Report on proposed CUSC modification CMP376

Prepared on behalf of Centrica plc

Non-Confidential Report

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Date: 29 September 2023

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1. INTRODUCTION

1.1. Purpose of this report

1. Centrica has retained Charles River Associates (CRA) to provide an independent report examining the inclusion of queue management processes within the Connection and Use of System Code (CUSC) under CUSC modification CMP376.

2. We have been asked to focus on both the proposed CMP376 solution (the Original Proposal) and the 11 Workgroup Alternative Code Modifications (WACMs) proposed during the workgroup consultation process.

1.2. Structure of this report

3. This report is structured as follows:

- In Section 2, we provide an Executive Summary;
- In Section 3, we outline the nature and genesis of the issues with the existing queue system, and how these issues are impacting investment;
- In Section 4, we summarise the proposals under CMP376, including the history of discussion around queue management and the proceedings and consultations to date; and
- In Section 5, we set out the rationale for adopting the alternative option WACM7 assessing and quantifying its impact on the existing queue, the electricity system as a whole, and the UK's net zero goals.

2. EXECUTIVE SUMMARY

4. The current system for connecting new projects to the transmission grid was designed for an electricity system based on a small number of large fossil fuel generators connecting each year.

5. With the rapid proliferation of renewable energy projects, the existing queue for Transmission Entry Capacity (TEC) has become oversubscribed by a factor of 3-4. This oversubscription has become significantly worse in the last few years.

6. Of the current 371GW of projects in the queue, 114GW (54%) has an expected connection date of before 2029. However, 62GW of this (54%) is still in the scoping phase and, as far as National Grid ESO (NGESO) knows, has not secured land rights, nor applied for planning consents.[1]

7. A longer queue and longer wait for connections increases uncertainty for developers. For example, there are no available sites to connect generation in the regions of South Wales, North Wales, the North West or the South West before 2036.[2] This has a damaging effect on the investments required to meet the UK's energy transition and net zero goals.

8. CMP376 proposes to rectify these issues by conferring on NGESO (as transmission system operator) the power to manage the queue in order to more efficiently allocate capacity. This would be achieved by setting milestones for existing projects within the queue which, if not met, would see their Construction Agreements terminated.

9. The Original Proposal would see this applied to new or modified projects. Due to the large number of delayed projects in the current queue, this would have a limited effect.

10. WACM7 proposes to apply the same processes to all existing projects in the queue. Imposing WACM7 would be beneficial for electricity consumers, net-zero targets, and the wider electricity system.

11. Through analysis of typical project development timelines we find that 12.3GW of solar PV, onshore wind, stand-alone storage and co-located storage projects with expected connection dates prior to 2029 would be unlikely to connect without delay.[3]

12. If WACM7 were applied, many of these projects would be at risk of termination through the missing of milestones. If an additional 12.3GW of solar PV were to connect over this period instead, it would account for 3.3% of system demand in 2029. This hypothetical solar PV generation would reduce carbon emissions from energy supply and from fossil fuels in totality by up to 4% and 1.1% respectively and reduce wholesale prices through reduction of system long-run marginal cost (LRMC).[4]

13. A reduction of wholesale prices, which make up a large proportion of retail bills, would reduce energy costs for consumers. In addition, whilst more solar PV would otherwise increase network costs, this would be offset by the high volume of storage capacity connecting during this period.

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1 CRA analysis of the TEC register.

2 CRA analysis of the NGET Research Assistant (ConnectNow | Research Assistant (nationalgridet.com)).

3 CRA analysis of the TEC register.

4 See Section 5.4.

3. BACKGROUND

14. This section summarises the nature of the problem observed in the transmission connection queue. We consider issues around the length and composition of the queue and how it may impact investment.

3.1. The current queue is oversubscribed

15. From various angles, the current transmission connection queue appears oversubscribed. According to National Grid, GB needs between 123-147GW of low carbon generation to be connected to the grid by 2030, or additional capacity of 40-64GW relative to the 83GW currently on the system.[5]

16. In September 2023, 371GW of generation had contracts for future connection to the transmission system. [6] 166GW of this is due to be connected by 2030. By this very simple comparison, the queue is oversubscribed by a factor of 3-4, therefore, as compared to what is needed. Given limitations on network development and time taken to develop projects, we should reasonably expect a queue. A queue does not necessarily imply that this oversubscription is inefficient and needs to be eliminated.

17. We can use economic theory (Little's Law) to think about how long a queue is likely to be with a known need for connecting capacity each year. Little's Law relates the equilibrium length of a queue to the number of people entering a queue and the average waiting period before leaving it. This is illustrated in Figure 1 below.

Figure 1: Queue length theory

Little's Law

$$L = \lambda W$$

Where:

L = length of queue
λ = arrival rate (i.e., the number of people arriving in any period)
W = average waiting time of people in the queue

18. In an equilibrium, we can assume the length of the queue is not changing and the waiting time is not changing. This means the rate at which people exit the queue (the exit rate) is also equal to the arrival rate.

19. For example, if we know from National Grid modelling that about 11GW of new capacity needs to connect and start production each year between now and 2030 (64GW / six years) and if we approximate a normal waiting time of 5-7 years[7] then the queue would need to be 77GW long (exit rate * waiting period, or 11GW *7).

20. This is, obviously, quite a stylised and simplistic way to assess the scale of the problem but it is intuitively it is illustrating something reasonable. It would, however, also imply that the current connection queue is oversubscribed (by a factor of about two if we assumed all

5 NGESO, February 2023, https://www.nationalgrideso.com/news/eso-leads-way-major-initiative-accelerate-connections-electricity-transmission-grid

6 Excluding embedded generation.

7 Ofgem Open letter on future reform to the electricity connections process, pp. 5, 6.

projects in the queue will connect) for what is needed to output 11GW of new connections each year given the average waiting period and the 2030 objective.

3.2. The composition of the current queue

21. An analysis of the current projects holding positions in the queue for transmission capacity highlights the scale of the existing problem. The TEC register reports all projects currently in the queue, although does not indicate their position in the queue. Of the 371GW of capacity listed, there is a large majority of projects which are still in the early stage of development and may be blocking other projects more likely to reach completion earlier.

22. At the time of this report,[8] the TEC register contains 1,492 projects, of which 302 are classified as "Built", 131 as "Consents Approved", 872 as "Scoping", 162 as "Awaiting Consents" and 25 as "Under Construction/Commissioning".[9]

23. When projects that are already connected, projects related to reactive compensation, projects removing capacity and any embedded generation with a Bilateral Embedded Generation Agreement are removed, there are 10 "Built", 103 "Consents Approved", 774 as "Scoping", 152 "Awaiting Consents" and 17 "Under Construction/Commissioning".

24. Therefore, projects in the scoping phase (i.e. with a higher degree of uncertainty) make up 73% of all projects awaiting connection (representing 76% of capacity, or 282GW).[10] If those in the awaiting consents phase are also included (i.e. all pre-approval projects) this figure rises to 88% (representing 90% of capacity, or 335GW).[11] This is shown in Figure 2 below.

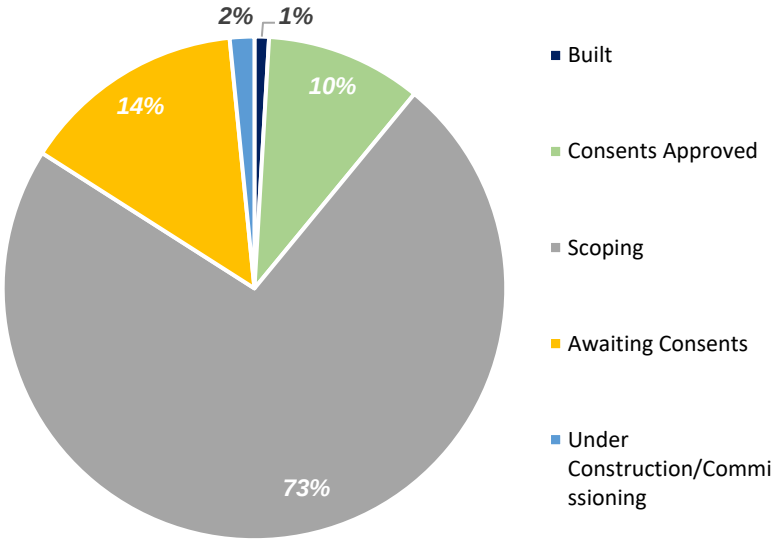
8 All references to the current TEC register refer to the version extracted as of 26/09/2023.

