connection cost is proving prohibitive for users where this is the case (or, if in fact, it is in fact the totality of the connection cost).

*Table 2: cumulative annual quotations issued and rejected*

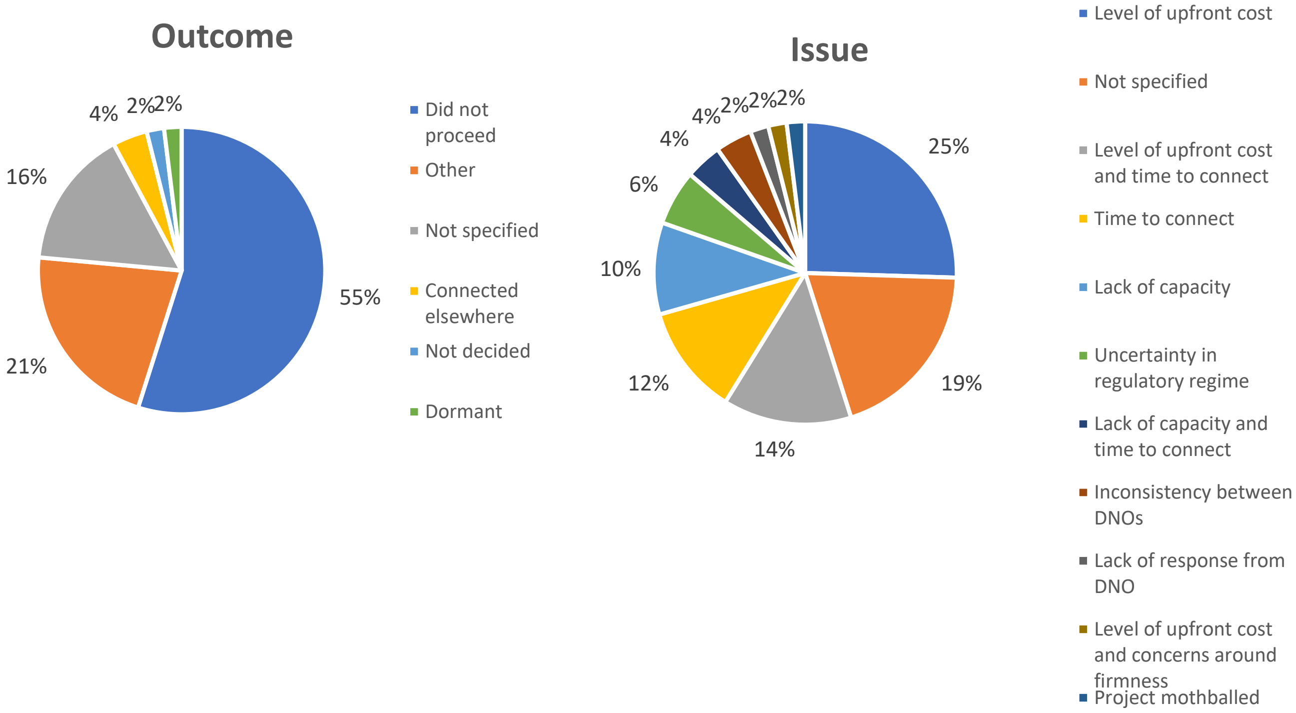
| | | Element of the connection that is sole use funded | | | Element of the connection that is subject to the apportionment rule - customer funded | | | Element of the connection that is subject to the apportionment rule - DUoS funded | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Connection offers** | **Total cost** | **% of total cost** | **Ave cost** | **Total cost** | **% of total cost** | **Ave cost** | **Total cost** | **% of total cost** | **Ave cost** |
| **Full acceptance** | 56k | £670m | 71% | £12k | £64m | 7% | £1k | £179m | 19% | £3k |
| **Not accepted** | 55k | £4.27bn | 68% | £78k | £722m | 11% | £13k | £1.16bn | 18% | £21k |

*Source: RIIO-ED1 reporting, 2019*

1.28. We issued a call for evidence to members of the Access SCR Challenge Group and other interested stakeholders in October 2019 to explore this matter further. Respondents were asked to provide examples where the current connection charging arrangements had caused problems when seeking to connect to the distribution network, what was the outcome in each case and the driver(s) behind this.

