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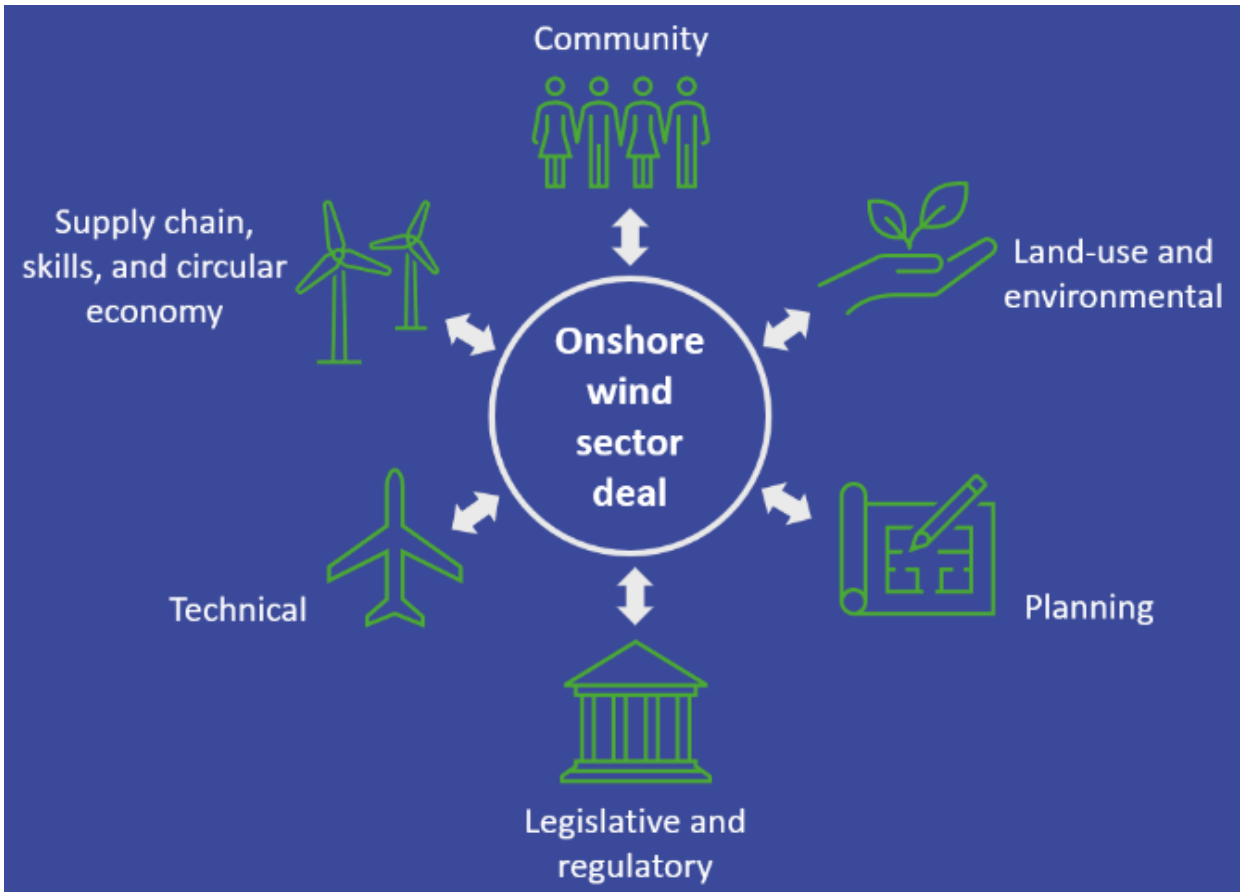

Client discretion

Scotland onshore wind pipeline analysis 2024-2030

April 2024 update

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Executive summary

This report provides the first update to the original pipeline analysis which was published in November 2023. The update is driven by using the latest information from the rUK EnergyPulse Database (EPDB), reflecting changes to the development pipeline that have occurred in the intervening six months. It also incorporates improvements to the underlying pipeline model, with the overall narrative improved to accommodate feedback we have received on the original report.

Energy Pulse Database

Comparing with the original November 2023 report, the key changes are:

- 1,397 projects in the EPDB, an increase of 30 from November 2023
- 31 GW of capacity (+0.5 GW)
- 218 (+5) developers
- 231 (+4) owners

Changes in EPDB are due to the addition and removal of projects from the EPDB based on real time project progression in the period between August 2023 and late March 2024.[i]

Developer engagement

Developer engagement was not repeated in this update, although a few changes were made in the way that developer provided information was dealt with:

- Developer data was out of sync with the data in rUK's EPDB and to avoid conflicting dates only future dates supplied by developers at the time of updating – 25th March 2024 – were considered.
- We went through a process of checking all additions to the rUK EPDB against developer advised future projects, removing future projects where it was clear that the project was one of the EPDB additions.
- Where a lump capacity of future development was provided rather than specific projects, that capacity was split into a number of "standard" individual projects. This allowed more accuracy in calculations which consider project numbers.

The combined effect of these changes from the original November 2023 report are:

- 234 projects (18 GW) timelines were altered, a reduction of 54 projects (0.9 GW).
- 112 developer advised future projects (10.9 GW), an increase of 31 projects but with an overall reduction in future capacity of 0.1 GW.[ii]

Timelines

Following feedback from industry, we have updated the expected "time at stage" when establishing a typical project timeline.[iii] The changes are summarised in Table 1. Time in planning and operational life remain unchanged and are not included in the table.

[i] The initial report was based on an August 2023 download of the rUK EPDB, this update is based on a download from late March 2024.

[ii] The increase in the number of projects is due to the splitting of lump capacities into individual projects, this has no impact on overall capacity. The overall capacity is reduced due to removing future projects that now appear in rUK's EPDB.

[iii] The analysis which determined the updated timeline is included in Appendix E.

Table 1 Comparison of timelines between November 2023 and April 2024 update.

Project stage	November 2023	April 2024 update	
	Time at project stage (years)	Time at project stage - standard timeline (years)	Time at project stage – accelerated timeline (years)
Pre-submission	3	2	2
Consented	1	3	1.5
Construction	1	2	1.5

Scenarios and KPIs in 2030

In this update, we consider three different scenarios to represent a low, medium and high growth of onshore wind out to 2030. The differences between these scenarios are driven by altering the average project timelines (standard or accelerated) and whether or not future projects are included (that is, projects that are not yet listed in EPDB but which the developers have informed us about).

In each scenario we generate capacity timelines based on project stage. From these timelines we generate pipeline KPIs such as:

- Number of projects in the planning system and from this, the number of planning decisions required
- Number of abnormal loads expected, and
- Estimated community benefit generated.

These are summarised in Table 2

Table 2 Key scenario results.

Scenario	2030 operational capacity (GW)	Average annual no. of planning decisions required, 2024-2028 inclusive*, **	Average annual no. of abnormal loads, 2024-2030 inclusive	Total community benefit contributions, 2024-2030 inclusive (£M)
Scenario 1 (low)	15.2	ECU: 18-22 LPA: 6-23	2,177	436
Scenario 2 (medium)	20.9	ECU: 35-37 LPA: 11-27	4,744	531
Scenario 3 (high)	24.6	ECU: 37-39 LPA: 12-29	5,585	574

*ECU for projects equal to and greater than 50 MW capacity, LPA for projects less than 50 MW capacity.

**Our analysis predicts that some projects which are currently in the planning system may be removed/resubmitted prior to a consent decision being made, hence we show the "number of consent decisions" as a range.

Impact of resource limits

In this update we provide narrative on some practical resourcing limits which may impact on Scotland's ability to deliver the 2030 ambitions:

- Energy Consents Unit (ECU) - planning decisions per year

  For Scenario 2, the average minimum no. of decisions required per year (2024-2028) is expected to be 35, peaking at 45 in 2028. The current ability for ECU to deliver planning decisions is around 17 per year.
- Police Scotland - abnormal loads per year

For Scenario 2, the average no. of abnormal loads per year (2024-2030) is expected to be 4,744, peaking at 8,118 in 2029. The current ability to support abnormal loads in Scotland is estimated to be 2,700 per year.

- Contracts for difference (CfD) allocation rounds - allocated capacity per year

  To fulfil the potential of Scenario 2, we estimate that annual CfD allocations in AR6 (2024) through AR9 (2027) inclusive needs to be 2.4 GW, peaking at 2.8 GW in AR6. AR5 delivered 1.7 GW and AR6 is currently expected to deliver a further 0.5 to 0.7 GW.

- Grid connections – new capacity requiring grid connection, per year

  To fulfil the potential of Scenario 2, we estimate that the average annual connection rate (2024-2030) needs to be 1.8 GW, peaking at 2.8 GW in 2027.

Although the pipeline in Scenarios 2 and 3 contains enough projects to achieve Scotland's 20 GW target by 2030, these KPIs suggest that Scotland's ability to hit that target may be restricted by its current ability to resource these key supporting services. This gap between current capabilities and future requirements becomes wider when considering the higher capacity delivered under Scenario 3.

Contents

1. Introduction

In September 2023 the Scottish Government (SG), Scottish renewables (SR) and the onshore wind sector launched the Scottish Onshore Wind Sector Deal (SOWSD), outlining an ambition of 20 GW of operational onshore wind in Scotland by the end of 2030 and setting out the actions that Government and the sector will take to realise that ambition.

To help support the delivery of the 2030 ambition, and to address a specific commitment of the SOWSD itself, BVG Associates (BVGA) was commissioned by SR to build a database that facilitates a detailed analysis of the onshore wind pipeline in Scotland. The initial analysis of this pipeline was published in November 2024. This report presents the April 2024 update, incorporating the latest information from rUK's Energy Pulse Database (EPDB) reflecting changes to the development pipeline that have occurred in the intervening six months.[iv] It also incorporates improvements to the underlying pipeline model, with the overall narrative improved to accommodate feedback we have received on the original report.

[iv] https://www.renewableuk.com/page/EnergyPulse

2. EnergyPulse database

As of March 25th 2024, the EPDB contained 1,397 projects in Scotland, totalling 30.9 GW. Thirty six of these projects did not have a nameplate capacity assigned to them, though all but one had a value for the number of turbines. We estimated these project's capacities assuming 3 MW turbines.[v] A further project had neither nameplate capacity or number of turbines, so we assumed a capacity of 50 MW. These edits provided an extra 530 MW.

This represents an increase of thirty projects, 400 MW of total capacity and 130 MW of additional capacity compared to the original EPDB dataset.

The spread of capacity (MW) across the stages of a project lifetime is shown in Figure 1.

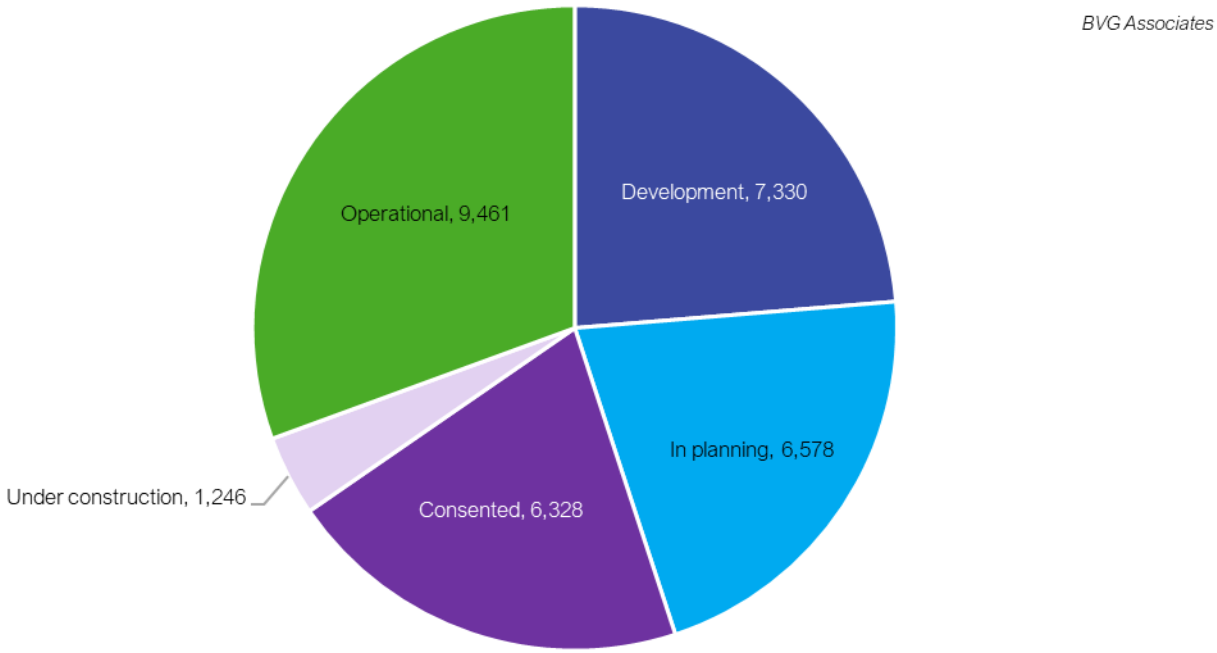

Figure 1 Summary of pipeline of Scottish projects (MW) in the EPDB March 2024.