9 NGESO provides the following definitions for Scoping, Consents Approved and Awaiting Consents: Scoping – National Grid are not aware that a planning application has been made; Awaiting Consents – National grid are aware a planning application has been made; Consents Approved – National Grid are aware that planning application has been approved.

10 Note – for the purposes of this analysis we are including all prospective projects seeking direct connection to NGET, Scottish Power Transmission (SPT), Scottish Hydro Electricity Transmission (SHET) and Offshore Electricity Transmission (OFTO). We omit embedded generation with Bilateral Embedded Generation Agreements.

11 NGESO does not actively track the status of projects, instead relying on project developers to update NGESO when, for example, a planning application is lodged. Therefore, it is possible that some projects categorised as in scoping may be more advanced.

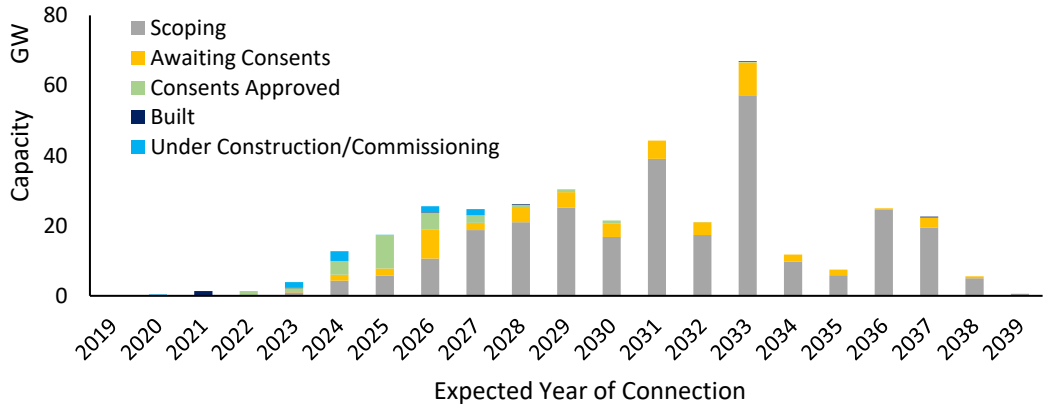
Figure 2: Projects by phase of development



Source: CRA Analysis of TEC register.

25. One would expect projects with connection dates well into the future to be in the scoping phase. However, of the 371GW in the queue, 114GW is expected to connect before 2029, and of this, 62GW (54%) is still in the scoping phase. A breakdown of projects by phase of development and their expected date of connection is presented in Figure 3 below.

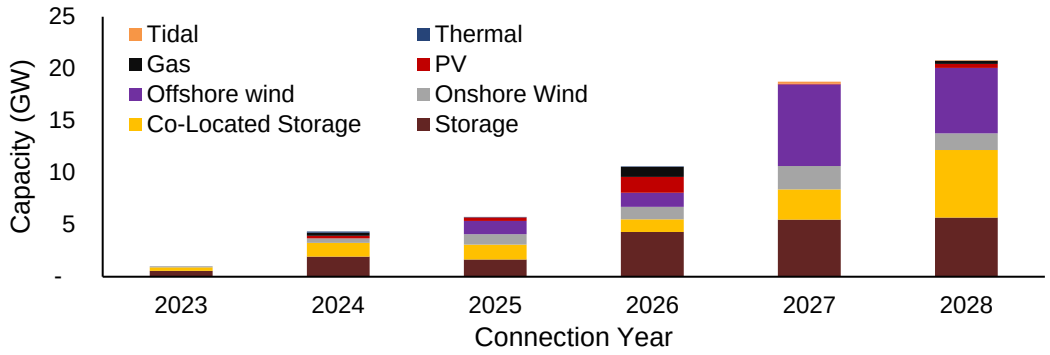
Figure 3: Project by phase of development and connection date



Source: CRA Analysis of the TEC register.

26. The 61GW of capacity in the scoping phase with a connection date before 2029 is predominantly storage (20GW), offshore wind (17GW), storage co-located with other assets (14GW), onshore wind (7GW), and solar PV (3GW). The breakdown of these projects is presented in Figure 4 below.

Figure 4: Projects in the scoping phase with connection dates before 2029 by technology type



Source: CRA analysis of the TEC register.

27. In November 2022, National Grid Electricity Transmission (NGET) noted that in England and Wales, there are about 170 projects (nearly 30GW) contracted to connect by the end of 2025. Of these, only half the capacity is shown to have planning consents in place, making it very unlikely that all these projects will be ready on time.[12]

3.3. The problem is getting more severe

28. Despite the length of the transmission connection queue, the queue has grown rapidly in recent years.

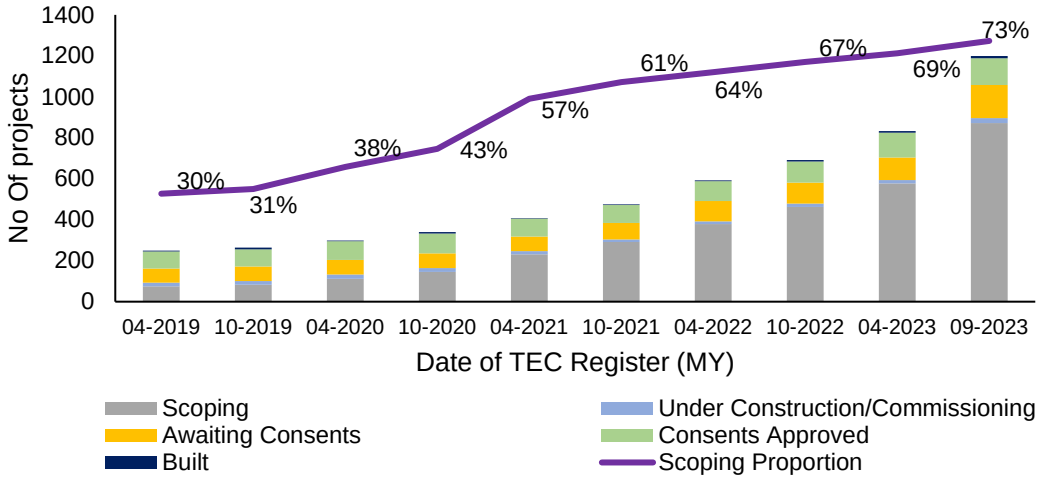
29. Our analysis of historical registers from September 2019 shows exponential growth in both the number (Figure 5 below) and capacity (Figure 6 below) of projects awaiting connection to the system. Our earliest records show a queue of 249 projects comprising 74GW of capacity, this has increased to 1,199 projects now comprising 380GW[13] of capacity, an almost 5-fold increase in the number of projects and an over five-fold increase in capacity.[14]

12 https://www.nationalgrid.com/electricity-transmission/queue-management-next-step-accelerating-grid-connections

13 Including embedded generation.

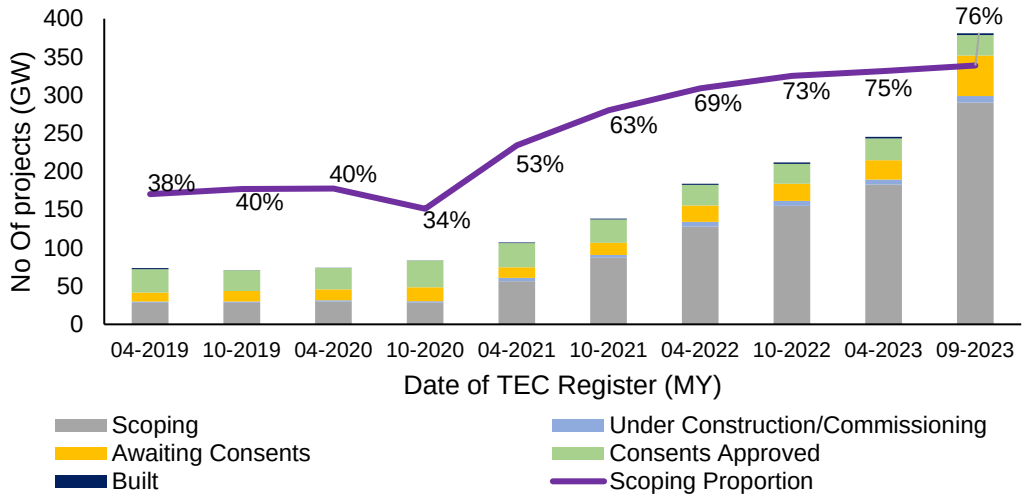
14 We define projects here as each potential entry to the grid, multi-stage entries to a grid for a single project are treated individually by this definition.