1.29. We received information on 51 projects where stakeholders had experienced some difficulty in connecting to the distribution network. In the majority of these cases (55%), the connection did not proceed. In the second largest category, the majority went ahead although at a lower capacity than was originally requested. A number of respondents explained that this resulted in a sub-optimal outcome from their perspective. For example, where a connection was requested to facilitate the roll-out of public EV charging infrastructure, a reduced number of charging points were ultimately installed. Only a small proportion (4%) decided to locate elsewhere. It is difficult however to draw definitive conclusions as it represents only a small proportion of connecting customers and results may be influenced by those users who had experienced a negative outcome being incentivised to respond.

***Figure 3: initial findings from Ofgem call for evidence***

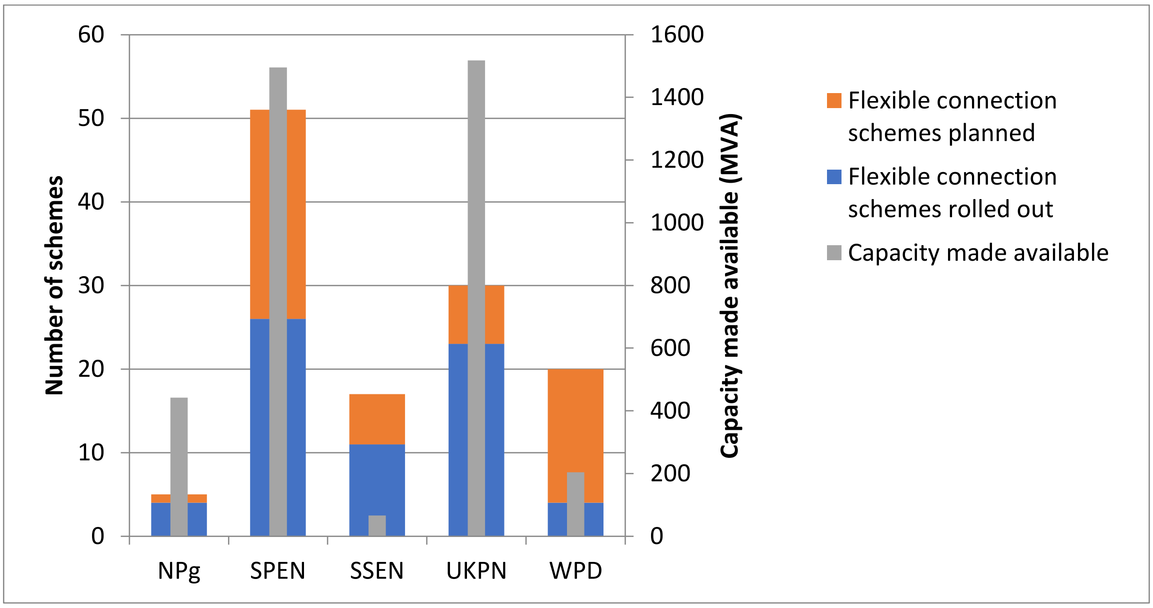



1.30. The main reason respondents gave for projects not proceeding as planned was the level of upfront cost. This, when expressed either on its own or with other factors, was the driver behind 41% of connections not going ahead as originally planned. It was not clear in all responses whether this was the cost of extensions assets or reinforcement. We think this is an area where further evidence and analysis is needed. In addition, for example, while the upfront cost of a connection may make a project prohibitively expensive, it can also signal potentially inefficient network investment costs (especially if the project has the flexibility to locate elsewhere, or to reduce its capacity requirements so as to mitigate the need for reinforcement). We think it will therefore be important for our assessment to consider the value of the signal.

1.31. The second largest factor (individually or combined with others) was time to connect (30%). We are aware though that there are a number of factors (other than the electricity connection) that influence whether a project goes ahead. However, in terms of the time to connect, and general engagement by DNOs with their customers, we think there is evidence to suggest that improvements are already being made.