These projects are being developed, constructed, and operated by 218 different developers and are currently owned by 231 different commercial entities. An increase of five developers and four owners.

[v] All were in the pre-submission phase and their average maximum tip height was 163 m, so this is likely a conservative estimation.

3. Developer engagement

In preparing the initial report we engaged with developers to confirm details of projects within the rUK database and ask for details of future projects not yet in the public domain. Through this engagement process, we contacted 20 major developers, including all members of the G12 group. [vi,vii] This enabled us to review approximately 65% of all the capacity currently listed in the EPDB.

In this update of the report we did not repeat the engagement process. We did, however, make the following changes to the developer data:

- The developer data was lagging behind the latest data in rUK's EPDB. To avoid conflicting dates only future dates at the time of updating – 25th March 2024 – provided by developers were considered.
- We were aware that some projects which were considered developer advised future projects in the last update may now be in the public domain and therefore be included in rUK's EPDB. To ensure such projects were not double counted we went through a process of checking all additions to the rUK EPDB against developer advised future projects, removing future projects where it was clear that the project was one of the EPDB additions. Developer advised dates for such future projects were included for the EPDB entry.
- We also split developer advised future capacity where a lump capacity was provided rather than specific projects. For such capacities, an average project capacity of approximately 90 MW was assumed, based on feedback for other future projects. For example, "630 MW in the Highlands" would become 7 projects of 90 MW in the Highlands. This allows more realism and insight in calculations which consider project numbers.

Based on these updates, we have received future dates for 234 projects, representing 18 GW of capacity in the EPDB. We have added 112 developer advised future projects, 105 of which are pre-submission projects and seven are re-submissions which developers have told us are "In planning" (but are not in rUK database). This results in 10.9 GW of additional capacity (10.6 GW pre-submission and 0.3 GW In planning) 2.2 GW of which is repower. There are also seven future projects with no capacity or number of turbines, these were assumed to have a capacity of 50 MW, resulting in a further 350 MW.

[vi] The "G12" is a group of 13 major developers formed as a key stakeholder group representing the interest of industry during the development of the SOWSD. The members of the G12 are: Banks Renewables, EDF Renewables, Energiekontor, ESB, Fred. Olsen, Muirhall, Renantis, RES, RWE, ScottishPower Renewables, SSE Renewables, Statkraft, Vattenfall.

[vii] The other seven developers we reached out to were: Belltown Power, Community Windpower, E Power, Force 9 Energy, Infinergy, Muirden Energy, Vento Ludens.

4. Model overview

4.1. Project lifecycle milestones

The model develops project lifetimes, marking the milestones of when a project:

- Is submitted for planning consent
- Receives its final consent decision
- Starts construction
- Reaches commercial operation, and
- Reaches end of life.

For any of the above dates that are not yet known, the model allows user-defined values to determine how long on average projects take to transition from one state to the next as shown in Figure 2.

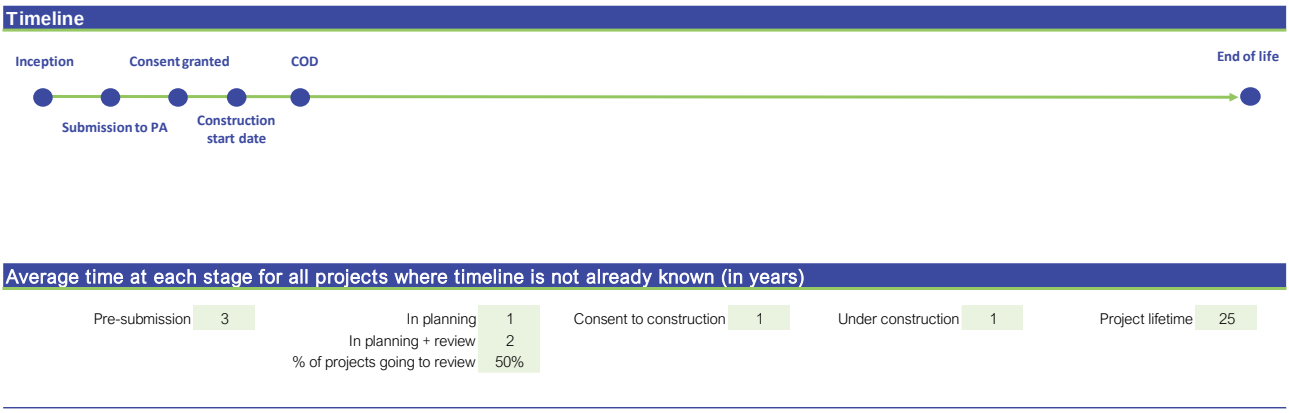

Figure 2 User interface Project lifecycle milestones

4.2. Pipeline projects which may not reach commercial operation

The model provides a series of options for the user to test thresholds which will stop some projects from progressing to the next stage. For any project where at least one of these thresholds are exceeded, the model will remove the project from the analysis These options are shown in Figure 3 and consist of:

- Maximum length of time that a project can remain at a milestone without progressing further. If a project has not progressed after a reasonable amount of time we could consider it dormant and unlikely to be progressed further by the developer.
- Specifications of the consented turbines that present a barrier to projects being built as the consented dimensions (specifically the turbine tip-height) and proposed turbine are no longer available on the market.
- Overall progression rates for projects moving through the milestones. Specifically, we consider projects moving from general development to receiving a positive consent decision.

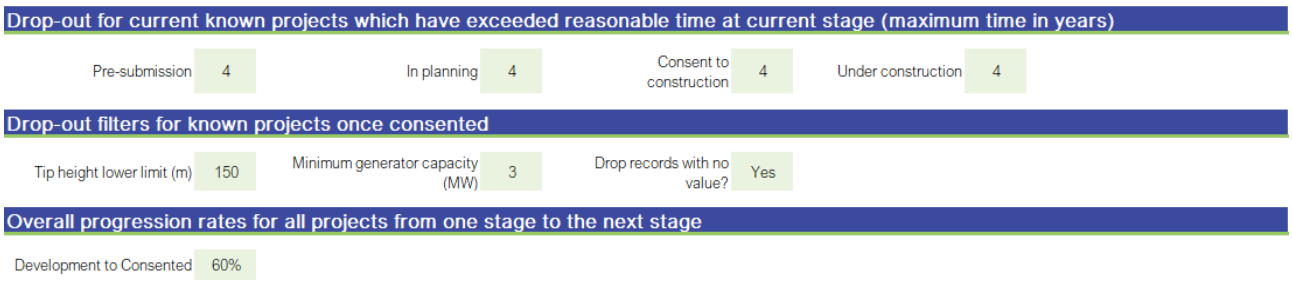

Figure 3 User interface: "Drop-out" parameters

4.3. Developer timelines

The user can override the standard durations between milestones with project specific dates provided by the developers as part of the engagement process. The user can also choose to include the future projects as provided by the developers.

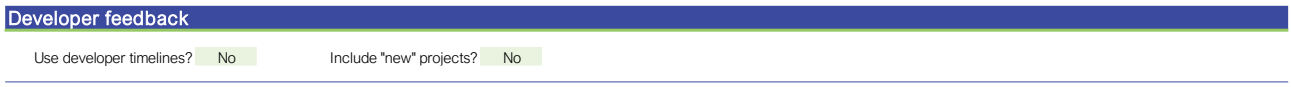

Figure 4 User interface: Developer feedback

4.4. Repowering and deficit backfill parameters

There are two scenarios where the model itself introduces new projects into the pipeline:

- When a current project reaches the end of its life, it may get repowered. The user can choose what percentage of projects are repowered, by how much repowering will increase the nameplate capacity of the site, and what size of turbines will be used on the repowered site.
- If the total operational capacity in 2030 is less than the target 20 GW, the model will calculate how much new capacity needs to be introduced into the timeline to address the deficit, and when. The user can specify the capacity of each additional backfill project that will be required, and the capacity of the turbines that will be used.

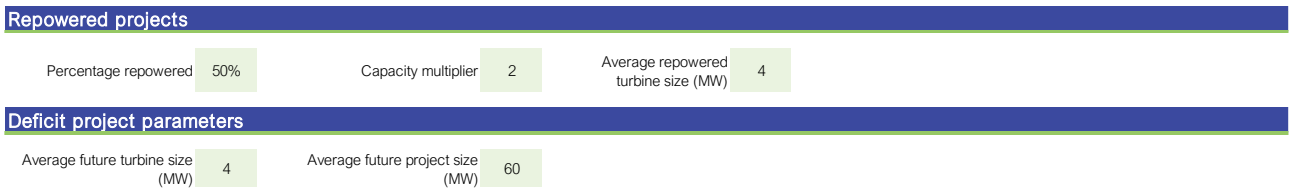

Figure 5 User interface: Backfill parameters

4.5. Output calculation parameters

The model outputs information on four key performance indicators (KPIs):

- The amount of community benefit created
- The amount of abnormal loads to be managed
- The amount of projects going through the planning process at any given time, and
- The amount of capacity that may be required to be allocated in future contract for difference (CfD) rounds.

The user has access to basic input parameters for these KPIs, as shown in Figure 6.

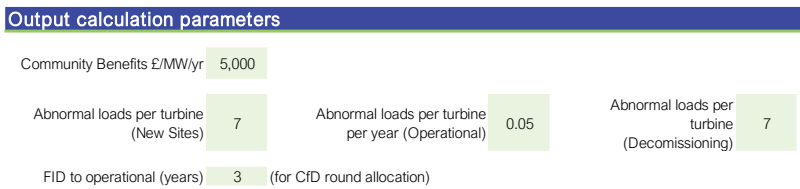

Figure 6 User interface: Output calculation parameters

5. Scenario generation

5.1. Timelines

One of the main factors which differentiates scenarios presented is altering the average project timeline. In the first iteration of this report, we focussed only on changing the time projects spent in the planning system under a standard timeline and an accelerated scenario in line with commitments in the SOWSD. In this update we have updated our assumptions as described below.

5.1.1 Standard timeline

This timeline uses analysis of projects in the current rUK EPDB which have reached commercial operation to predict the average timelines of projects yet to reach operation. This led to the following timeline:

- Pre-submission: 2 years. A reduction of 1 year compared to the initial report.
- In planning: 2 years, extending to 4 years for "challenged" projects, 50% of projects assumed to be "challenged" resulting in an average time in planning of 3 years. No change from the initial report.
- Consented: 3 years. An increase of 2 years compared to the initial report.
- Construction: 2 years. An increase of 1 year compared to the initial report.
- Operational: 25 years. No change from the initial report.

Our analysis which resulted in the above timeline can be seen in Appendix E.

5.1.2 Accelerated timeline

This timeline accelerates aspects of the standard timeline in line with commitments made in the SOWSD.

The SOWSD makes several commitments which will have a positive impact on project timelines. These include but are not limited to:

- Streamlining and standardising templates for consent applications. This has the potential to reduce the time taken for the planning authority to review applications, as well as reducing the number of applications refused.
- Engaging with grid and networks to manage the connection queue to improve the connection process. This has the potential to reduce the time between consent being granted and the start of construction date as grid connection is a key factor in final investment decision (FID).
- Identifying gaps in the supply chain, addressing with appropriate training, and promoting opportunities to those not already involved in the industry. This has the potential to reduce time between consent being granted and the start of construction as available supply chain is a key factor in FID. Availability of skills and supply chain also has the potential to reduce construction timelines.

Considering all positive impacts which the SOWSD may have, we believe the following values for "time at stage" reflect the improvements that would contribute to an "accelerated" timeline:

- Pre-submission: 2 years. A reduction of 1 year compared to the initial report.
- In planning: 1 years, extending to 2 years for "challenged" projects, 20% of projects assumed to be "challenged" resulting in an average time in planning of 1.2 years. No change from the initial report.
- Consented: 1.5 years. An increase of 0.5 year compared to the initial report.
- Construction: 1.5 years. An increase of 0.5 year compared to the initial report.
- Operational: 25 years. No change from the initial report.

5.2. Data

Another factor which differentiates scenarios is the data that is included. These are:

- rUK's EPDB only, which Includes only projects already in the public domain.
- Developer information included, which:
  - Adds projects learned of through developer engagement to rUK's EPDB, and
  - Adds developers expected dates to future projects and projects within rUK's EPDB.