Figure 5: Number of projects in the queue over time



Source: CRA analysis of the TEC register.

Figure 6: Capacity of projects in the queue over time



Source: CRA analysis of the TEC register.

30. In that time the proportion of "scoping" projects has effectively doubled on a capacity basis. This increase began in earnest during 2021. The number of projects sitting in the scoping category no doubt reflects the length of the queue to connect with many more projects having longer dated connection dates.

31. Prior to that period the proportion of projects at each categorisation remained fairly consistent, which suggests a queue with an entry/exit rate closer to equilibrium. With the expected volume of projects required to connect to the grid for the UK to reach net-zero targets of grid decarbonisation this trend of increased capacity additions is unlikely to slow down or revert to historical trends over the next decade.

3.4. Customers rarely leave the queue

32. Of this queue, National Grid expects, however, only 30-40% of the projects in the queue to reach completion.[12] We find ourselves, therefore, in a situation where, notionally, the queue is oversubscribed for current needs but there is limited certainty that sufficient numbers of

that queue will be in a position to connect. If National Grid is correct in its project completion expectations, then the real queue is actually about 111-148GW (30-40% * 371GW).

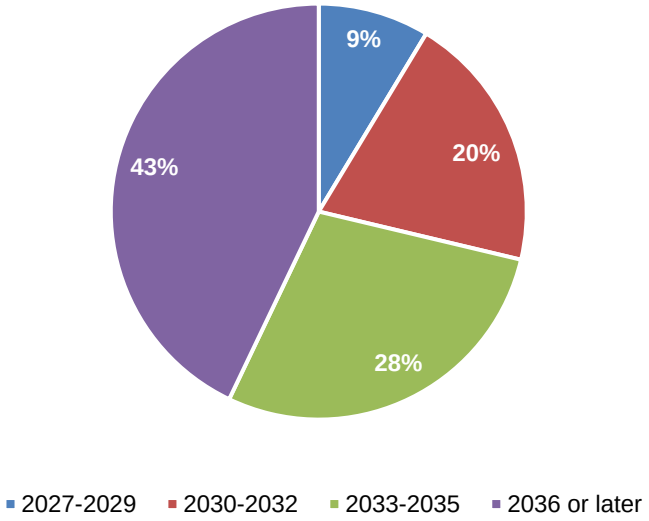
33. Whilst this means that the degree of oversubscription is less it means that some capacity which would be able to connect earlier cannot and some capacity which would like to connect cannot for want of available capacity held by the 60-70% of projects unlikely to reach completion. In addition, therefore, to being notionally too long, its composition would appear inefficient in that it does not adequately prioritise those projects most ready to connect.

3.5. The queue is impacting on new investment

34. The combination of a greatly oversubscribed queue and a queue in which few customers leave means that there is a strong limitation on the availability of new connections. This will have a detrimental effect on the scope for investment in GB low carbon energy.

35. Figure 7 shows the percentage of sites available for generation connection in England and Wales (total 289) by different time periods, as reported by NGET.[15]

Figure 7: Availability of transmission connections in England and Wales



Source: CRA analysis of the NGET Research Assistant.

36. Less than 10% of currently available sites in England and Wales to connect to the transmission network are available before 2030 (and none before 2027). 43% of sites could only be available to connect by 2036 or later. There are no available sites to connect generation in the regions of South Wales, North Wales, the North West and the South West before 2036.

37. The underlying data, according to NGET, is only indicative and does not consider any site-specific constraints which may prevent connections in the timeframes shown. Hence, with further system studies, it is likely that actual number of sites available for connection may be even lower.

15 NGET Research Assistant ConnectNow | Research Assistant (nationalgridet.com)

38. The UK electricity market must compete of investment with other parts of the economy as well as investment opportunities in the energy sector abroad. A determining factor for low carbon generation and storage investors is the relative certainty of future cost and revenue streams associated with the project over the development and life of the proposed asset.

39. The energy system is no stranger to long investment time horizons. Normally, time to start-up is an important feature of any investment decision. In the past, the primary constraint has been in the speed with which a project could be permitted and constructed. The costs of development would largely be predictable. The current system demands not only that but also that new investors take a view on the future viability of projects in the middle 2030s some 10-15 years into the future.

40. A longer queue increases, therefore, both uncertainty around future market conditions applicable to a project and the construction and development costs of the project itself. Other things being equal, this will discourage future investment and/or raise the costs of investment (or reduce access to capital) and so ultimately increase the costs to electricity consumers.

41. Current inflationary pressures in the supply chain illustrate this problem. There has been in the past year significant changes in the cost of development for low carbon energy projects that may well not have been predicted just five years ago.

42. Conversely, by shortening the waiting period for new connections, investors will gain higher revenue certainty, reducing the risks new low carbon energy projects currently face, in turn lowering the cost of capital and overall costs for consumers.

43. It is important that the UK be an attractive investment location. Regulatory treatment of investments is part of any investor's considerations. The ability to get a timely connection and the inability of NGESO to speed up the connection process is, however, a detriment to investment incentives. The issue of delays in connections is not limited to the UK. The extent to which the UK addresses this issue should in fact increase the appetite to investment in low carbon energy. For example, the US Energy Regulator recently adopted new interconnection rules to impose commercial readiness requirement on new generator interconnection applicants, requiring more concrete interconnection plans and forfeitable deposits. It also enacted a transition process to move existing interconnection applications to the new rules to comply with its first ready first served cluster approach.[16]

16 US Energy Regulator Adopts New Interconnection Regime | Perspectives & Events | Mayer Brown

4. CMP376

44. In this section, we provide an outline of the background and timeline for proposals to alter the CUSC to include changes to the queue management process. In particular, we focus on the options to include queue management provisions for existing projects in addition to future ones.

45. The current CMP376 proposal is derived in part from previous work by the Energy Networks Association which culminated in changes to how Distribution Network Operators (DNOs) managed queues. This section will, therefore, also summarise learnings from implementation of queue management in distribution networks with focus on its application to existing projects.

4.1. Background and timeline

46. The Energy Networks Association (ENA) published its initial progression milestones for projects looking to connect to distribution networks in 2016,[17] following Ofgem's request to develop principles and rules that apply milestones in connection offers to deal with wider queue management issues.[18]

47. ENA, under its Open Networks project, published an updated queue management guide[19] building upon the conclusions from 2018, 2019 and 2020 stakeholder consultations which proposed application of queue management principles to distribution and transmission projects in connection queues starting July 2021.

48. The updated queue management guidelines applied to all distribution network applications received on or after 1 July 2021.[20]

49. This was also followed by initial implementation of new queue management guidelines in transmission Construction Agreements beginning September 2021.[21] In parallel, a formal code modification was raised (CMP376) to apply these changes to CUSC.

50. However, based on initial engagements with industry stakeholders on the code modification, NGESO concluded that the ENA queue management process for transmission connections needed to be more robust and appropriately designed for transmission level projects. As a result, NGESO paused the inclusion of queue management clauses in the transmission Construction Agreements in Feb 2022.[21]

51. NGESO engaged with the wider industry stakeholders and developed a queue management proposal informed by the feedback received from customers and Transmission Owners (TOs) under CMP376.