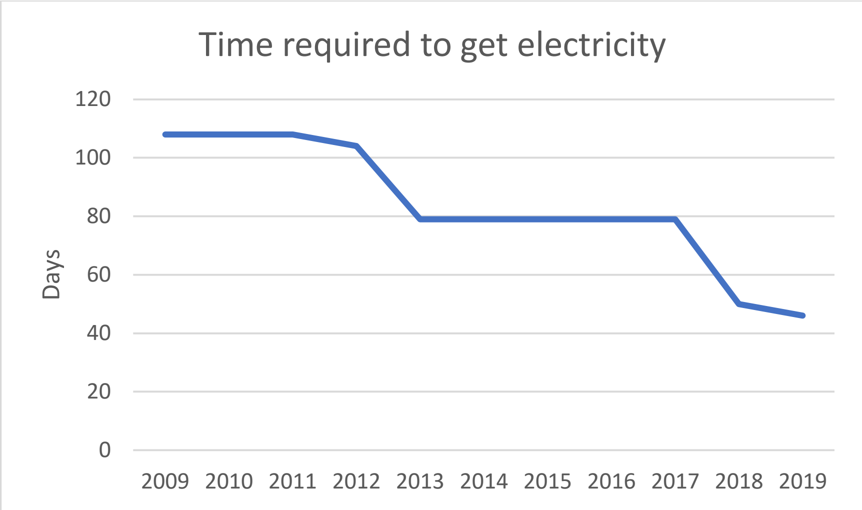
1.32. As noted above, one change that DNOs have made is to introduce the option of flexible connections, which have allowed a significant number of parties to connect quicker and with a lower connection charge than if they had opted for a standard connection. Figure 4 below shows the adoption of flexible schemes in 13 out of 14 DNOs as of May 2016, with more planned at the time these figures were reported.

***Figure 4: Flexible connection schemes implemented, with capacity released, and schemes planned as of May 2016 (Source: Ofgem, 'Unlocking the capacity of the electricity networks')***




1.33. Furthermore, figure 5 below, published by the World Bank, shows that the time required to get electricity in UK has more than halved since 2009. We also run an annual Incentive on Connections Engagement (ICE) process. Under the ICE, DNOs must provide evidence that they have engaged with their connection stakeholders and responded to their needs – including their engagement plans for the coming year. If they fail to do this, they could incur a penalty. We consider this has helped drive improvements in how DNOs have facilitated connections.

*Figure 5: Time required to get an electricity connection - United Kingdom (Source: World Bank, Doing Business project)*




**Potential distortions between transmission and distribution**

1.34. A second potential issue is whether different arrangements at distribution and transmission are influencing investment decisions. Where there is a choice, differences between transmission and distribution arrangements may lead to inefficient decisions to connect at a particular voltage. These inefficiencies could be realised through a number of ways. For example, it could cause a customer to re-design their project to be less optimal (such as changing to a less desirable location), or it could distort competition between different sizes of generators or storage facilities who locate at different voltages.

1.35. The connection boundary subgroup has been developing an illustrative view of "lifetime" charges (both connection and use of system) faced by users connecting to transmission and distribution networks in a range of scenarios across GB. This is building on earlier work carried out by the Energy Networks Association (ENA) Open Networks Project,[11] exploring the cumulative costs to connectees of equivalent connections at different voltages. This work will be published on the Charging Futures website once finalised.

1.36. We acknowledge that this exercise can only provide an illustration of what charges a user might face and so we welcome further evidence to support our assessment. In particular,

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[11] ENA Open Networks Project charging scenarios, 2017 (http://www.energynetworks.org/assets/files/electricity/futures/Open_Networks/ON-WS4-Charging%20Scenarios-170818.pdf).

we would welcome any evidence from other parties that the different connection charging boundary at transmission and distribution (when taking into account other differences in use of system charges, such as local circuit charges within TNUoS) is causing distortions in investment decisions.

1.37. We consider that it will be important to have regard to the arrangements that users face in the round. This includes connection and use of system charges, but also covers any costs faced by parties themselves in order to connect to the network and/or other financial commitment.

**Efficient investment and network development**

1.38. The cost of reinforcement which could be required to obtain a standard connection in significantly constrained areas can reach into the tens of millions of pounds. Where reinforcement that is carried out is expected to enable multiple connections, the connecting party only pays for their share of the cost. However, if the reinforcement undertaken only meets the needs of the connecting party, only they will be liable for the customer funded proportion of the connection charge. This approach could potentially deter investment and delay beneficial development of the network. We note however the "second comer" rule would apply where the customer has fully-funded assets that are used by subsequent connecting users. In such cases, the first connecting user will be refunded some of the cost of their connection reflecting the fact that other subsequent users are benefiting from the reinforced network.