5.3. Scenarios

To simplify the message of this report we have opted to focus on three scenarios. These are presented in Table 3.

Table 3 Scenarios modelled.

Scenarios	Timeline	Data source	Additions
Scenario 1	Standard	rUK EPDB only	None
Scenario 2	Standard	Developer information included	None
Scenario 3	Accelerated	Developer information included	Minimum of 50% of repowering at double original capacity[viii]

Across all scenarios, certain model parameters remain consistent. These are outlined in Appendix F.

[viii] At an aggregated level (i.e. not project specific) the model ensures that repowering is included for 50% of all projects decommissioned at double their original capacity. In this calculation the model considers actual repower projects coming online in a given year and only adds additional repower if the expected repower level is not met by existing projects.

6. Analysis

In the following section we analyse results from modelled scenarios. Full results, figures and tables can be found for scenarios 1 to 3 in Appendices A to C, respectively.

6.1. Pipeline analysis

Under Scenario 1, which only considers projects already in the public domain, the model shows that there are not enough projects in the pipeline to reach the 20 GW of onshore wind by 2030 target. This scenario achieves 15.2 GW in 2030, resulting in a deficit of 4.8 GW. This scenario is not focussed on in the main body of this report as considering only projects in the public domain is a scenario in which developers cease to add projects to the pipeline and this is extremely unlikely.

The inclusion of developer advised future projects removes this deficit. Under both Scenario 2 and 3, the model shows that there are enough projects in the pipeline to reach the 20 GW by 2030 target.

- Scenario 2 which follows current average project timelines reaches 20.9 GW in 2030.
- Scenario 3 which follows accelerated timelines potentially achieved through SOWSD commitments reaches 24.6 GW in 2030.

Figure 7, shows the operational capacity for each scenario in 2030.

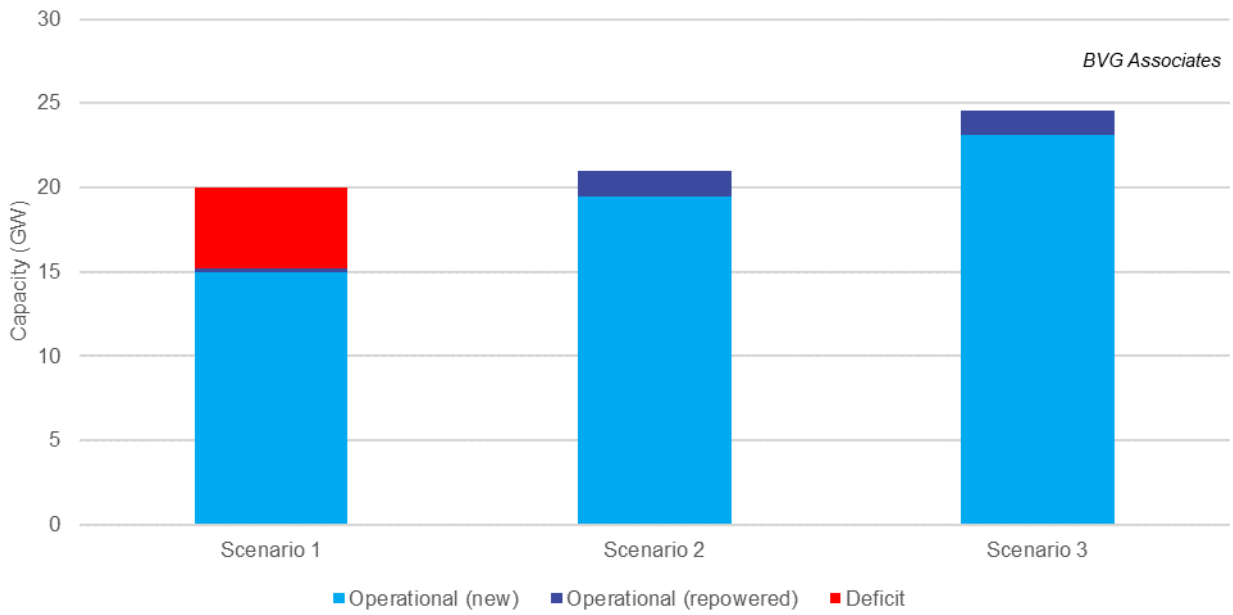

Figure 7 Comparison of operational capacity in 2030 for scenarios 1, 2 and 3.

6.2. Projects in planning

In terms of understanding the throughput of projects in the planning system and how this compares to current capabilities we must consider the number of consent decisions which need to be made each year. Figure 8 and Figure 9 present the range of consent decisions which are required in each year for Scenario 2. These figures are split by planning route, with:

- Figure 8 showing projects equal to or greater than 50 MW being consented at national level through the ECU, and
- Figure 9 showing projects less than 50 MW being consented at a local level through the local planning authority.

The minimum consent decisions required excludes projects which may "drop out" of the planning system before a consent decision is reached (see Section 4.2 and Appendix F) while the maximum value includes them.

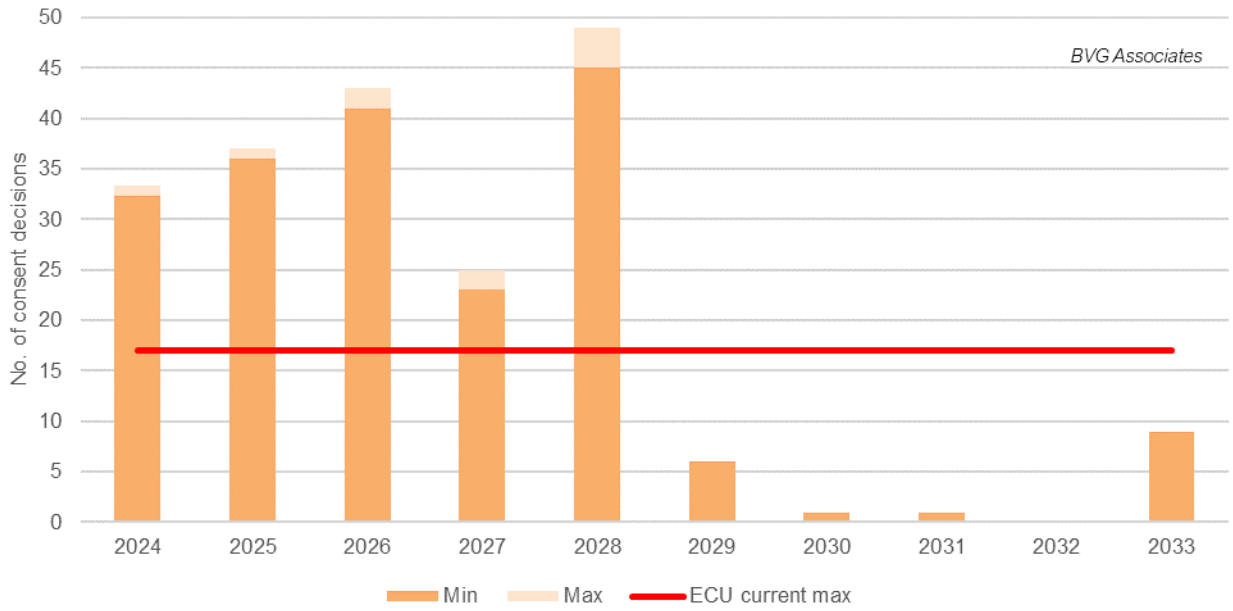

Figure 8 Minimum and maximum number of consent decisions required at ECU level for Scenario 2.

The maximum number of consent decisions which have been made in one year by the ECU is 17.[ix] It can be seen in Figure 8 that this current maximum rate will need to increase significantly to achieve the minimum number of consent decisions expected for Scenario 2. Using the minimum number of consent decisions required as a benchmark, the ECU's decision rate must increase from 17, to 32 in 2024, 36 in 2025 and reach 41 consent decisions in 2026. Although this number reduces in 2027, it reaches a peak in 2028 of 45 consent decisions required for Scenario 2 to stay on track.

Scenario 3 presents a greater challenge, with a peak of 47 consent decisions required in 2026 and an average of 43 consent decisions required annually between now and 2027. These results can be viewed on page 33 in Appendix C.

In summary, it is clear that a significant increase in consent decisions made each year at ECU level will be required to reach the 20 GW by 2030 target.

[ix] Informed by engagement with ECU on determinations made yearly between 2019 and April 2024.

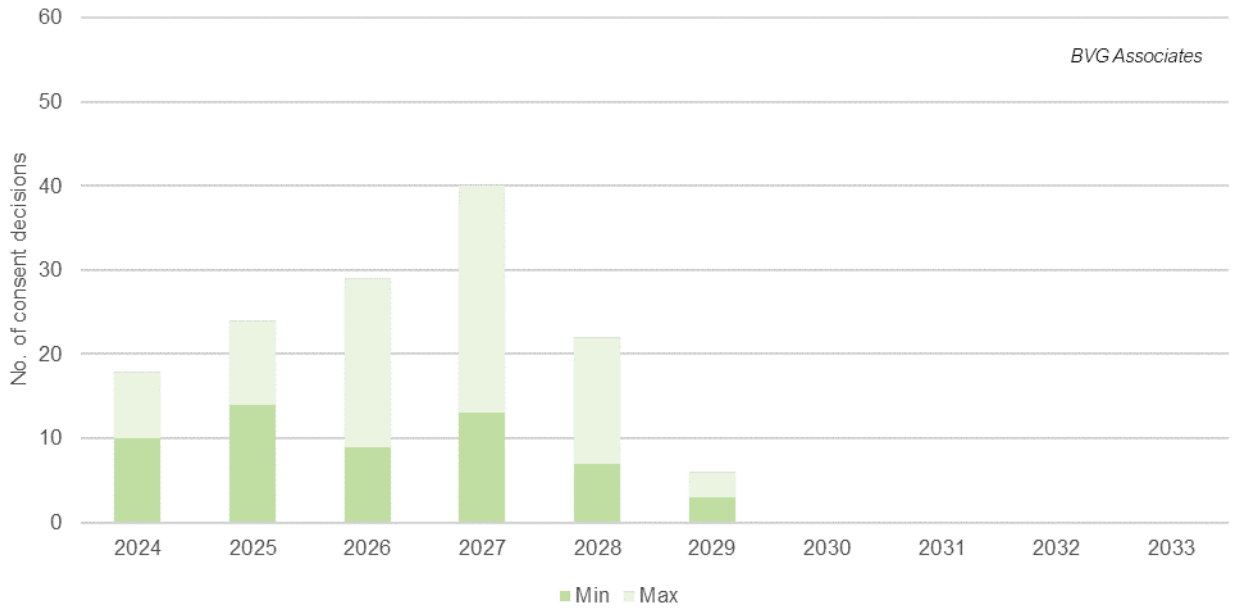

Figure 9 Minimum and maximum number of consent decisions required at LPA level for Scenario 2.

The large range of possible consent decisions required annually at LPA level (Figure 9) reflects the large number of projects under 50 MW which we predict have a significant chance of being withdrawn from the planning system prior to a consent decision being made.

The "current maximum rate" is not shown as we have not established this at LPA level.

6.3. Abnormal loads

Based on conversations with hauliers, and previous BVGA work on failure rates and major component exchange during operations, our analysis assumed the following:

- 10 abnormal loads per turbine during construction: 3 blades, 4 tower sections, 1 nacelle, 1 hub and 1 drivetrain.
- 6 abnormal loads per turbine during decommissioning: 1 for blades, 2 tower sections, 1 nacelle, 1 hub and 1 drivetrain.
- 0.05 loads per turbine per year during operation: 1% of gearboxes, 1% of generators, 2% of transformers, 1% of blades.

Feedback from industry estimates that Police Scotland's capability to support abnormal loads limits abnormal load movements to a maximum of 800 MW per year. Assuming an average turbine size of 3 MW and 10 loads per turbine in construction, this equates to approximately 2,700 abnormal loads per year.[x]

This limit is based on individual component movements, convoys of multiple abnormal loads are not considered.

Figure 10 shows this maximum resource superimposed to the abnormal loads results for Scenario 2.

[x] Average turbine size of 3 MW is based on the average turbine size for all projects in the EPDB where capacity and number of turbines are known.