17 ENA Milestones Best Practice Guide 2016

18 Quicker and more efficient distribution connections | Ofgem

19 Open Networks Project Queue Management User Guide

20 Open Letter to the implementation of Queue Management principles in GB

21 https://www.nationalgrideso.com/document/244946/download

4.2. Proceedings to date

52. The CUSC is the contractual framework for connecting to and using the National Electricity Transmission System.[22] However, there are currently no mechanisms in CUSC that allow network operators to actively manage connection queues to ensure that the available capacity on the system is utilised and allocated efficiently. The network operators rely on the First Come, First Served (FCFS) principle which does not consider projects that can progress more quickly.

53. CMP376 proposes to introduce queue management processes into the CUSC, including a right for the NGESO to terminate contracted projects which are not progressing against specified milestones.[23]

54. The CMP376 Original Proposal would introduce the new queue management approach to all new applications, new modification applications and new Agreements to Vary (ATVs) for parties with a Construction Agreement.

55. The workgroup consultation and the code administrator consultation were an integral part of the modification process. Workgroup members proposed 11 WACMs to the Original Proposal (see Figure 8 below. These primarily centred around the themes of applicability of CMP376 to existing agreements, adjustments to proposed milestones,[24] and dynamic queue management. These are described in more detail below.

Figure 8: CMP376 WACMs

Other Solutions	How does it differ from Original
WACM1	Milestone M6 to say "Submit" rather than "Agree" Construction Plan
WACM2	As WACM1 but applies as per WACM7
WACM3	Milestone M3 Land Rights changed to blanket 3 months after connection offer date
WACM4	As WACM3 but applies as per WACM7
WACM5	Milestones M7 Project Commitment and M8 Construction bilaterally negotiated
WACM6	As WACM5 but applies as per WACM7
WACM7	Applies to all existing agreements with a connection date of 2+yrs or less than 2yrs if not progressing
WACM8	ESO's immediate right to terminate is removed for milestones M5 to M8 and replaced with reassignment of queue position i.e. dynamic queue management
WACM9	As WACM8 but applies as per WACM7
WACM10	User can agree with ESO which category of milestone duration applies.
WACM11	Allows for User not meeting M7 Project Commitment because it is waiting on confirmation of a governmental or regulatory subsidy for the project

Source: CMP376 Final Modification Report, Workgroup Alternatives.

Adjustment to proposed milestones (WACMs 1, 3 & 5)

- Discussions on modifications of milestone M6 (Agree Construction Plan), M3 (Land Rights), M7 (Project Commitment), and M8 (Initiate Construction) focused on

22 https://www.nationalgrideso.com/industry-information/codes/connection-and-use-system-code-cusc

23 https://www.nationalgrideso.com/document/203236/download

24 CMP376 defines milestones as "benchmarks agreed or set out contractually between network companies and customers to measure and track project progress towards a contracted connection date". The Original Proposal applies milestones back from the contracted completion date. Milestones M1-M3 ("Conditional Progression Milestones") result in automatic termination if missed, whereas milestones M5-M8 ("Construction Progression Milestones") give NGESO the "right" to terminate, instead of automatic termination.

providing projects more flexibility to reduce risk of stranded investment and provide NGESO more clarity on status of projects.

- Application of these WACMs is also considered for existing projects through alternate WACMs which cover all the Construction Agreements in the queue (new and existing).

Dynamic queue management (WACM8)

- Some workgroup members argued for removal of NGESO's right to terminate projects for missing milestones M5 to M8 and instead permanently reassigning their position in the queue. It was argued that for projects which have committed significant funds but are albeit progressing at a slower rate than the listed milestones, it would be harsh to push them out of the queue completely.
- This modification is also considered to be applied to existing projects through alternate WACM9 which covers all the Construction Agreements in the queue (new and existing).
- NGESO is entitled to exercise discretion under the Original Proposal and is unlikely to terminate viable projects subject to genuine delays. However, as projects are incentivised to remain in the existing queue position (as outlined in Section 5.1 below), removing the right to terminate could see no longer viable projects remaining in the queue for longer than necessary (as, for example, they negotiate with NGESO or remain in a lower queue place). Furthermore, NGESO's termination rights may incentivise delayed projects to submit a modification application sooner, making the whole queue more efficient.
- These termination rights would be unlikely to dissuade genuine projects, as they would either be on time, would have submitted a modification application, or could be confident that NGESO would exercise discretion.

56. Overall, the panel unanimously agreed that the Original Proposal, WACM1, WACM5 and WACM10, and by majority all the other solutions, better facilitated the CUSC objectives. The workgroup also concluded by majority that all the proposed solutions (except WACM9) better facilitated the CUSC objectives than the current baseline.[23]

4.3. Applicability of CMP376 to existing projects

57. The existing projects in the queue which do not submit any modification applications would not be subjected to CMP376 under the Original Proposal. CMP376 aims to address short term challenges associated with transmission connections.[23] WACM7 applies queue management milestones to all Construction Agreements (where the contracted completion date is more than two years away, or projects with a contracted completion date of less than two years but are not progressing).

58. Similarly, other proposed WACMs (2, 4, 6 & 9) would apply proposed workgroup modifications to all existing agreements (with a contracted completion date of two years or more, or projects with contracted completion date of less than two years but are not progressing) after the implementation date of the code modification.

59. The proposed implementation of CMP376 to existing agreements involves a phased approach where NGESO will issue a notice to all customers with an existing Construction Agreement once CMP376 is implemented and giving them six months to exercise relevant options.

- Projects with a contracted completion date of less than two years will face no change to their agreements, unless their project is no longer progressing.
- Projects with a contracted completion date of greater than two years could choose from two options within next six months. These customers could decide whether to keep their existing completion date and accept the ATV or to submit a modification application to change their completion date. This would allow inclusion of queue management milestones to their existing agreements aligned with their updated completion date (based on the option exercised).

60. The main arguments put forward during the workgroup discussions were that:

- The Original Proposal would take longer to fully realize the benefits. This is because it will solely rely on existing customers submitting a modification application for inclusion of milestones in their existing agreements.[25]
- Inclusion of existing projects would make a significant difference to the current issues with queue management by allowing NGESO to assess older, potentially stalled projects which are holding capacity, and utilise the CMP376 process to consider terminating and freeing up capacity in the queue.[26] It was argued that most stalled projects in the queue will be excluded without WACM7.
- Excluding existing projects by default from the scope of CMP376 implementation risks the creation of two-tier contracting regime, with uneven treatment between new and existing projects, which will reduce effectiveness of the CMP376 in delivering connections economically and efficiently. [27] It would also increase the disincentives for existing stalled or speculative projects to exit the queue.[28] WACM7 was, therefore, designed to ensure even treatment between projects.

61. Some parties raised concerns against the application of CMP376 to existing projects as it would mean modifications to terms of contracts that have already been agreed.

- This may create a precedent that allows for modifications to change terms of existing contracts that have already been agreed. Hence, this implementation approach would introduce a new risk for developers considering investing in the UK market.[29]
- Introduction of WACM7 may risk inefficient implementation of CUSC arrangements by bringing administration and efficiency challenges due to requiring the majority of users to transition to queue management.[30]

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25 NGESO, WACM7 Proposal.

26 Annex 8, CUSC Alternative and Workgroup Vote, Voting Statement SHET. Other respondents to Code Administrator Consultation like Field, Renewable Energy Systems Limited, Zenobe, ScottishPower Energy Networks, Eclipse Power Networks, SSE Generation Ltd., Innova Renewables Ltd., Scottish Government supported application of QM principles to all parties in the queue.

27 Annex 8, CUSC Alternative and Workgroup Vote, Voting Statement NGET.

28 Annex 10, Code Administrator Consultation Responses, Centrica.

29 Annex 8, CUSC Alternative and Workgroup Vote, Voting Statement RWE.

30 Annex 10, Code Administrator Consultation Responses, Drax.

- The possibility of applying provisions to the existing queue had not been clearly flagged to parties in advance which could additionally undermine market confidence.[31]

4.4. ENA's implementation of queue management to existing agreements

62. The queue management principles which underlie CMP376 have been derived from earlier work by the ENA on queue management to address growing issues with scarcity of connections and inefficiencies in how the queue allocated scarce capacity. As noted above, the ENA approach was implemented for connections to the distribution network but not the transmission network. It is useful, however, to note that this topic was under discussion for a number of years before the ENA issued its open letter in March 2021 announcing the implementation of queue management principles in GB. This was intended for all GB network companies to include queue management process in new and modified connection applications starting July 2021. This updated queue management guide was a result of extensive stakeholder consultations in 2019 and 2020.