1.39. The DNOs have told us that their network planning and design today is largely driven by individual connection requests. More work is needed to investigate this but it might be leading to a fragmented and inefficient approach to developing the network relative to a more strategic, forward-looking approach that is less driven by individual requests. This is something we will be focusing on in our plans for the DNOs next price control framework ("RIIO-ED2"). We intend to consider further to what extent unlocking these benefits is contingent on amending the connection boundary such that all reinforcement costs are recovered through DNOs' allowed revenues under their price control agreements.

1.40. One existing option available to developers to overcome these costs is to establish a consortium of other users wishing to connect to the same area of the network and share the connection charges between the parties involved. The idea is that a DNO would collate interest for new connections in an area and facilitate (with the customers' permission) the coming together of the interested parties so that they could seek to create a combined connection request. However, this has proved challenging in practice because of the difficulties in the connecting parties coordinating and aligning projects to commit and move forward together.[12]

1.41. In the future, we know that increasingly flexible technologies such as battery storage or demand-side response will be available, that can help offset the need for network reinforcement as they help to reduce network peaks, and make better use of existing network capacity. One concern that DNOs have raised is that the current connection charging arrangements make it difficult for them to use flexible sources to manage reinforcement for new connections. We understand this is because connection charges recover capital costs ahead of connection – whereas in this scenario, the DNO would need to pay the flexibility provider over time once the new user has connected.

1.42. We intend to consider further the extent to which this issue is a barrier. We also note that other options for reform that are being considered – the potential for shared access and for trading of access – could help overcome this issue, as these changes might allow the connecting user to contract with the flexibility provider directly to allow it to connect without triggering reinforcement.

## Section 3 - Overview of the options under consideration

1.43. In our SCR launch letter, we said that the distribution connection charging boundary is included as part of the SCR, while the transmission connection charging boundary is excluded from the SCR and wider review. We said that the current arrangements at the distribution level may create a barrier to entry and efficient investment in the networks, by targeting a proportion of reinforcement costs on the last party that is deemed to trigger the reinforcement. The majority of respondents supported us reviewing the distribution connection charging boundary.

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[12] https://www.ofgem.gov.uk/system/files/docs/2017/02/unlocking-the-capacity-of-the-electricity-networks-associated-document.pdf

1.44. We did not think these issues are replicated in the transmission arrangements, where there is a shallow connection boundary and strong locational signals through transmission use of system charges. We also did not receive further evidence as part of the consultation to justify including the transmission connection charging boundary arrangements as part of this SCR – for example, evidence that the transmission connection boundary was creating a barrier to entry. The options that have been developed by the connection boundary subgroup therefore considered changing the distribution connection charging boundary only.

1.45. The subgroup identified a range of possible options to change the distribution connection charging arrangements, moving increasingly shallow. These have been developed giving consideration to how they could help contribute to our overall objective of ensuring that electricity networks are used efficiently and flexibly, reflecting users' needs and allowing consumers to benefit from new technologies and services while avoiding unnecessary costs on energy bills in general. The subgroup's report describes these options in more detail with an assessment against various criteria. These criteria were informed by the SCR guiding principles, as set out in the table below.

***Table 3: subgroup assessment criteria for connection charging options***

| SCR guiding principle | Subgroup assessment criteria |
|---|---|
| Arrangements support efficient use and development of system capacity | • Efficient signals for network users<br>• Supporting efficient network development<br>• Addressing distortions<br>• Reducing barriers |
| Arrangements reflects the needs of consumers as appropriate for an essential service | • Impact on DUoS charges<br>• Time to connect |
| Any changes are practical and proportionate | • Ease of implementation (time, cost, complexity) |

1.46. This section sets out our preliminary views for options grouped under three varying connection boundary depths:

- Shallow-ish – including modifications to the current approach.
- Shallower – still recovering some reinforcement costs through connection charges, but less than now.

- Shallow – no longer recovering any reinforcement costs through connection charges.