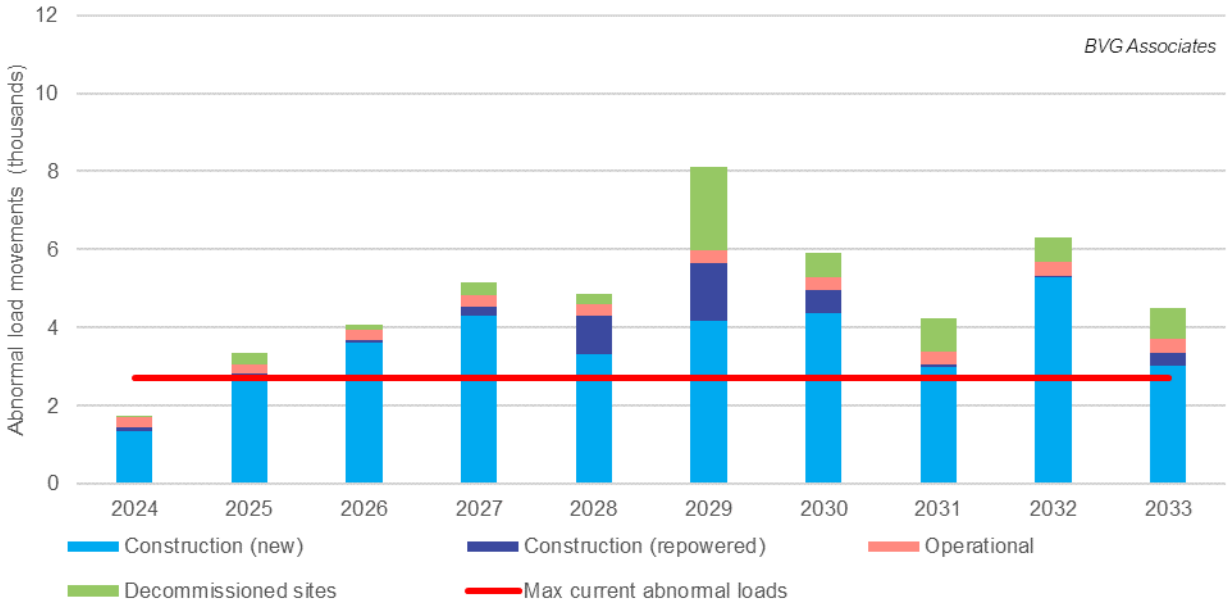

Figure 10 Number of abnormal loads required by project stage for Scenario 2, with available resource.

Based on Figure 10, the following key points can be noted:

- The current abnormal load maximum is exceeded from 2025 onwards.
- By 2027 almost double the current yearly maximum will be required annually.
- A large number of decommissioned turbines in 2029 results in over 8,000 abnormal loads being required – over three times the current maximum.

For Scenario 3, beyond 2025 a much more rapid increase is observed than that for Scenario 2, with an average of 5,585 abnormal loads between now and 2030 and a peak of over 11,000 loads in 2029. These results can be viewed on page 34 in Appendix C.

To achieve the timelines required to reach 20 GW or more by 2030 it is clear that a significant increase in the current maximum number of abnormal loads which can be supported by Police Scotland will be required. Discussions between developers, hauliers and Police Scotland should be prioritised in the short term to identify potential mitigation options.

6.4. CfD allocation

Table 4 shows the eligible capacity for, and the capacity which should be targeted in future CfD Allocation Rounds (ARs) for Scenario 2. Assuming all projects in the pipeline are to be financed via future ARs.

Each AR has a three year window for eligibility. The eligible capacity is made up of projects expected to enter operation in a three year period beginning two years after the AR date. The eligible capacity will therefore overlap between rounds. To avoid counting overlap and to focus on projects which are most likely to be ready to be built we have included target capacity. Target capacity is made up of all projects entering operation in the calendar year three years after the AR.

Table 4 Capacity eligible for and target capacity required for future CfD rounds for Scenario 2.

CfD Allocation round	CfD year	Eligible (GW)	Target allocation (GW)
5	2023	4.9	0.9 (1.7 actual)
6	2024	5.9	2.8
7	2025	7.6	2.3
8	2026	6.5	2.7
9	2027	5.8	2.0
10	2028	4.4	0.7
11	2029	5.8	1.7
12	2030	4.8	2.8

For Scenario 2, ARs 6 through 9 will need to increase from the 1.7 GW for onshore wind in AR 5 to an average of 2.5 GW per AR.

The increase in target capacity for Scenario 3 is even more substantial remaining at around double AR 5's 1.7 GW from AR 6 through 9. These results can be viewed on page 35 in Appendix C.

The analysis shows that an increase in the allocation for onshore wind is required to meet Scotland's 20 GW by 2030 target. It is currently expected that the onshore wind allocation in AR 6 will be around 0.5 to 0.7 GW.[xi] If this lower allocation reflects the ambition expected in future rounds, an effective and high volume alternative route to market will need to be established quickly if the ambition of 20 GW by 2030 is to be achieved.

6.5. Grid connection

Figure 11 shows the capacity entering operation in each year and requiring a grid connection for Scenario 2. This has been included to show the vast increase in capacity coming online between 2026 and 2030. We do not currently have data on annual grid connection capacity available to assess limitations of the grid to deal with such an increase. This graph is included to inform and facilitate necessary discussions around resourcing and capability to help meet this increase in demand.

[xi] https://www.energy-uk.org.uk/publications/energy-uk-explains-how-much-renewable-energy-can-we-expect-from-allocation-round-6/

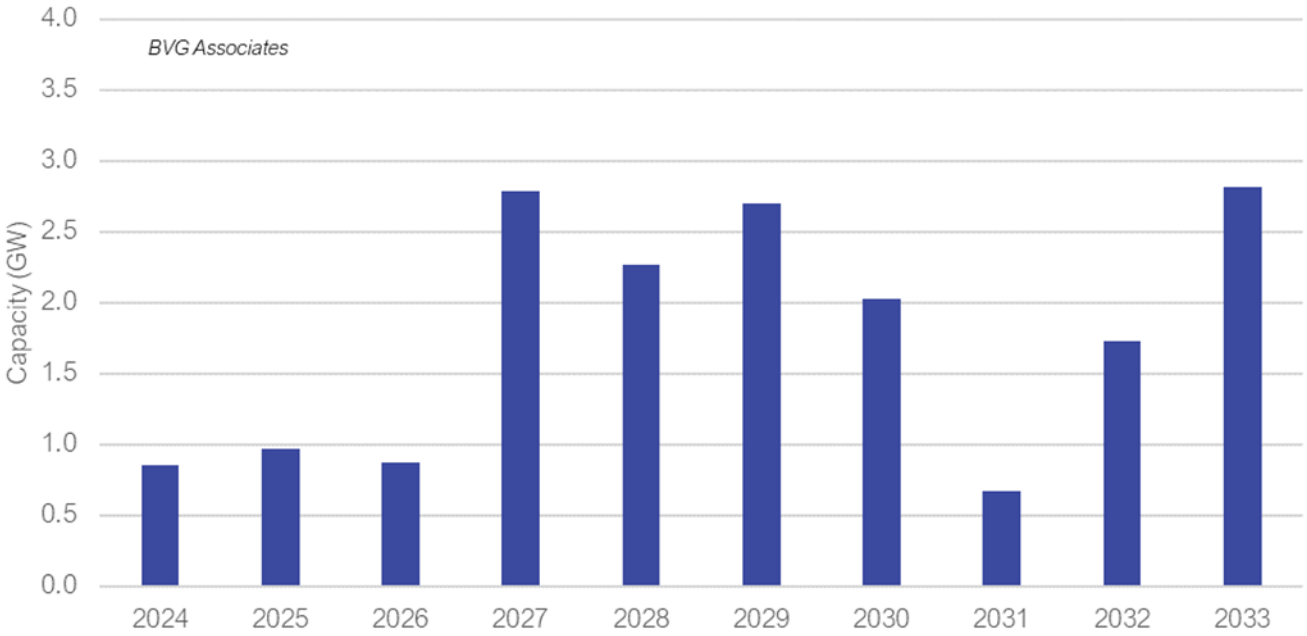

Figure 11 Capacity requiring grid connection per year for scenario 2.

7. Summary

Our original work on the pipeline analysis built a model which enables the user to look ahead to 2030 and beyond, examining the sensitivities of the future pipeline to a number of key parameters. This included an extensive engagement with 20 developers whose combined portfolios cover a total of around 65% of the available pipeline capacity. Their feedback has enabled us to both adjust likely project timelines, including the important aspect of bringing repowering options forward in time, and to introduce to the pipeline potential projects that are not yet in the public domain.

This first six monthly update of the pipeline has further developed the analysis and refined the conclusions. It continues to show that the target of 20 GW by 2030 will most likely not be achieved using only the known current pipeline of projects as recorded in rUK's EPDB. Based on this dataset only (Scenario 1) we predict 15.2 GW operational onshore wind by 2030.

It is more realistic to assume that more projects are added to the pipeline as time passes. Adding developer-advised future projects shows that 20 GW by 2030 is achievable in both Scenario 2 and Scenario 3. They achieve:

- 20.9 GW (Scenario 2), which assumes "business as usual" timelines for project development, and
- 24.6 GW (Scenario 3), which assumes accelerated timelines achieved through commitments made in the SOWSD.

Additional analysis introduced in this updated shows that our ability to deliver 20 GW by 2030 is likely to be restricted by current resource constraints. Our analysis predicts that:

- The number of current consent decisions in the ECU will at least need to double for at least three of the next five years.
- The current maximum number of abnormal loads required in any given year will increase from 2025 onwards under Scenarios 2 and 3. This will peak at:
    - Three times the current maximum capacity of Police Scotland (in 2029) under Scenario 2, and
    - Four times the current maximum capacity of Police Scotland (in 2029) under Scenario 3.
- If future projects are to use the CfD framework as their route to market, allocation for onshore wind in the next four ARs (AR 6 to AR 9), compared to AR 5's actual allocation of 1.7 GW, will need to:
    - Increase by 0.7 GW to around 2.5 GW per year on average to achieve the Scenario 2, and
    - Almost double to around 3.4 GW each year to achieve Scenario 3.
- We note that the capacity which will require grid connection increases significantly from 2026 to 2030, based on projects reaching operation in each year. We have not, however, analysed what restrictions there may be on these grid connections in future years – this may be covered in a future update.

We highlight these differences between current capabilities and the estimated future requirements so that all relevant stakeholders can begin the process of preparing for and enabling systems to deal with these increases.

Detailed results

Results at national level are presented in Appendix A to Appendix C.

Appendix D provides data at LPA level for the maximum number of projects in planning, the number of abnormal loads expected and community benefit generated for Scenario 2. Pipeline information at LPA level is available, however in the interest of space has not been included in this report.

This pipeline update will be accompanied by briefing notes to key stakeholders, focussing specifically on projects in planning and abnormal loads.

Appendix A Scenario 1

In Appendix A through C, the results for Scenario 1, 2 and 3 are presented respectively. These results include:

- Expected timeline to 2033.
- Projects in planning yearly to 2033:
  - Split by planning route – ECU (=> 50 MW) or LPA (< 50 MW), and
  - Split by project stage – "new" project or repowered project.
- Minimum and maximum number of consent decisions required yearly to 2033, at ECU and LPA level.
- Number of abnormal loads yearly to 2033.
- Community benefit yearly and cumulatively to 2033.
- Target allocation for onshore wind for future CFD allocation rounds.
- Capacity requiring grid connection yearly to 2033.

To allow for easier comparison of results between scenarios we have kept the y-axes consistent.

Pipeline

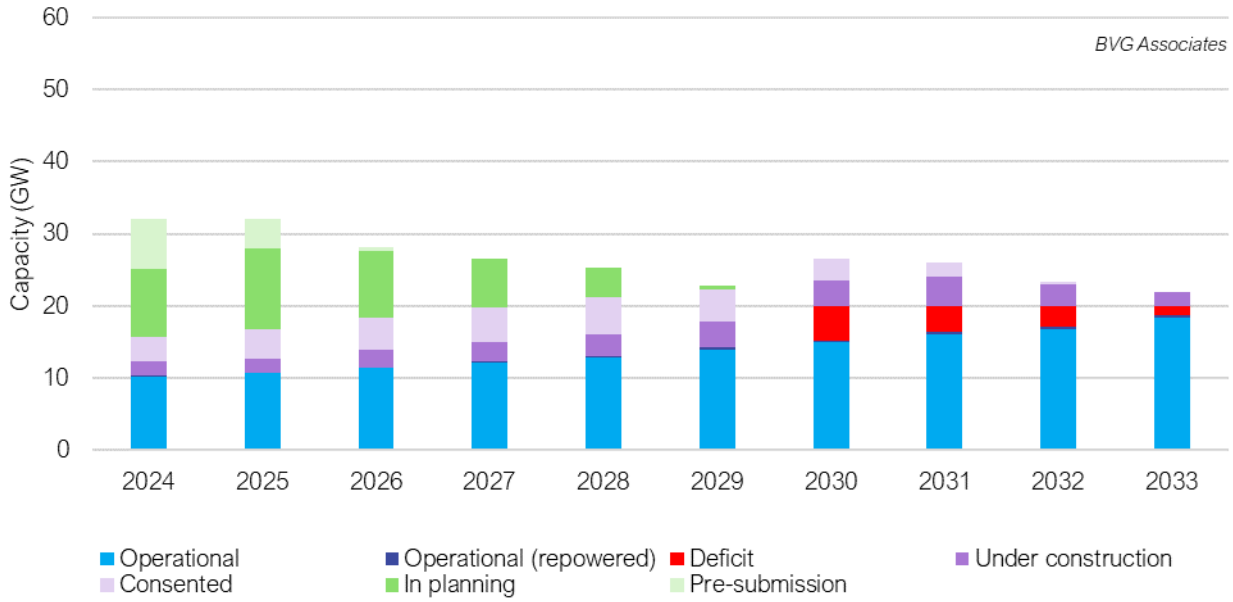

Figure 12 Expected timeline to 2033 for Scenario 1.