63. In its 2020 consultation,[32] the ENA sought stakeholder comments on the ENA Queue Management User Guide across various themes including whether this queue management approach should apply to existing contracts. Under the consultation, it was concluded that while existing projects are subject to specific contractual terms, new process (such as the proposed queue management approach) could be applied with the agreement of both parties.[33] At the time of implementation, existing projects prior to 2017 were not included.

64. While the DNOs have already been working bilaterally with users to modify older Construction Agreements, this process has not proved sufficient to free up stalled capacity in the distribution queue. This is reflected below in the recent action plan by ENA to further reform its distribution network connection queue.

65. To address scale of the connection issue due to volumes of projects trying to connect to distribution networks, ENA's Strategic Connections Group (SCG) identified short- and medium-term improvements to the distribution connection process.[34]

66. ENA's SCG recommended reforming the distribution network connection queue by identifying pre-2017 Construction Agreements and either applying progression milestones to them or removing them from the queue.[35] This will free up stalled capacity from older Construction Agreements that are not progressing to increase the pace of connections to distribution networks.

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31 Annex 10, Code Administrator Consultation Responses, EDF Energy.

32 https://www.energynetworks.org/industry-hub/resource-library-old/open-networks-2020-ws2-p2-queue-management-consultation-document.pdf

33 https://www.energynetworks.org/industry-hub/resource-library-old/open-networks-2020-ws2-p2-consultation-summary.pdf, p. 3.

34 https://www2.nationalgrideso.com/document/281561/download.

35 https://www.energynetworks.org/operating-the-networks/connecting-to-the-networks/improving-and-accelerating-customer-connections

67. In this regard, Ofgem itself noted in its open letter on future reform to the electricity connections process:

> *"Whilst most distribution connection agreements signed after 2017 contain milestones, this is not the case for older connection agreements. Furthermore, these older connection agreements generally relate to projects that are delayed. Without milestones, these older, delayed projects, occupy a place in the DNOs' connection queues and prevent other projects – that also have connection agreements – from being able to connect to the distribution network.* ***Ofgem, therefore, supports the principle of DNOs introducing progression milestones into older connection agreements to facilitate the more active management of distribution connection queues.*** *Any such changes to connection agreements should be agreed through bilateral discussions between the contracting parties, under the terms of these existing connection agreements. Ofgem also supports the principle of DNOs optimising the capacity headroom in distribution connection queues by actively accelerating projects that are ready to connect, ahead of projects that have failed to achieve their progression milestones and/or that are unable to connect currently due to the amount of capacity available. It is important that there is a consistent approach to determining which projects are ready to connect, and DNOs should work closely with each other, the TOs and ESO to agree relevant definitions."*

5. ADOPTION OF WACM7

68. In the previous sections, we set out how the existing queue is oversubscribed and comprises a significant number of projects which will either be delayed or will never complete. This section sets out a number of arguments as to why it is important to adopt WACM7.

5.1. Economic rationale for adopting WACM7

69. WACM7 is needed in order to correct for a common issue with FCFS. FCFS is simple and easy to understand. As it treats each project in the queue equally (on a like-for-like basis) and doesn't require frequent and complex reconsideration of scheduling, it is less administratively burdensome. But such a system – which guarantees each project will eventually get a chance to connect, as long as it is ready, and the network has enough resources to handle all the projects – is really only suited for situations absent scarcity or time constraints.

70. A significant issue arising from FCFS is the "convoy effect". Projects in the queue have the possibility, if delayed, to bottleneck projects behind them. This might be thought of like a queue of cars stuck behind a slow-moving truck without the potential to overtake, as illustrated in Figure 9 below.

Figure 9: The convoy effect

Source: CRA analysis.

71. Ideally, the slow-moving projects in the existing transmission queue would move out of the way. Notwithstanding all the other initiatives proposed to improve connection capacity and notwithstanding contractual considerations, any proposal that does not address the existing projects risks perpetuating the lengthy queue problem created by the convoy effect. In Figure 9 above, this would be like re-ordering the cars behind the truck.

72. In part, this is because there are several reasons why it is economically rational under the current system for certain projects to remain in the queue, even if they are not ready to connect, as we outline below.

Unearned value in a queue place

73. Some industries use queues as a mechanism to signal value in the product being waited for (for example at a restaurant, tickets for an event, or the release of a new consumer product). In such circumstances, gaining a place in the queue has some value in its own right. This value might be monetised in return for that place subject to the queuing rules in place.

74. The current transmission connection queueing system was designed for a system which connected a small number of large fossil fuel plants each year. It was never intended to manage connections as a scarce resource. However, its design has not kept pace with the

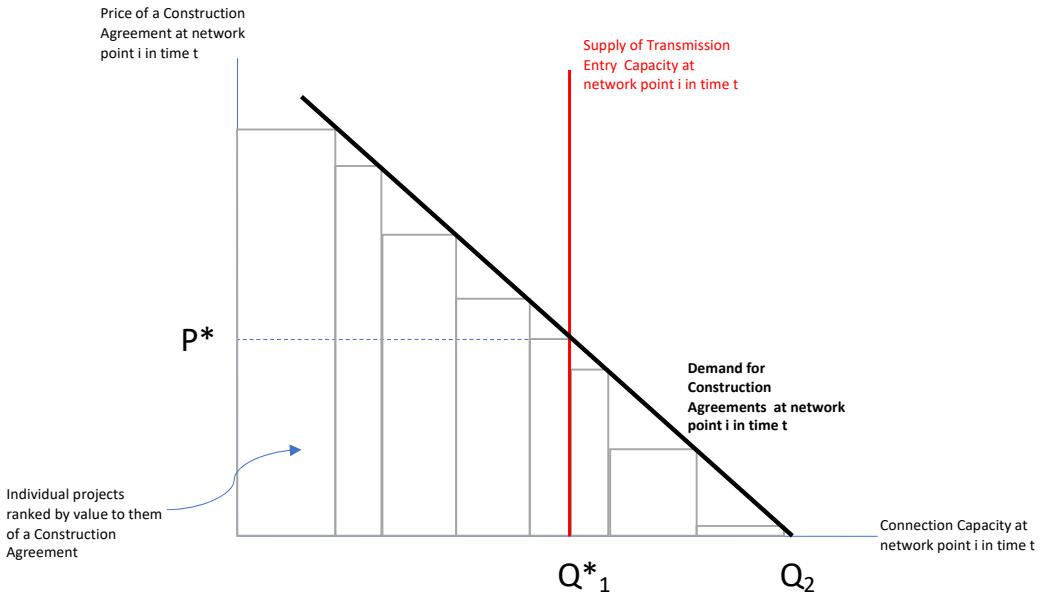
rapid changes seen in the energy sector. As a result, the queueing system is now, unintentionally, creating value in and of itself.

75. An alternative mechanism, given the existence of scarcity of connection capacity, would be to auction the rights to connect. An auction is not suggested here by us and has been rejected explicitly in the past (and involves potential negative implications not considered in this report). It offers, however, an instructive explanation – as a counterfactual - as to how such value has been created.

76. In an auction market design, those with the highest value to for a Construction Agreement would be prioritised (as they would bid the highest price). The value a project places on a Construction Agreement is a function of the economics of the underlying project and its likelihood of successful development. The two are, of course, correlated, with more economically viable projects being more likely to succeed (and in a shorter timeframe, all else being equal).

77. Currently, there is no explicit market price for a connection date. In fact, the cost of the Construction Agreement is low. Figure 10 below illustrates how this combination of circumstances creates excess demand.

Figure 10: Illustrative supply & demand for connections



Source: CRA analysis.