**Connection boundary options**

*Shallow-ish*

1.47. The first option considered by the subgroup was keeping the existing shallow-ish boundary. This provided a baseline against which the other options can be assessed. Retaining a shallow-ish connection boundary gives a strong signal to users about locating where spare capacity exists – but the timing and level of connection charge may prove to be prohibitive for some projects. Furthermore, while this helps to promote efficient network development to the extent that it seeks to avoid unnecessary network reinforcement, it is a weak incentive for the DNO to consider alternative solutions or take a more strategic approach to network development.

1.48. One possible variant could therefore be to keep a shallow-ish connection boundary but require distributors to offer alternative payment terms such as an ability to pay over a number of years. This is already available to transmission connectees with payments being made over a period of up to 40 years. This would keep a strong signal to users about where to locate on the network but potentially reduce issues associated with upfront cost (although the absolute cost would remain the same). It would also reduce the differences with other arrangements for transmission (where some of the connection costs are recovered through TNUoS charges over time).

1.49. The potential benefit to users could depend on whether alternative payment terms are offered for the cost of extension assets, reinforcement or both. We also note any move away from upfront payment would place a risk of bad debt on distributors in the event of default. We will consider as part of our future assessment how to mitigate this risk and protect existing customers from the cost of inefficient or stranded investment by the distributor. This could include some form of securities mechanism, such that the connecting customers need to provide some financial commitments. However, requiring customers seeking to connect at distribution to provide a level of security in advance of the connection might reduce the level of potential benefit if it imposes a similar barrier. We discuss potential securities requirements in more detail later in this note.

*Shallower*

1.50. Moving to a shallower connection boundary reduces, but keeps some, of the contribution that is required from connecting customers to any reinforcement needed. There are multiple ways this could be achieved, as discussed below. In general terms, a shallower boundary results in a weaker signal for new users than the current shallow-ish boundary:

- The difference in costs involved in connecting in different locations would be reduced. This could result in more connection requests in areas where network reinforcement is required.
- It might result in connecting customers oversizing their capacity requests (eg, if the cost of their connection is capped and/or they bear a lower share of the cost of any associated reinforcement). Furthermore, this could negatively impact efficient network development as it reduces the level of confidence a DNO has in capacity requests as a reliable indicator of future requirements.
- It could reduce the willingness for users to accept flexible connections that can avoid the need for reinforcement (because the connection charging discount would be less). However, this could be mitigated if our reforms lead to ongoing use of system charges being discounted for those with flexible connections.

1.51. However, there will still be some signal to show where a part of the network is constrained or not, which could offset the possible impacts above. The strength of this signal will need to be considered further. We will also consider whether where spare capacity would be sufficiently signalled through other means – including through use of system charges, any securities and liability requirements and through differences in the time to connect.

1.52. This option might bring benefit in giving DNOs more opportunity to consider alternatives to traditional reinforcement and in enabling more strategic reinforcement where warranted. The subgroup considered that this could potentially result in more overall efficient solutions, taking into account investment ahead of need, though this is less clear cut than if moving to shallow boundary (as the connecting customer is still making some contribution to reinforcement). We intend to consider this further, alongside the consideration of encouraging more strategic investment by DNOs under RIIO-ED2.

1.53. A shallower boundary could help reduce the problems faced by some connecting parties as well as any distortions between transmission and distribution. However, as noted above, while the upfront cost of a connection may make a project prohibitively expensive, it can also signal potentially inefficient network investment costs. If the customer has the opportunity to locate elsewhere, or resize their capacity request, then the current arrangements may be operating as they are intended to do.

1.54. Our analysis so far shows that the options for a shallower connection boundary would be relatively straightforward to implement. This is largely because they are variations on the current distribution arrangements. How this interacts with any form of liabilities and securities mechanism and/or transitional arrangements could impact the final assessment of whether the options are practical and proportionate.

1.55. There are a range of options for achieving a shallower connection boundary than exists today. These options have the effect of recovering (to a greater or lesser extent) more of the cost of reinforcement from existing and future customers. For example:

- **Cap connection charges:** connecting users would not pay for any reinforcement costs over a certain level. These would instead be recovered from existing customers.
- **Remove the High Cost Cap**: currently, for distributed generation connections only, and where the cost of reinforcement is more than £200/kW, the connecting user pays for all reinforcement above this threshold. This protects existing customers from extreme costs but could be creating a barrier for some connections. If the cap is removed, these costs would be recovered from all customers instead.
- **Amend the voltage rule**: connecting users currently contribute to reinforcement at the same voltage level as their point of connection, plus the one above. In this option, connecting users would only be charged for reinforcement at same voltage as the point of connection but anything above this would be recovered from existing customers.
- **Amend or replace the CAF**: the CAF currently apportions the cost of reinforcement between the connecting user and existing customers. This calculation

could be amended or replaced, for example, with a scaling factor, to reduce the cost of reinforcement borne by new users.