KPIs

Projects in planning

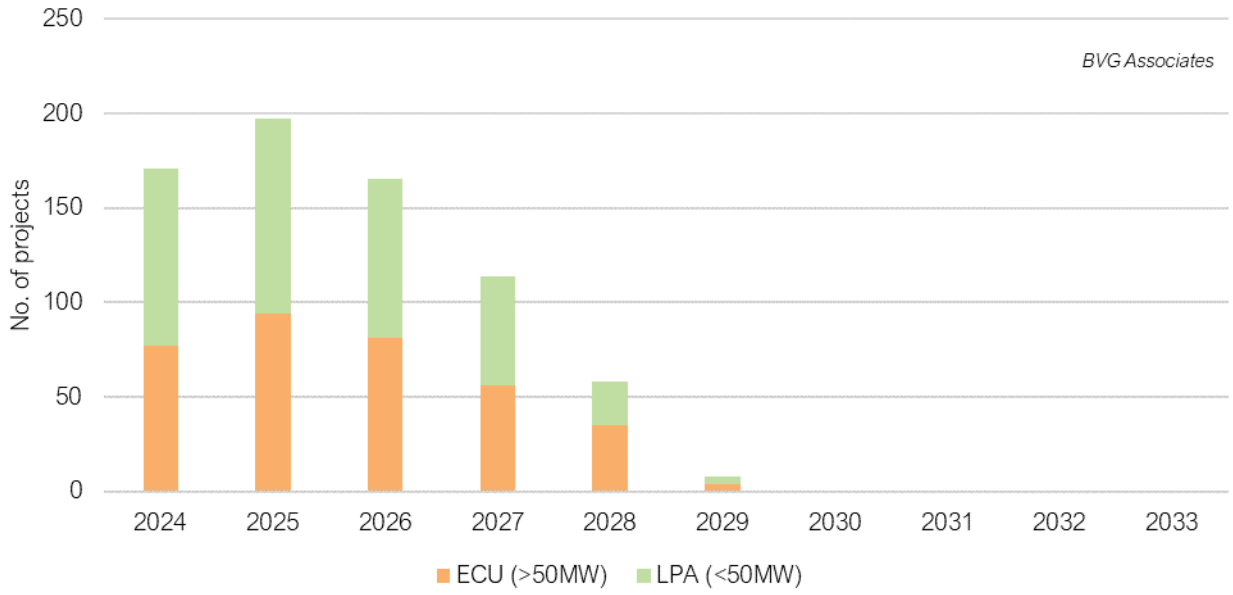

Figure 13 Number of projects in planning by planning route to 2033 for Scenario 1.

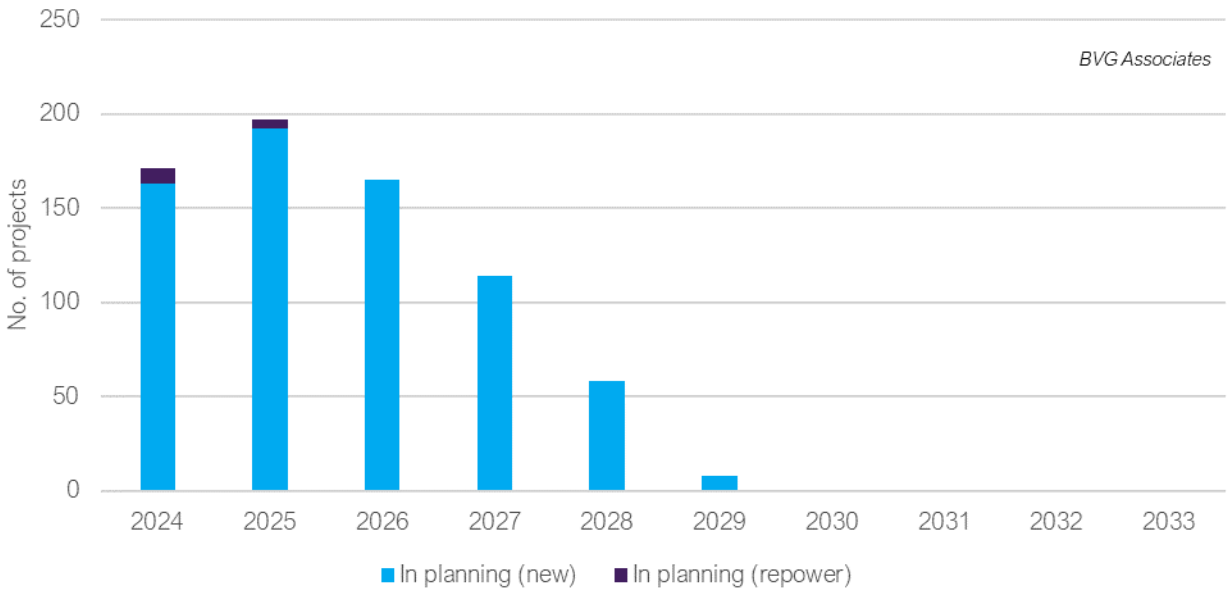

Figure 14 Number of projects in planning by project type to 2033 for Scenario 1.

Consent decisions

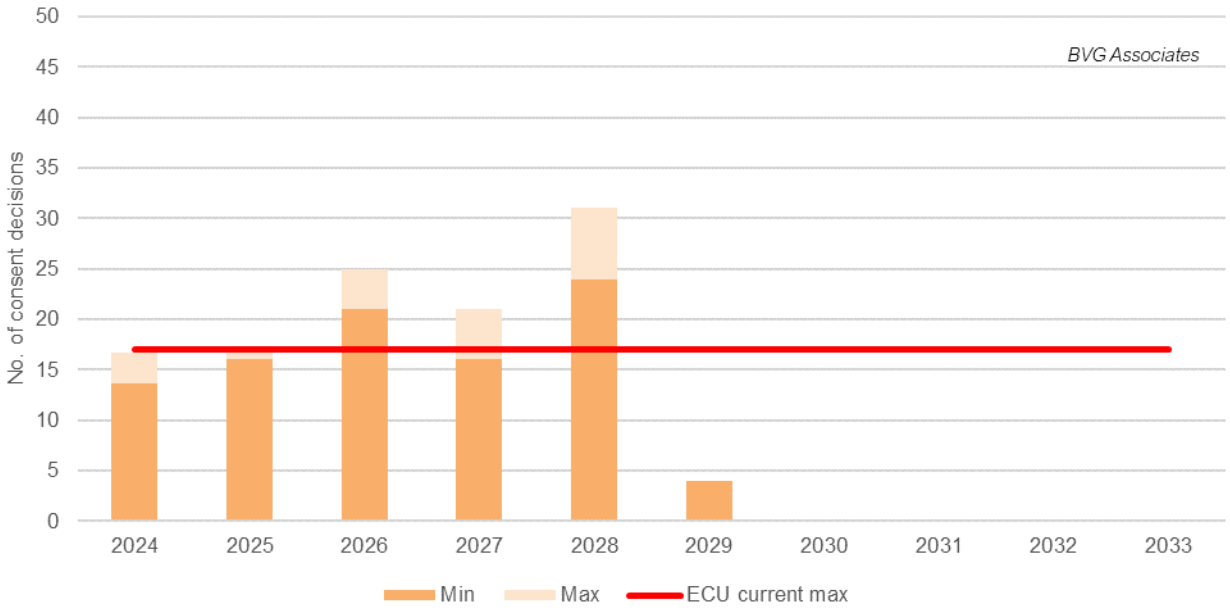

Figure 15 Minimum and maximum number of consent decisions required at ECU level for Scenario 1.

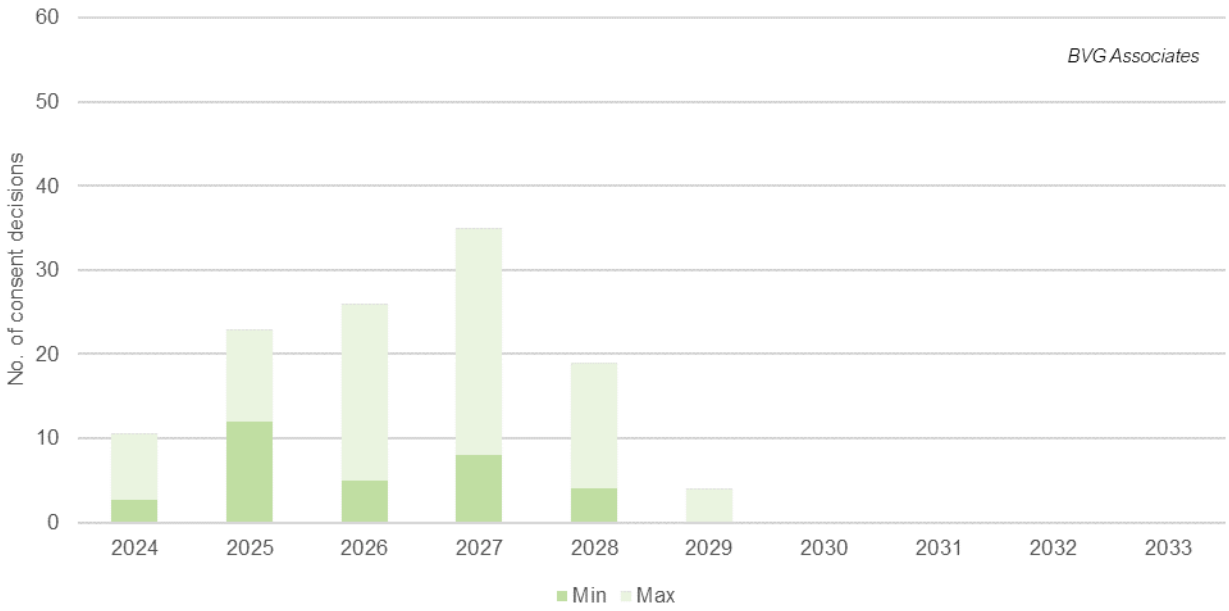

Figure 16 Minimum and maximum number of consent decisions required at LPA level for Scenario 1.

Abnormal loads

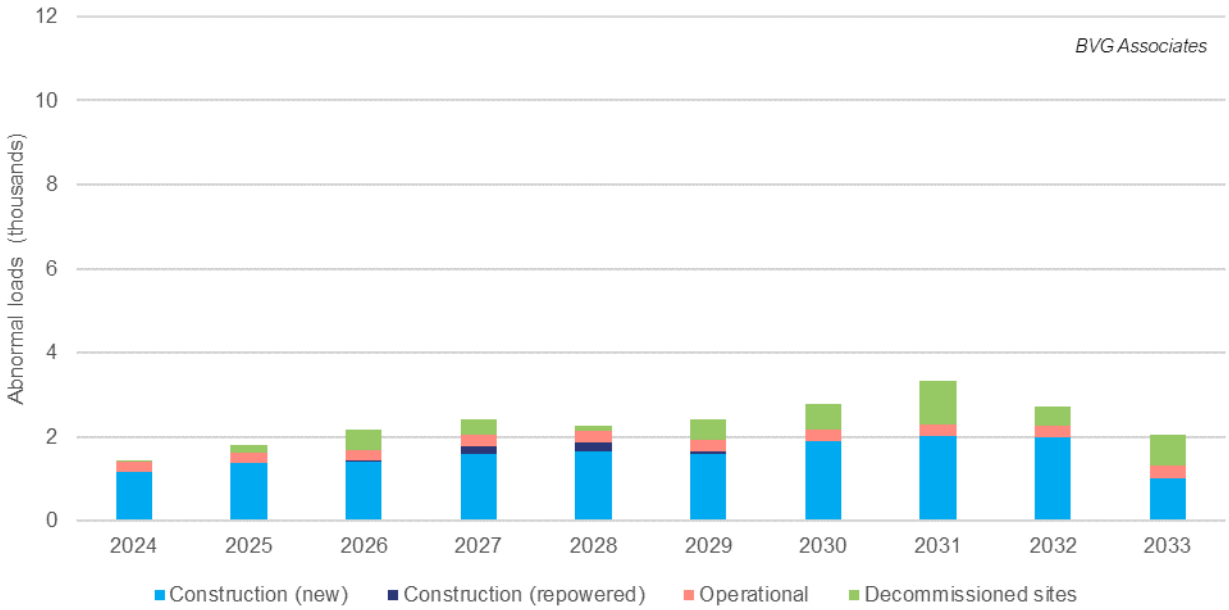

Figure 17 Number of abnormal loads required by project stage for Scenario 1.