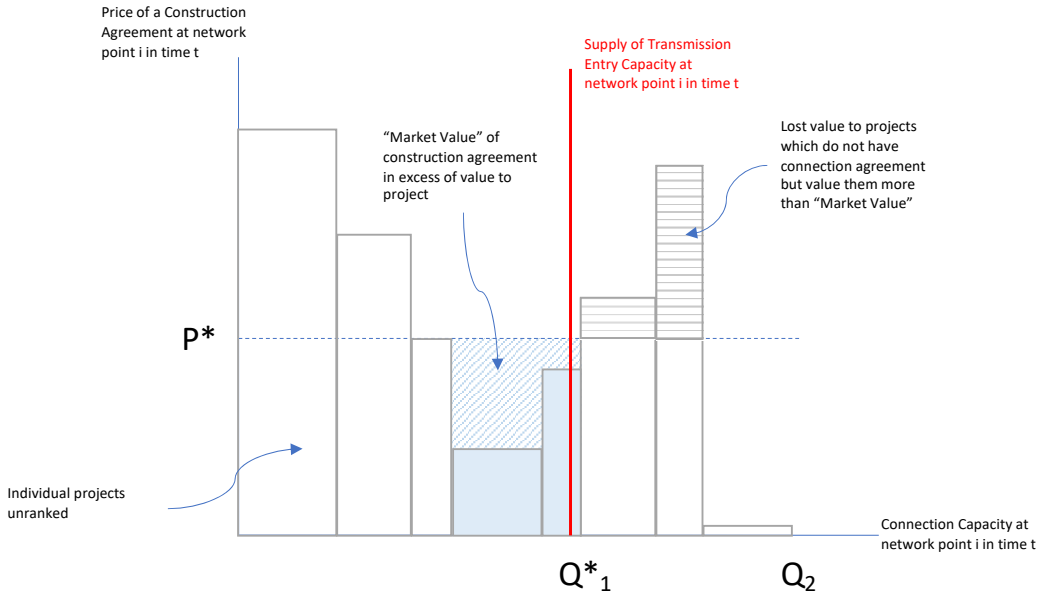
78. In this simple example, the supply of connections at network point i at time t is fixed at Q^*_1. Given the demand for connections in the same place and time, were an auction for those Construction Agreements held then the price for a connection would be P* and supply and demand of connections would equalise at Q^*_1. Furthermore, only projects which valued a connection at greater than price P* would secure Construction Agreements.

79. As no explicit value is ascribed through an auction in the current system and the cost of holding a place in the queue is small, instead demand is Q_2 and an excess of demand over supply results of $(Q_2 - Q^*_1)$.

80. In addition, whilst an auction would organise potential projects by the value they placed on a connection, the current system does not. In effect, some of the projects in the range (Q_2

- Q^*_1) have Construction Agreements even though there are other projects which value an agreement at more than P* but do not have one. This is shown in the Figure 11 below.

Figure 11: Illustration of unearned rent generation



Source: CRA analysis.

81. In this example, the two shaded projects have agreements that would not have received them under an auction approach and two projects which would have won under an auction format have lost out. These projects now possess a place in the queue which has a value greater than the price they would have been willing to pay for it (shown by the blue shaded area).

82. The value to the winners is unearned value. It does not relate to the value of the project but rather the inefficiency of the queuing system.

83. This auction example is hypothetical. However, P* could be said to represent the market price of the secondary market for places in the queue. This secondary market was recognised in the Scottish Government's response to the Code Administrator Consultation:[36]

> *"[This] Reiterates the need for wider additional reform to queue management* ***to reduce the growing trading market in obtaining and selling connection contracts*** *to enable swift connection to those who are ready to connect." (Emphasis added)*

84. Due to the scarcity of the resource, and the limited cost in obtaining a place in the queue, a secondary market 'producer' (a holder of a higher place in the queue) is able to sell its good (the place) at a price higher than the value it places on it to a secondary market 'consumer' (a project with a lower place in the queue), thus capturing a larger proportion of the overall economic surplus.

85. This value, represented by the blue hatched area in Figure 11 above, might be extracted as profit via the secondary market. This raises costs for all electricity consumers as projects

36 Annex 10, Code Administrator Consultation Responses, Scottish Government.

which have had to pay for a place in the queue on the secondary market need to recoup those costs through higher electricity prices.

86. It is important to note that the shaded projects highlighted in Figure 11 above are not necessarily unviable. Some may be more expensive projects that would be unable to pay as much for a place in the queue as other projects (under the hypothetical auction scenario). However, based on the analysis presented in Section 5 it seems likely that some proportion of projects in that position are broadly speculative.

Cost penalties

87. Once a project holds a Construction Agreement, it is liable to certain cancellation charges if it wishes to cancel said Construction Agreement. Depending on the stage and progress of the project, these amounts are different at different times. However, some fee applies at all times following the conclusion of a Construction Agreement.

88. As a result, this provides an incentive to remain in the queue even if a project has a low probability of success. This is exacerbated if a project is holding unearned value from its place in the queue (as outlined above) which is higher than the cancellation charge. NGESO has recognised the effect of this incentive by providing an amnesty on such charges for projects volunteering to exit or reschedule in the queue. However, many potentially delayed projects did not take advantage of this amnesty, suggesting that their place in the queue is more valuable.

5.2. Impact of WACM7 on existing projects

89. By applying timelines and milestones to existing projects, WACM7 eliminates the possibility for projects to accrue value simply by holding a specific position in the queue:

- By implementing a timeline, it increases the risk of speculative applications as it increases the risk of bearing costs from delays in the project or cancellation fees. WACM7 does not remove the risk of penalty, but it does remove the ability of projects to capture unearned rent from their position in the queue; and
- By more quickly eliminating (or moving back in the queue) existing projects with limited possibility to complete it makes the queue more efficient or commensurate with timelines required to bring a project to completion it reduces the value of a position in the queue. Developers would know if they chose to get a connection date later that it would not adversely affect the time to development.

90. In addition, several objections and concerns were raised to applying CMP376 to existing projects through WACM7, both in the workgroup consultation[37] and the code administrator consultation.[38]

91. These concerns generally revolve around the following arguments:

- That application to all projects forces a new regime on existing contracted parties,[39] or that application would be unfair to existing agreement holders;[40]

37 Annex 5, CMP376 Workgroup Consultation Responses.

38 Annex 10, CMP 376 Code Administrator Consultation Responses.

39 Annex 9, CMP376 Code Administrator Consultation Responses Summary Table, Bank Renewables Limited.

40 Annex 4, CMP376 Workgroup Consultation Responses Summary Table, Floating Energy Allyance.

- That application to all projects would set a precedent of changing the terms of existing contracts, thereby introducing additional risk for potential investors;[41]
- That parties with existing agreements have not been made aware of a potential change to the queue management process;[42] and
- That NGESO should not have the automatic right to terminate for certain milestones.[43]

92. In our view, these arguments do not preclude application of CMP376 to existing projects (as per the WACM7 option).

93. While some responses argued that WACM7 would amount to forcing a new regime and new contractual terms on existing Construction Agreement holders, this does not appear to be the case. The standard NGESO Construction Agreement is subject to the CUSC, and any updates to the CUSC are to be reflected in Construction Agreements.[44]

94. Ofgem note that *"[the] industry codes [including the CUSC] are 'live' documents, meaning that they can be changed"*.[45] In addition, NGESO (as administrator of the CUSC) publishes a monthly modification tracker. As a result, developers are aware of the possibility of changes being made to the CUSC, and that those changes would be translated into any existing Construction Agreements (as outlined above).

95. CMP376 was initially raised in July 2021. However, that was an intermediate step of a longer process. As outlined in Section 4 above, the code modification proposal followed the publication of the ENA's guidelines on milestones for connections to distribution networks in 2016 (following a request from Ofgem). Therefore, although an official code modification proposal was not raised until later, the prospect of reform to the queue management procedures has been a live issue regarding distribution networks for more than eight years.