- **Recover the cost of transmission reinforcement through distribution charges**: currently, if a connection requires reinforcement at transmission, the connecting user is liable for this. Under this option, these costs would be recovered from existing customers.

*Shallow*

1.56. Under a shallow connection boundary, the full cost of network reinforcement will be recovered from existing customers (through increased DUoS charges), with only the cost of the connecting user's extension assets paid for by the connecting user. There are then different options for how extension assets are charged for. For example:

- **Charge for all extension asset costs through connection charges:** this option would mean that the connecting customer pays for all extension costs involved in their connection. The "second comer" rule could continue to apply if another user subsequently connects and uses those assets, such that the first user would be refunded some of the costs.

- **Recover extension asset costs through connection charges and use of system charges**: this option would aim to precisely reflect the transmission arrangements, where connecting customers would pay for their extension assets up to a specific point on the network (classed as sole use assets in transmission). Anything beyond this, plus the cost of any reinforcement, would be classed as a shareable asset and recovered via use of system charges. This could also involve introducing the concept of "local circuit charges" into DUoS charges, so that the costs are targeted back on to specific users.

- **Standard connection charges**: a standard charge for extension assets and/or reinforcement could be calculated, with the remainder of any costs recovered from existing customers. This, if applied to extension assets, would go beyond a shallow boundary with existing users making some contribution to connecting user's extension assets (in addition to any reinforcement).

1.57. Recovering the cost of all reinforcement from existing users removes the entire locational signal from connection charges for connecting users. This could increase the risk of speculative bids from developers driving extensive network reinforcement for schemes that don't subsequently materialise.

1.58. However, a shallow boundary could potentially provide an increased opportunity for DNOs to consider more strategic and flexible approaches to developing their network and/or addressing new requests for capacity. One of the aspects of our assessment will be how dependent this is on moving to a shallow boundary – or if it would be possible through less substantial reform of the current arrangements. A shallow boundary could also go further in reducing the upfront cost faced by connecting users and potentially remove this as a barrier to new entrants.

1.59. Our assessment will consider this trade-off and we will also consider whether any of the options introduce the risk of any cross-subsidies between different users. For example, whether it would be appropriate for existing customers to contribute to a connecting user's own extension assets (as could happen with capped or standardised charges where the connection offer is less than the actual cost).

1.60. Our work will consider the implications of implementing a shallow connection boundary, as we are cognisant this would be a more substantial change to the current arrangements for users compared to other options.

1.61. Our initial assessment is that the option of all extension costs being recovered through connection charges may be preferable to the other options highlighted under paragraph 1.55. Recovering some costs through ongoing use of system charges risks introduces excessive complexity given there would be a need to consider local circuit charges (as existing within TNUoS charges). Standard connection charges risk blunting locational signals and introducing cross-subsidies between users. Both these latter options could also adversely impact the scope for IDNOs or ICPs to compete with DNOs in providing connections.

Table 4: summary of the comparison of different connection boundary depths

| Connection boundary depth | Pros | Cons |
|---|---|---|
| **Shallow-ish** (eg, keep the existing boundary combined but could still implement other options such as alternative payment terms) | + Delayed payment may reduce issues associated with high upfront cost (dependent on whether alternative payment is for extension assets or reinforcement or both).<br>+ Potentially straightforward to understand | - Could expose DNOs to bad debt risk. |
| **Shallower** (still recovering some reinforcement costs through connection charges, but less than now) | + Amending the apportionment rules would reduce cost but keep some locational signal depending on where any new level is set.<br>+ Recovering more reinforcement costs from DUoS charges could give networks more opportunity to consider innovative/ more strategic solutions to network development. | - Weaker locational signal but could be mitigated by more locational DUoS charging. |
| **Shallow** (no longer recovering any reinforcement costs through connection charges) | + Increased opportunity for DNOs to consider alternative approaches to developing their network, under current arrangements<br>+ Lowest level of upfront cost to connecting users | - Weakest locational signal for new connecting users (as above, will be considered alongside scope for more locational DUoS).<br>- Reducing reinforcement costs met by the connectee could create an incentive to over–request capacity that is needed (especially where connecting and DUoS customers are different).<br>- Some options may be excessively complex and or risk introducing cross-subsidies between users. |