Community benefit

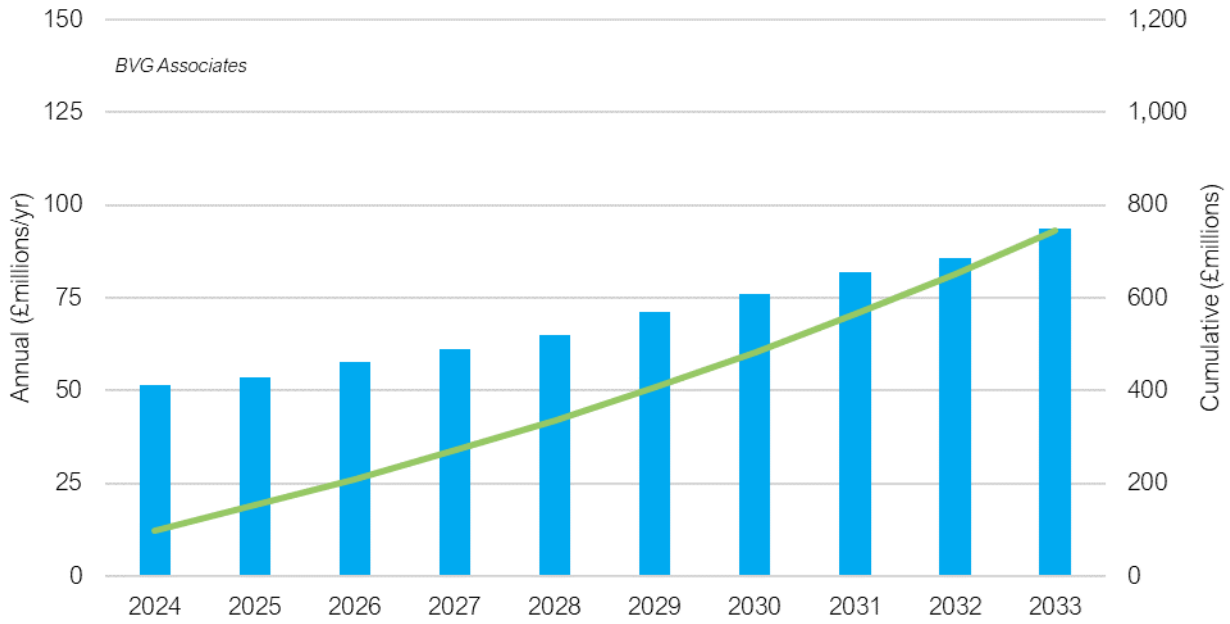

Figure 18 Community benefit achieved yearly and cumulatively for Scenario 1.

CfD allocation required

Table 5 Capacity eligible for and target capacity required for future CfD rounds for Scenario 1.

CfD Allocation round	CfD year	Eligible (GW)	Target allocation (GW)
5	2023	2.1	0.9 (1.7 actual)
6	2024	2.9	0.8
7	2025	3.3	0.8
8	2026	3.3	1.3
9	2027	3.4	1.1
10	2028	3.2	1.4
11	2029	4.2	1.1
12	2030	2.6	1.7

Grid connection

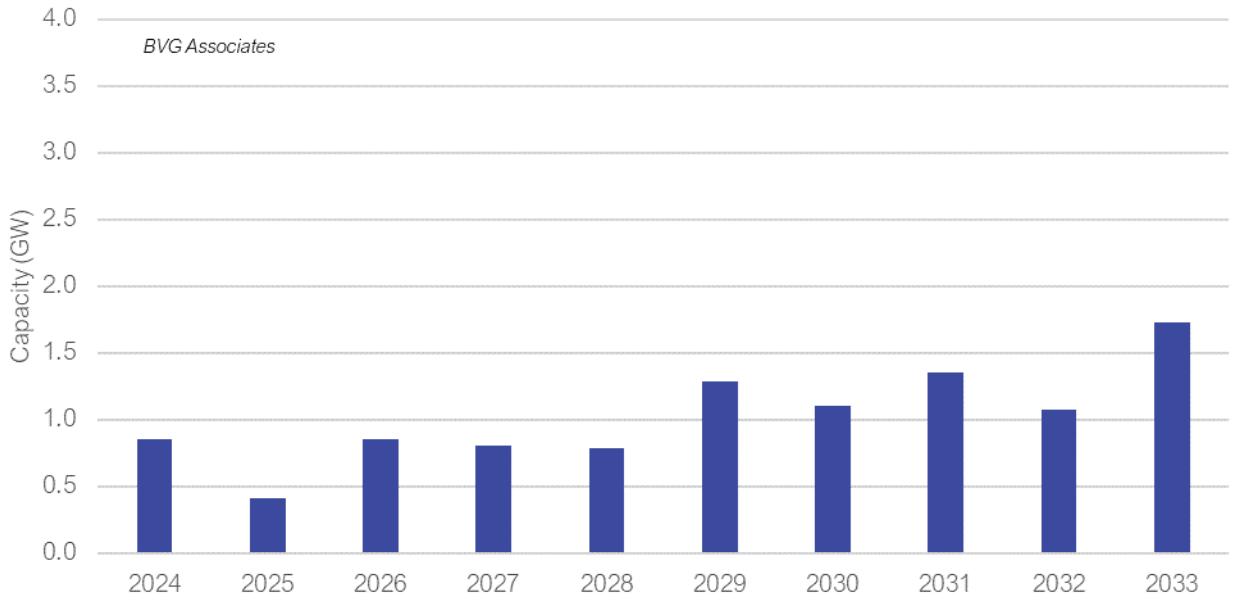

Figure 19 Capacity requiring grid connection per year for Scenario 1.

Appendix B Scenario 2

Pipeline

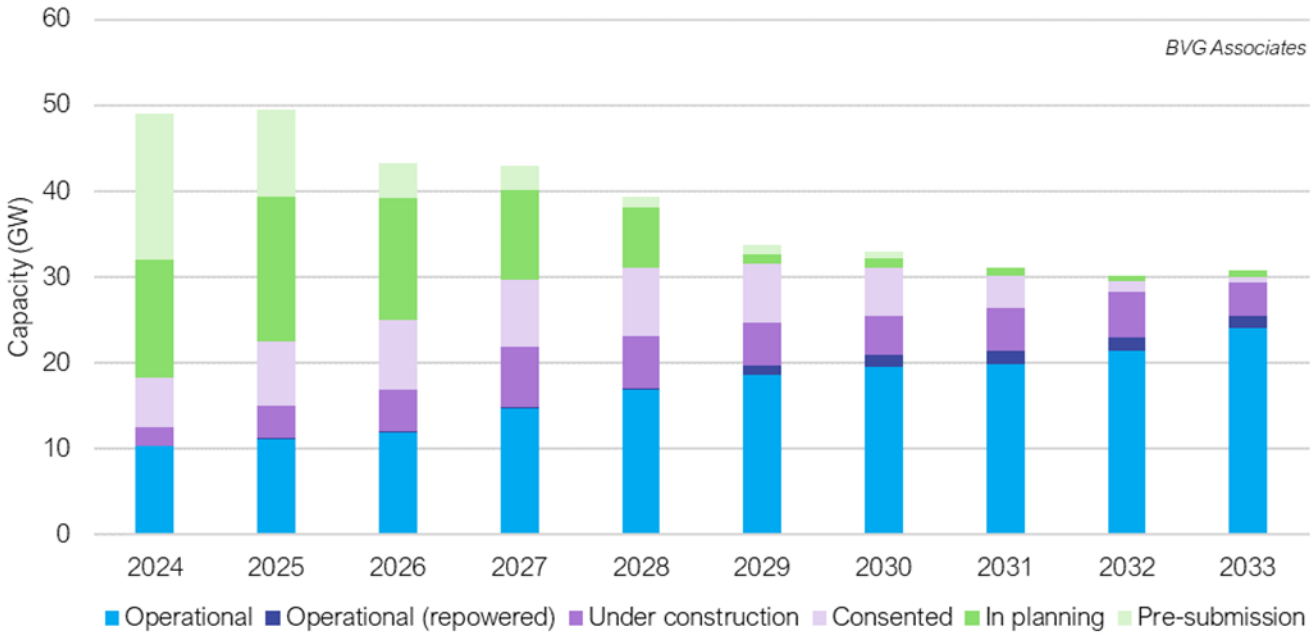

Figure 20 Expected timeline to 2033 for Scenario 2.

KPIs

Projects in planning

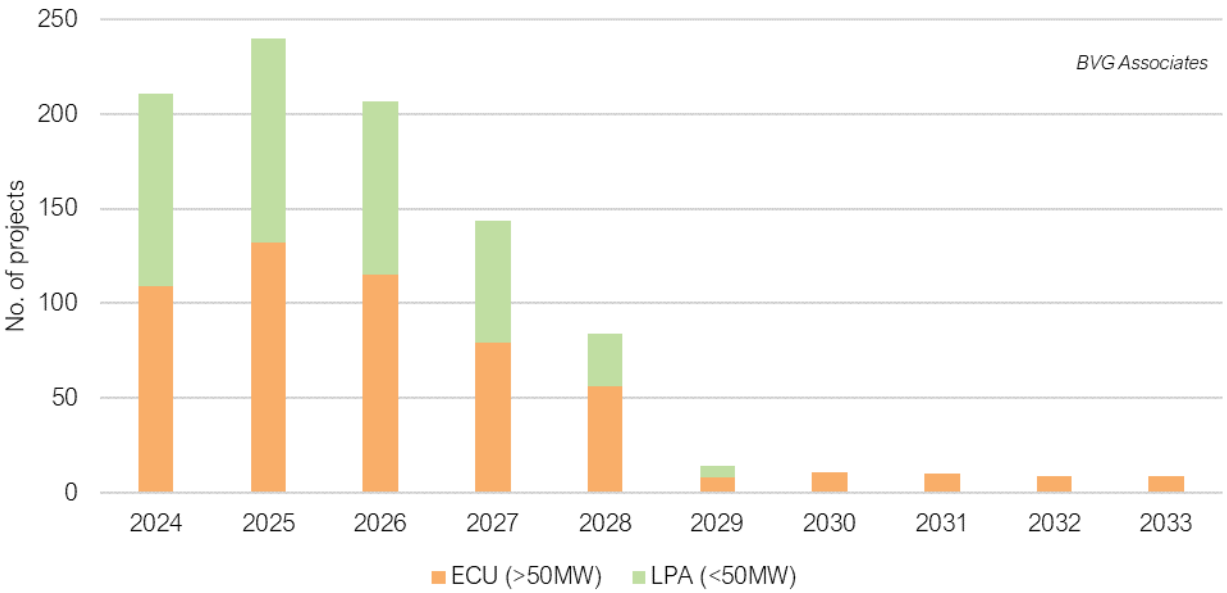

Figure 21 Number of projects in planning by planning route to 2033 for Scenario 2.