96. Given the similar drivers behind queue management issues in distribution and transmission networks, in our view it would have been foreseeable even in 2015 that such issues could possibly arise for transmission networks. In any case, by 2020 it was clear that this issue would also be examined in relation to transmission networks.[46]

97. Furthermore, the application of CMP376 to all existing projects would not be unfair to those already holding a Construction Agreement. If a project is on track, it would not be affected by application of the approach under CMP376. Only projects that are delayed or not progressing would be affected. Those projects are, by definition, not likely to be ready to connect by the agreed connection date. Based on the concepts outlined in Section 5.1 above, the only value affected is the unearned and unintended value from simply owning a position in the queue. Therefore, either negotiating a new date or being moved to the back

41 Annex 9, CMP 376 Code Administrator Consultation Responses Summary table, RWE. Note that RWE response mostly relates to situations where existing projects have procurement contracts signed which may not conform to milestones.

42 Annex 9, CMP376 Code Administrator Consultation Responses Summary Table, EDF Energy.

43 Annex 4, CMP376 Workgroup Consultation Responses Summary Table.

44 CUSC Schedule 2 Exhibit 3 - Construction Agreement v1.13

45 https://www.ofgem.gov.uk/energy-policy-and-regulation/industry-codes-and-standards

46 Contracted Connections Queue Management Consultation Document

of the queue (assuming a project reapplied) would have a very limited effect on only the least viable projects.

98. This is particularly true given that, even if it lost its existing position in the queue, the project would now be operating under the new approach of CMP376. As a result, it would be significantly less likely to be held up by other projects once it were ready to connect (and could feasibly overtake other projects in the queue if they were delayed).

99. Indeed, if CMP376 were not applied to existing projects, this could artificially inflate the value of pre-reform Construction Agreements, unintentionally benefitting developers who have hoarded connection capacity with unviable projects (if, for example, they were able to sell their position on the secondary market).

100. Failing to apply CMP376 to all existing projects would result in a significant reduction in the benefits experienced by users of the transmission system and, by extension, all electricity consumers. As shown in Section 3 aboveAs shown in Sections 5.3 and 5.4 below, there is substantial connection capacity currently in the queue which may not be ready by its agreed connection date.

101. Without enabling NGESO to remove projects from the queue with low prospects of success (or success according to its existing timeline), the current issues with the queue would largely remain the same, and very little benefit would be felt by consumers.

In effect, this would be equivalent to implementing CMP376 with a lengthy period of delay, as NGESO would have to engage in bilateral negotiations with each delayed project, with no right to enforce termination or dynamic queue management. Any new applications operating under the CMP376 approach would still face an unnecessarily long wait to connect. Given the scale and inefficiency of the current queue, any delay (even if not explicitly a delay) is unjustified.

5.3. Impact of WACM7 on the existing queue

102. To quantify the effect of WACM7 on the existing queue, we examine all projects in the scoping phase and highlight those which would face short timelines to reach the milestones outlined by CMP376. M3 – successful acquisition of land rights – is the most imminent and may cause projects to be at risk of automatic expulsion from the queue.

103. To do this, we assume a hypothetical scenario where CMP376 is applied to all existing projects in the queue (per WACM7)[47] with an implementation date of 1 January.[48]

104. We then categorise each project according to the relevant time bracket outlined in the CMP376 Original Proposal (per the project's connection date). For example, a project with a connection date of 2 January 2026 would fall into the "2 up to 3 years from contracted Completion date" bracket.[49] This dictates the timeline for that project's milestones. This is illustrated in Table 1 below.

47 Excluding embedded projects and offshore wind. Offshore wind requires seabed leases with the Crown Estate (or evidence that such leases will be obtained) in order to apply for a Construction Agreement with NGESO. Therefore, we assume offshore wind projects in the TEC register would be able to achieve the M3 milestone upon implementation of CMP376.

48 Consistent with Implementation Approach outlined in CMP376 Final Modification Report pp. 47-48.

49 CMP376 Final Modification Report - Conditional Progression Milestones p. 11.

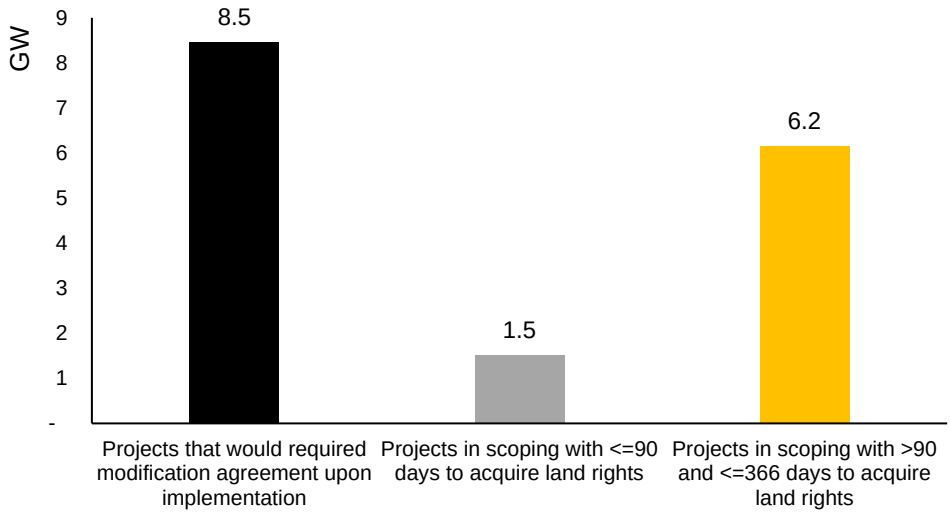
Table 1 - Illustrative calculation of date required to achieve M3 milestone

Expected Connection Date (a)	Contract Start Date (b)	CMP376 Bracket (c) = (b)-(a)	M3 milestone backdate from connection date (d)	Date of required M3 milestone (e) = (a) – (d)	Days to complete M3 (f) = (e) – (a)
02/01/2026	01/01/2024	Two to three years from contracted completion date	21 months	02/04/2024	92

Source: CRA analysis of TEC register.

105. If WACM7 were implemented, 16GW of capacity still in the scoping phase would have fewer than 12 months to achieve the M3 milestone (or would require a Construction Agreement modification as they would essentially have no time to secure land rights).[50] Of this, 8.5GW would require a modification agreement (as it has a connection date of less than two years), 1.5GW would have less than 90 days and 3.6GW would have between 180 and 366[51] days to meet the M3 milestone.[52] Notably, this is in excess of the capacity that responded to the recent TEC amnesty, as shown in Figure 12 below.

Figure 12: Capacity in the scoping phase by estimated time to complete CMP376 M3 milestone



Source: CRA analysis of the TEC register.

50 WACM7 proposes to apply the CMP376 proposals to projects with a connection date of less than two years in the future only if they are not progressing. Given typical project timelines, for the purposes of this analysis we have assumed that all projects with connection dates of less than two years that are still in the scoping phase are not progressing.

51 366 days are used as 2024 is a leap year.

52 As “scoping” reflects a project where NGESO are “not aware” of a planning application being made, it is possible that some projects in that phase have already secured land rights.

106. We note that projects in scoping that we highlight as requiring a connection date modification may have already submitted a modification request to NGESO or may be progressing without having informed NGESO. However, we highlight this number to illustrate the magnitude of capacity that may be at risk of expulsion from the queue upon the implementation of WACM7.

107. Acquiring land rights can be a complex process, particularly if more than one landowner is involved (as was highlighted in stakeholder comments to M3). This suggests a number of projects sitting close to the front of the queue may have a low likelihood of meeting their M3 milestones.[53]

108. We also note that if WACM4 was be implemented, a total of 282GW of scoping capacity would have either three or six months (dependent on whether there were multiple landowners) to secure land rights.

5.4. Potential benefit of WACM7 to the electricity system

109. To assess the potential benefit of WACM7 to the electricity system, we examine development cycles of different technology types. In particular we look at storage, co-located storage, solar PV, and onshore wind in the scoping phase and expected to connect prior to 2029 which comprises 42GW of the 61GW of 'scoping' capacity.

110. Whilst we only examine capacity in the scoping phase in the following analysis, it is likely that projects designated as awaiting consents and consents approved may also be contributing to the queue issues. For example, offshore wind projects have relatively long development cycles even after planning permissions have been submitted. These projects also typically require large capacity connections. It may be that projects such as these are blocking connection access to smaller projects which could be ready to connect earlier, but which obtained Construction Agreements at a later date. Therefore, the following analysis is likely to be a conservative estimate of the benefits of implementing WACM7.