### Liabilities and securities

1.62. Under the transmission arrangements, only a small proportion of the costs of connection for some demand and generation connections are recovered through connection charges, with the bulk of the costs being recovered through TNUoS charges that users pay once connected. The works required to connect these customers are typically high cost with long lead times. In the event that a project does not go ahead, and there has already been some investment made by the Transmission Owner, there is a risk that these costs will be recovered from existing customers.

1.63. Transmission connecting users therefore enter into agreement with the ESO that places liabilities on the user in the event they cancel. Users can also be required to provide financial security for some or all of the liability. For some works these liabilities fall away on energisation, while for others they continue after energisation. As well as protecting existing users, there are also wider benefits by incentivising the connecting user to keep the ESO informed of any changes to a project.

- For demand connections, the connecting user has to provide security for all of the liabilities; these are known as "Final Sums".
- For generation connections, the connecting party only has to provide security for a proportion of the liability; this is known as "User Commitment".

1.64. Moving to a more shallow distribution connection boundary will result in more of the cost of reinforcement being recovered via ongoing distribution charges. The risk of inefficient or stranded investment would therefore also shift to existing users. We think it is therefore prudent to consider whether some mechanism of liabilities and securities would be required at distribution should a more shallow boundary be introduced, to protect existing customers from the cost of connections that do not proceed.

1.65. In making our final decision, we will consider what is a proportionate response to the potential risk – balancing the likelihood of a project not proceeding as planned, and sums involved. The table below suggests that a number of distribution connections are, on average, low value (relative to transmission). Therefore, the risk to customers of, for example, a single low voltage (LV) connection not proceeding is low. More work is also required to understand the likelihood of cancellation. Implementing such arrangements for all distribution connections might be overly onerous for distributors to manage, and for consumers to understand. This suggests that, should some form of liabilities and securities be introduced at distribution, then some form of user segmentation may be appropriate.

***Table 5: comparison of distribution connections (source: 2018 RIIO-ED1 connections reports)***

| Market segment | Average charge to customer for a connection completed by the DNO (£) |
|---|---|
| Demand - LV work only | 1,595 |
| Demand - LV end connections involving HV work | 5,201 |
| Demand - LV end connections involving EHV work | 39,116 |
| Demand - HV end connections involving only HV work | 139,977 |
| Demand - HV end connections involving EHV work | 293,444 |
| Demand - EHV end connections involving only EHV work | 492,991 |
| Demand - HV or EHV connections involving 132kV work | 27,290 |
| Demand - 132kV end connections involving only 132kV work | 614 |
| DG - involving LV assets only | 9,607 |
| DG - with highest voltage at HV | 59,346 |
| DG - with highest voltage at EHV | 688,647 |
| DG - with highest voltage at 132kV | 17,165 |
| Unmetered | 812 |

# Section 4: Cross-cutting policy considerations

1.66. We intend to consider further to what extent it may be desirable to combine options. For example, we think that moving to a more shallow boundary could be combined with allowing users to pay for the connection costs associated with extension costs over time

1.67. We will also be considering how the options can be combined with other work streams in the Access SCR. We currently think the most important of these are the extent to which more locational DUoS can be achieved, and the final proposals for charge design.

1.68. The key interlinkage with locational DUoS options is the extent to which DUoS can provide a useful signal about reinforcement costs, meaning that there is less need for connection charging to provide that signal. For example, if new (as well as existing) users will be able to see where their DUoS charges will be higher due to an impending need to reinforce the network in that area then this could support moving to a shallow connection charge. This hinges on key questions we are considering within our work on locational DUoS options – can the extent of spare capacity in different locations be identified and reflected in ongoing charges, and will the charging model provide a sufficiently stable signal to influence new users' investment decisions? There could be different possible outcomes:

- we could conclude that improved signals are only possible at higher voltages, which might infer that connection charges would not need to recover any reinforcement needed at those voltages. This could lead to us retaining the shallow-ish connection boundary for low voltage connections, with shallower arrangements above this; or
- we could conclude that the DUoS charges should rise when the need for reinforcement approaches, but then fall once reinforcement occurs. A new connecting user could contribute to the need for reinforcement but only be able to connect once it has been completed, when DUoS charges will fall. This might infer that there is still a role for connection charges to provide a signal about the impact on reinforcement need to the connecting user. One option could be to set the connection charge they face to be similar to the DUoS charges that existing users pay as the need for reinforcement approaches.