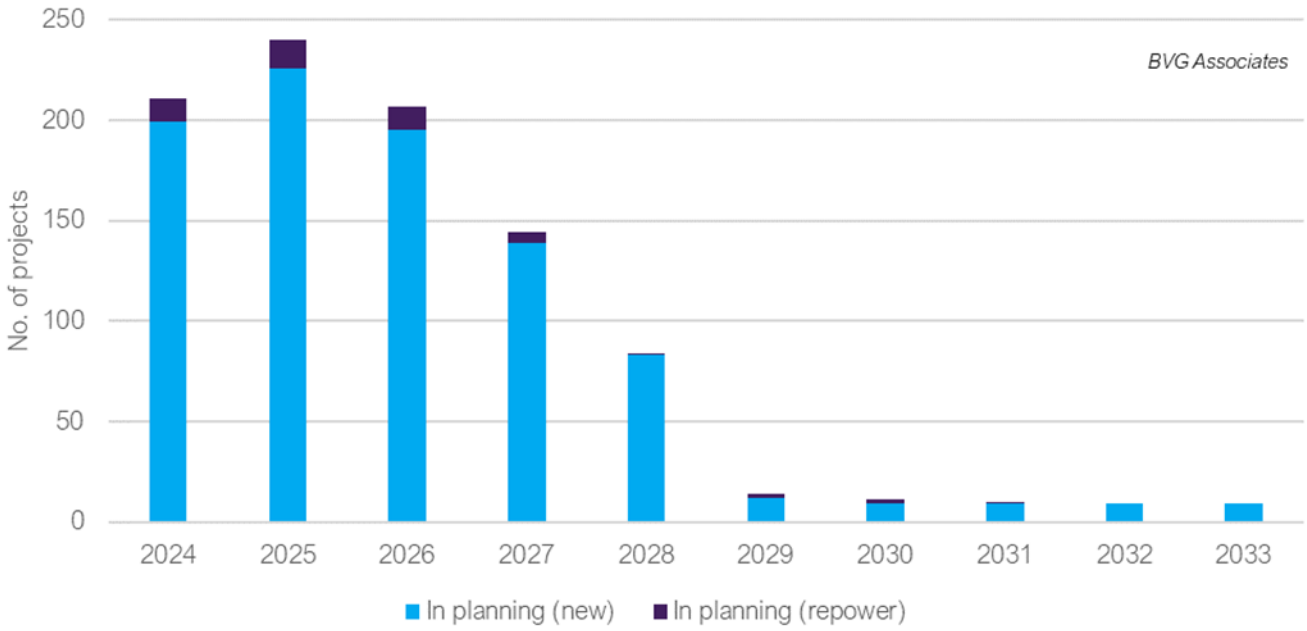

Figure 22 Number of projects in planning by project type to 2033 for Scenario 2.

Consent decisions

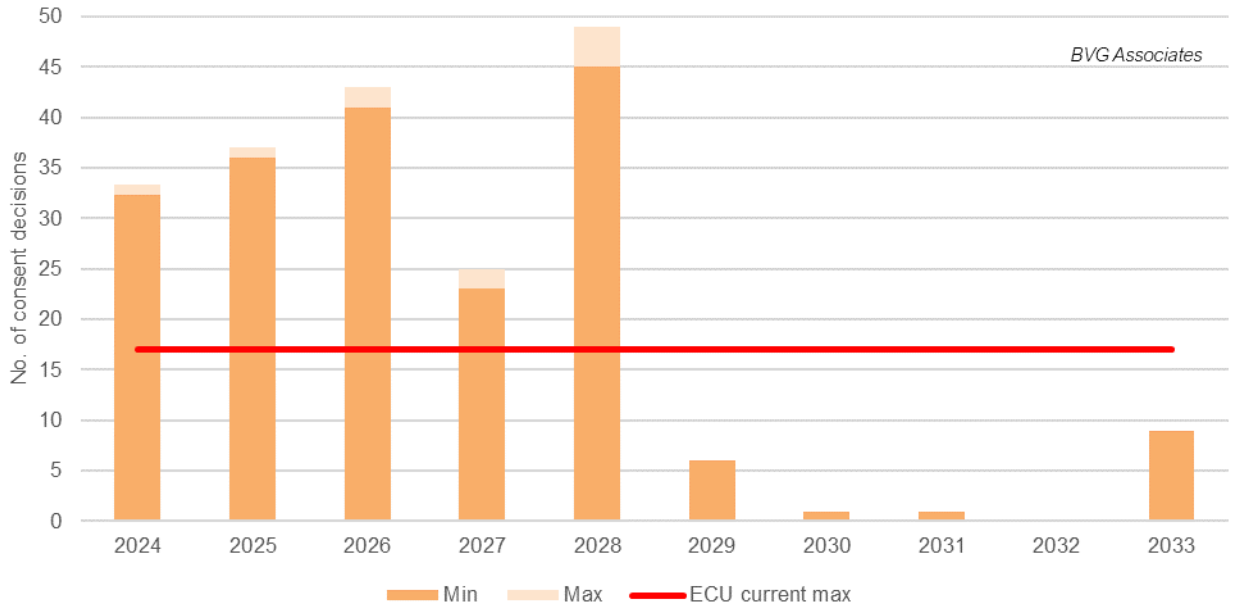

Figure 23 Minimum and maximum number of consent decisions required at ECU level for Scenario 2.

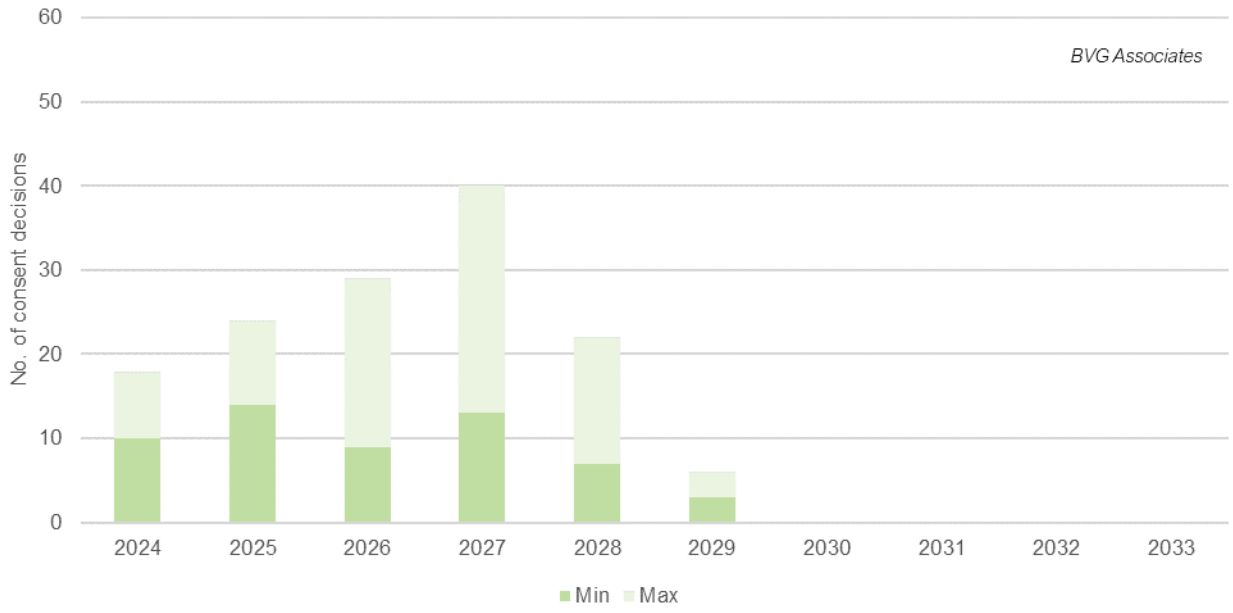

Figure 24 Minimum and maximum number of consent decisions required at ECU level for Scenario 2.

Abnormal loads

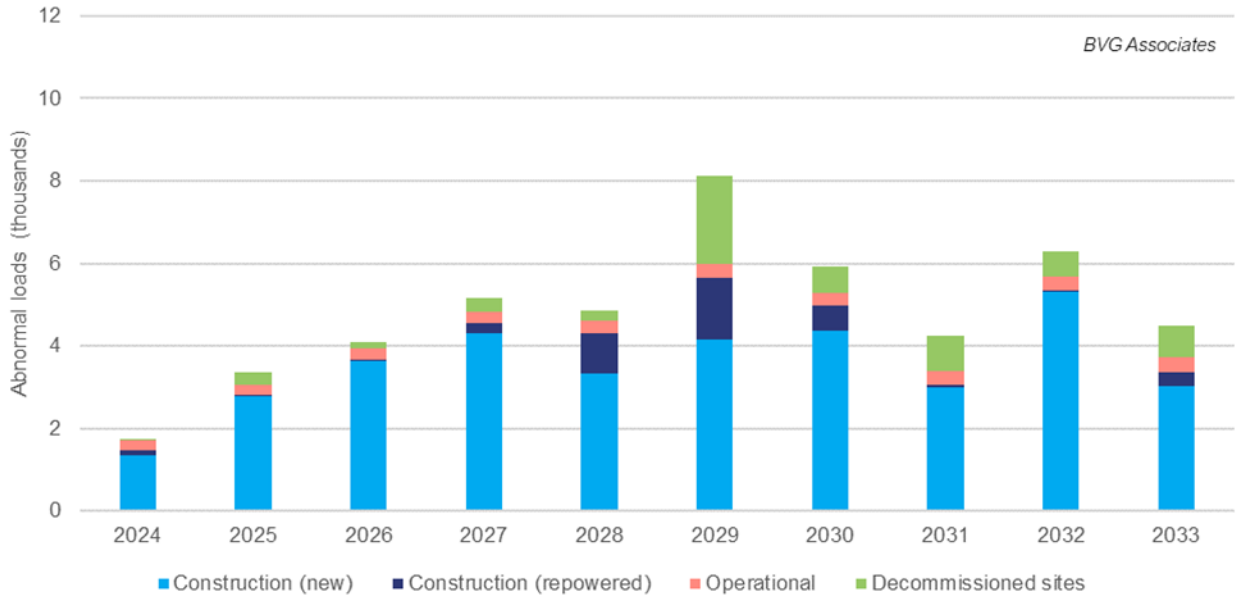

Figure 25 Number of abnormal loads required by project stage for Scenario 2.

Community benefit

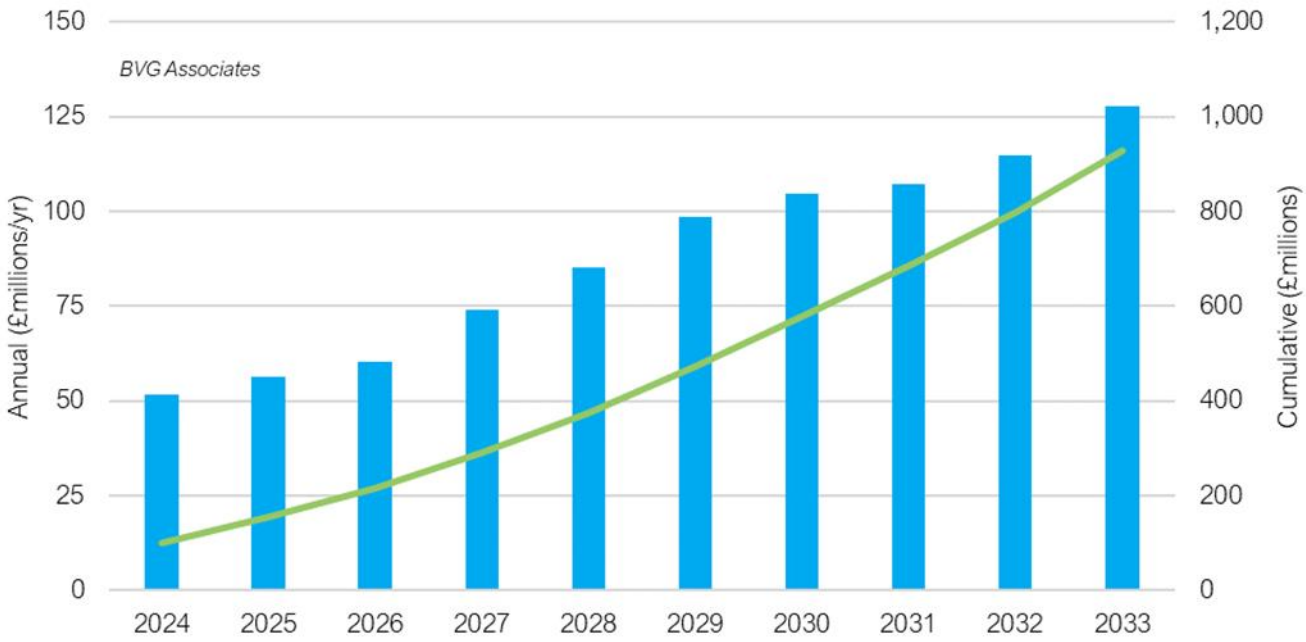

Figure 26 Community benefit achieved yearly and cumulatively for Scenario 2.

CfD allocation

Table 6 Capacity eligible for and target capacity required for future CfD rounds for Scenario 2.