111. Through analysis of the UK Government's Renewable Energy Planning Database (REPD),[54] we determine the time taken for projects of each technology type to go from "Planning application submitted" to "operational". Using this, we assess the likely quantity of projects that will be unable to move from the scoping phase to connecting by their expected connection date.

112. For example, the REPD shows that 60% of solar projects (<10MW) are able to connect within one year. Therefore, it is reasonable to assume that 60% of the solar capacity of <10MW scheduled to connect within one year will do so.

113. We further examined projects on the REPD in three buckets: <10MW, 10MW to <50MW, and >50MW. This accounts for the different development timelines associated with projects of varying size. We then applied these development timelines to the capacity scheduled to connect (and still in the scoping phase) according to the TEC register.

114. Through application of these calculated proportions we find that 4GW of the 19GW of scoping storage, 3GW of the 14GW of scoping co-located storage, 5GW of the 6GW of scoping onshore wind, and 312MW of the 2GW of scoping solar PV would be unlikely to connect by their expected connection date. This comprises 12.3GW of capacity that is

53 CMP376 Final Modification Report p. 31.

54 https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

potentially blocking the existing queue through inefficient allocation of expected connection dates.[55]

115. It is also clear that solar PV is best placed to quickly connect to the transmission system. According to our analysis of REPD projects, around 88% of the solar scoping projects in the scoping phase with an expected connection date before 2029 would be able to connect. Similarly, 84% of co-located projects in the same category would be expected to connect. The majority of co-located projects, both historically and in the TEC register, are solar with storage. It is also apparent, from written evidence provided by Solar Energy UK[56] to the government as part of the "A flexible grid for the future" inquiry, that the current queue system is disincentivising solar investment within the UK due to the current queue times. In that written evidence, Solar Energy UK say:

"*As it stands, grid constraints are actively blocking the development and construction of renewable generation with developers now being quoted connection dates of 2037. Developers are also experiencing year long delays on current connection agreements. This not only presents a problem for the UK's net zero timelines, but these delays will also negatively impact the UK's renewable investment environment. Such severe grid connection delays make the UK an undesirable market to invest in and could divert capital to competing markets, where generation assets can be deployed and start generating returns more quickly.*" [57]

116. As an illustrative example, if 12.3GW of solar capacity[58] was instead allowed to enter the queue as replacement for the capacity we estimate may not be able to connect then there would be an additional 10.8TWh of solar generation annually by 2029.[59] Moreover, this capacity would also help achieve the UK's 'Powering up Britain' target of 70GW of solar by 2035, which is currently not considered achievable by NGESO's Future Energy Scenarios (FES).[60] When looking at how this may develop over time, based on where the scoping projects sit in the queue, we estimate that this generation would be able to meet around 3.3% of system demand that is assumed in 2029 as part of NGESO's FES.[61]

117. In a hypothetical scenario where this solar generation directly replaces gas-fired generation, this would save up to 3.3m tonnes of CO2 per annum (up to 1.1% of total CO2

55 We note that this figure only accounts for projects that may not be able to connect due to typical project development times, it does not account however for capacity that may not be required by the grid at the time of connection.

56 Solar Energy UK is an industry body of solar stakeholders with over 350 member companies operating within the UK energy sector.

57 https://committees.parliament.uk/writtenevidence/123741/pdf/

58 In this illustrative scenario, we assume only solar would connect to the grid. If a combination of onshore wind and solar projects were to connect, the benefits would be even greater due to the higher load factor and similar LRMC of onshore wind compared to solar.

59 Assuming a 10% load factor as was observed in FY 21/22 in UK governments Feed in Tariff Load Factor analysis 2021/2022 published December 2022.

60 Powering up Britain manifesto published March 2023.

61 An average using the lower case presented in the system transformation scenario of 316TWh in 2029 and the higher case of 344TWh presented in the Leading the way scenario.

emissions from fossil fuels and 4% of total CO2 emissions from energy supply 2022)[62], which would have a clear material impact on the UK meeting its net zero targets.[63]

118. Furthermore, solar generation expected to commission between 2025 and 2030 is projected to have an LRMC of between £44/MWh and £39/MWh in 2022 prices.[64] The UK Government's forecast of wholesale prices as part of their "Energy and Emissions projections 2021 to 2040" predicts prices in 2029 to be around £74/MWh. The LRMC of solar represents a 40-47% discount to wholesale prices, meaning additional solar generation would have a positive impact on wholesale prices and, therefore, customer bills (of which wholesale prices can make up a large proportion).[65]

119. Additional solar generation would, ceteris paribus, increase network costs. However, when analysing the queue, there is expected to be a large quantity of standalone storage projects connecting within the next five years. If only the TEC register projects designated as "awaiting consents", "consents approved" or "under construction/commissioning" are assumed to connect within this timeframe, the total installed capacity of 7GW would on its own almost meet two of the three net zero scenarios foreseen by NGESO FES.[66] In addition, similar benefits would also be provided by new co-located storage connections.

120. If we also include the scoping standalone storage capacity which could be reasonably expected to come online by looking at typical development cycles from the REPD, this total comes to 23GW, as shown in Figure 13 below.[67] Whilst some proportion of this capacity will likely not come online, the network benefits from additional storage are likely to offset network costs from additional solar generation.[68]

62 These numbers are likely the highest end of the range as solar generation would be unlikely to replace gas generation in totality.

63 Using the UK government Gas Conversion factor of 0.18kg CO2 per KWh and assuming gas fleet efficiency of 60%. 3.3 million tonnes is 1.1% of 312 million tonnes of territorial carbon dioxide emissions and 4% of 82.2 million tonnes of carbon dioxide emissions from energy supply in 2022 reported by the UK Government in their 2022 UK greenhouse gas emissions, provisional figures released 30 March 2023.

64 Electricity Generation Costs Report 2023. Department for Energy Security and Net Zero Electricity Generation Costs 2023 -Converted from 2021 prices using inflation data from office of budget responsibility.

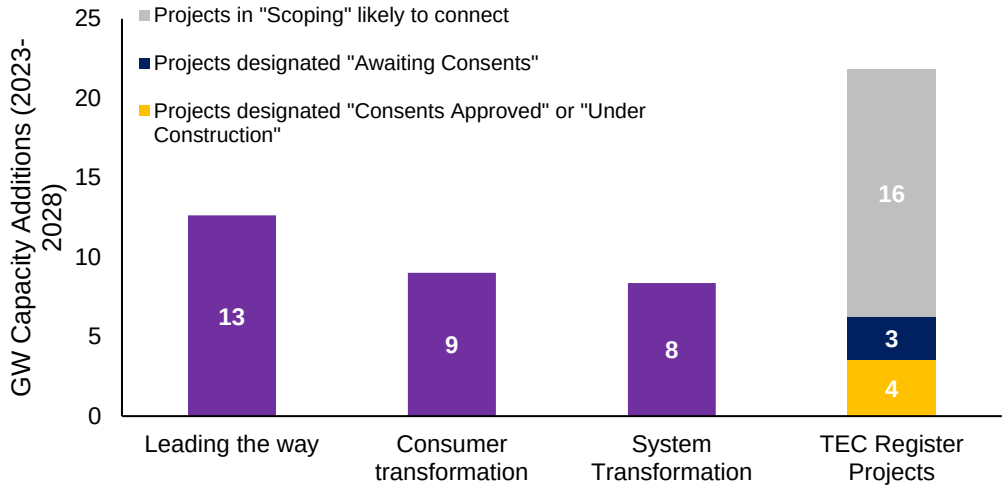
65 https://www.ofgem.gov.uk/publications/customers-pay-less-energy-bills-summer

66 https://www.nationalgrideso.com/future-energy/future-energy-scenarios

67 Our analysis shows 19.4GW of "scoping" storage less the 3.9GW referenced above is likely to connect.

68 Ofgem's Electricity Networks Strategic Framework: Enabling a secure, net zero energy system August 2022 -

Figure 13: Expected standalone storage additions in FES vs TEC register



Source: CRA analysis of the TEC register, National Grid FES 2023.