1.69. With regards to charge design, one of the consequences of a more shallow boundary could be that connecting users have a reduced incentive to request only the capacity they need; instead they could oversize their request without facing the additional cost of reinforcement required to provide that capacity. This could result in oversizing the network and inefficient investment. If the signal provided by the upfront cost is removed, then this might be mitigated by options being considered for DUoS charge design – if their ongoing charges are based on their agreed capacity then they would have an incentive not to overstate their needs.

1.70. We have set out above that there could be a case for some form of user segmentation. This could be driven by the extent to which more locational DUoS can be achieved (as described above) or by user type. For example, whether there is justification for having different arrangements for small users. We will consider this as part of our ongoing assessment, including the pros and cons of adopting a common approach across all work streams.

1.71. Another key consideration of our assessment will be how any new arrangements help facilitate decarbonisation in a way that avoids unnecessary costs to customers – including the uptake of LCTs. We will also consider how well they support the benefits that new, innovative approaches and business models (such as local energy models) will bring to the system.

1.72. If we move to a different set of arrangements, there will be a number of users who have connected under the previous "legacy" arrangements. That is, they will have paid towards network reinforcement that a user connecting under new arrangements may not face (as a greater proportion might be recovered through DUoS charges). We are mindful that users should not be double-charged, and will consider the impacts of moving to a shallow boundary on those that have previously paid connection charges that included reinforcement costs. We will consider whether there is a need for transitional arrangements and what evidence exists to support it. This will take into account the complexity it could introduce and potential scope to reduce the benefits for consumers from the reforms.

1.73. There are also important links between the connection boundary and RIIO-ED2. If more of the cost of reinforcement is funded through DUoS charges, this will impact the total revenue that each DNO is allowed to recover. It will therefore be important to ensure that DNOs' forecast expenditure and network developments plans are efficient and will deliver value for all consumers. We will continue to work closely with colleagues working on RIIO-ED2 to manage these linkages including:

- allowed revenues for price controls,
- design of outputs and incentives (particularly around the connection process and efficiency),
- regional engagement, and
- strategic investment.

## Section 5. Summary of our preliminary views

1.74. We think the evidence gathered so far is inconclusive on whether there are barriers to entry and/or distortions being caused by having different arrangements at transmission and distribution. We note comments from those customers who have experienced issues when seeking to connect but more analysis is required to understand whether going ahead with a proposed connection would have resulted in an inefficient outcome for existing and future customers. If this is the case, then it could be argued that the current arrangements are working as planned. However, if these signals can be provided through alternative means – including potentially through improved locational signals through DUoS – and clear evidence does emerge that upfront costs are causing barriers then this could support the case for a more shallow connection boundary.

1.75. The analysis so far also suggests that there are likely to be trade-offs between different options. Connection charges currently give a strong signal about locating in different areas of the network – and moving to a more shallow connection boundary will reduce the signals on spare capacity faced by customers wishing to connect. On the other hand, recovering more of the cost of reinforcement from network charges might give DNOs an opportunity to be more strategic and flexible in considering their approach to reinforcement.

1.76. We consider that there will be a need to consider whether there may be case for some kind of user segmentation – by voltage level or some other means. However, we do think that the evidence is less convincing for going beyond a shallow boundary for all users (eg, capped or standard charges for extension assets) which could have negative unintended consequences in some cases. Where options such as a cap on charges may have merit, is in the protection of certain users from excessive charges. We discuss this further in our working paper on small users.

1.77. We will explore the options for liabilities and securities in more detail as part of our assessment. We think it is important that customers are protected from the cost of inefficient investment – but need to better understand the likelihood of this risk. We also note there is a material difference between types of distribution connection in terms of cost. We think that this could further strengthen the case for some form of user segmentation.