CfD Allocation round	CfD year	Eligible (GW)	Target allocation (GW)
5	2023	4.9	0.9 (1.7 actual)
6	2024	5.9	2.8
7	2025	7.6	2.3
8	2026	6.5	2.7
9	2027	5.8	2.0
10	2028	4.4	0.7
11	2029	5.8	1.7
12	2030	4.8	2.8

Grid connections

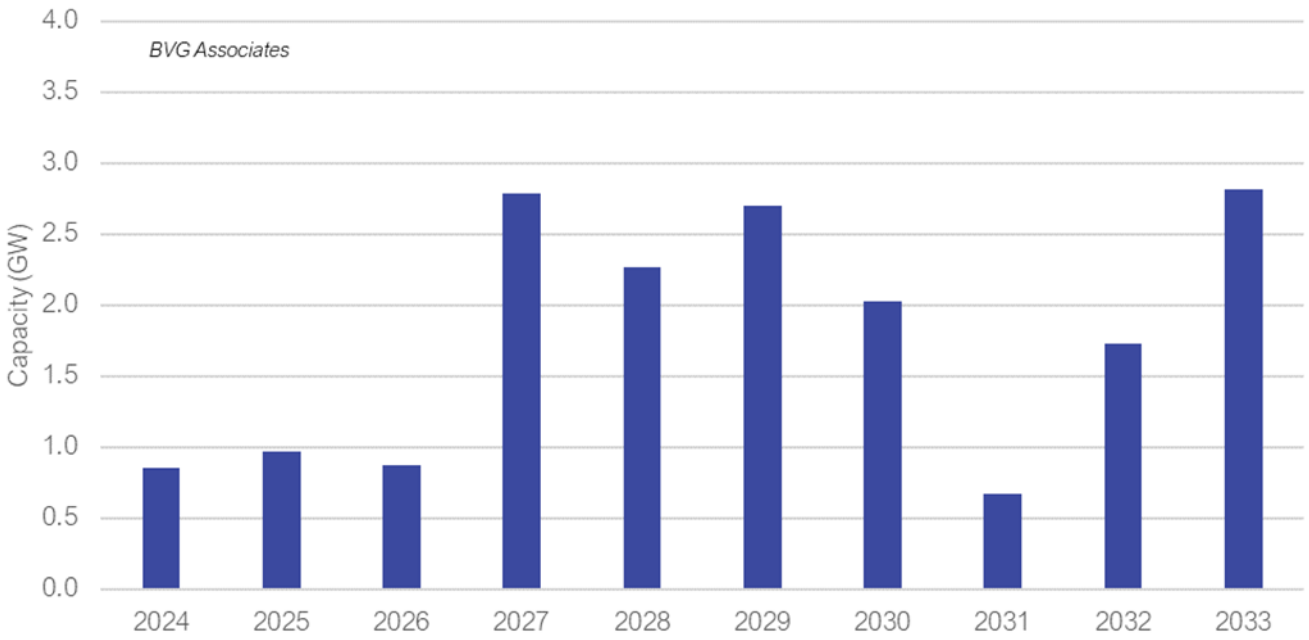

Figure 27 Capacity requiring grid connection per year for Scenario 2.

Appendix C Scenario 3

Pipeline

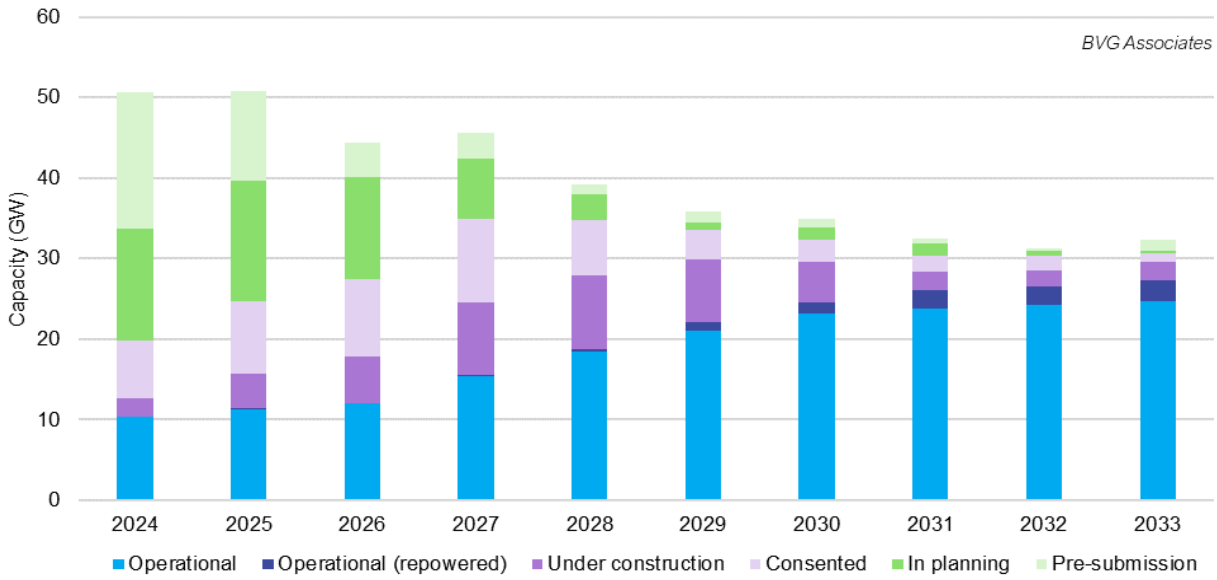

Figure 28 Expected timeline to 2033 for Scenario 3.

KPIs

Projects in planning

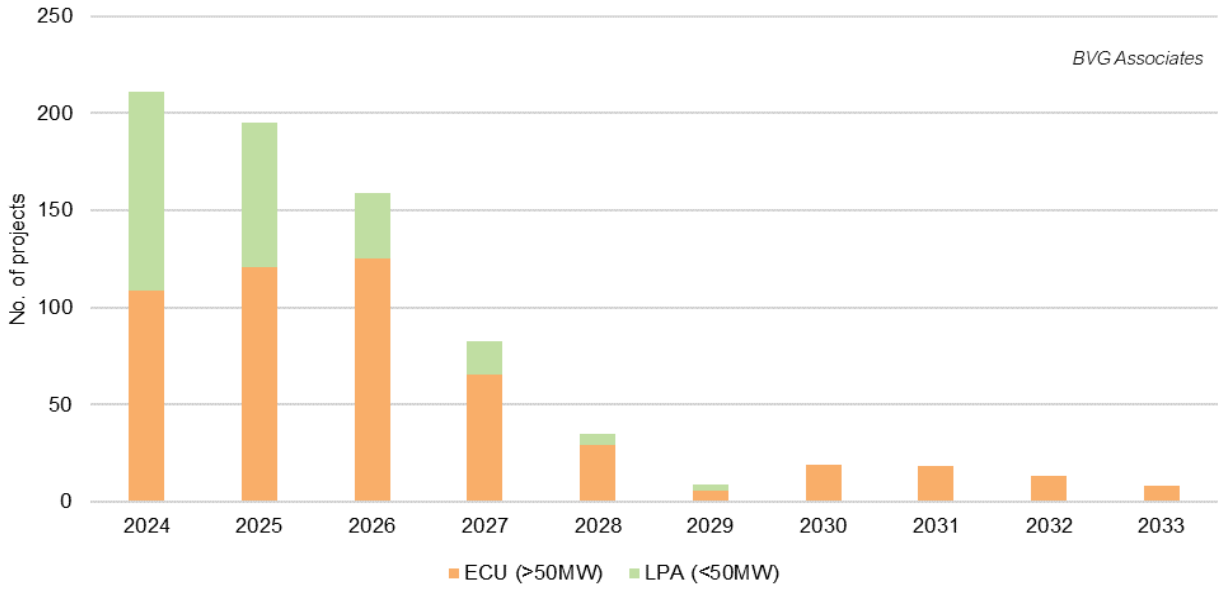

Figure 29 Number of projects in planning by planning route to 2033 for Scenario 3.

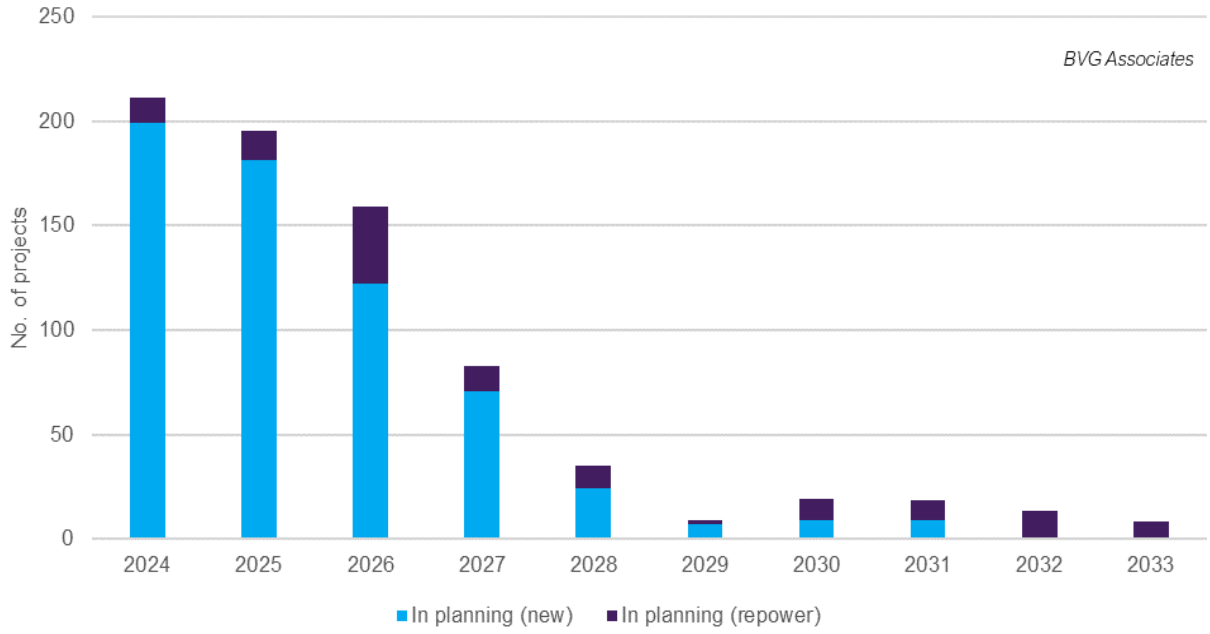

Figure 30 Number of projects in planning by project type to 2033 for Scenario 3.

Consent decisions

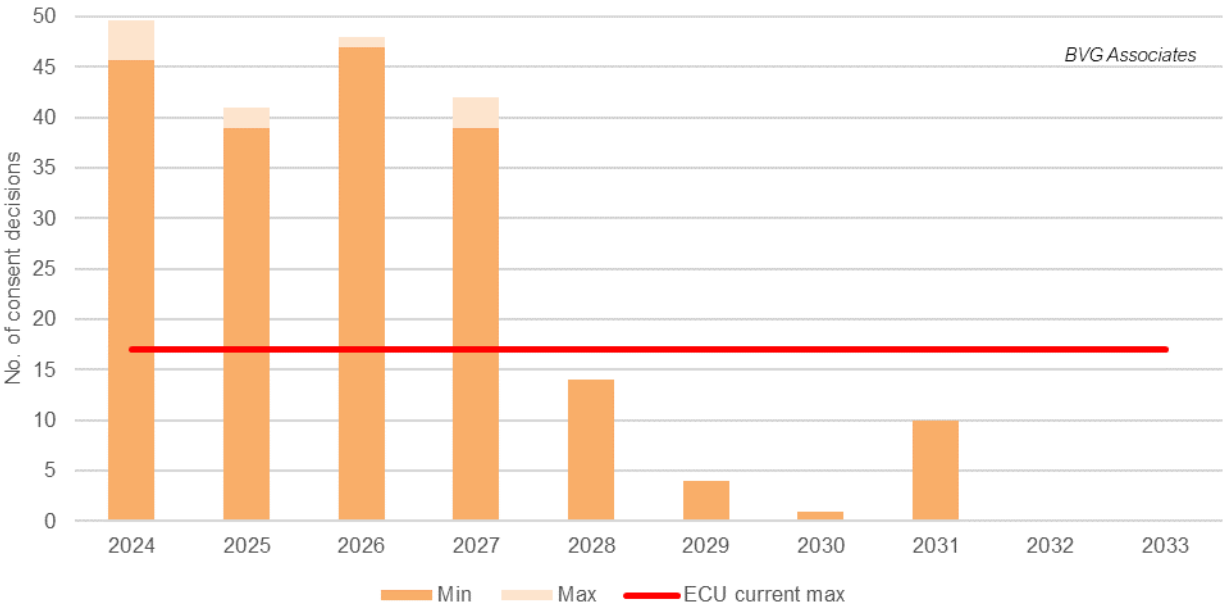

Figure 31 Minimum and maximum number of consent decisions required at ECU level for Scenario 3.

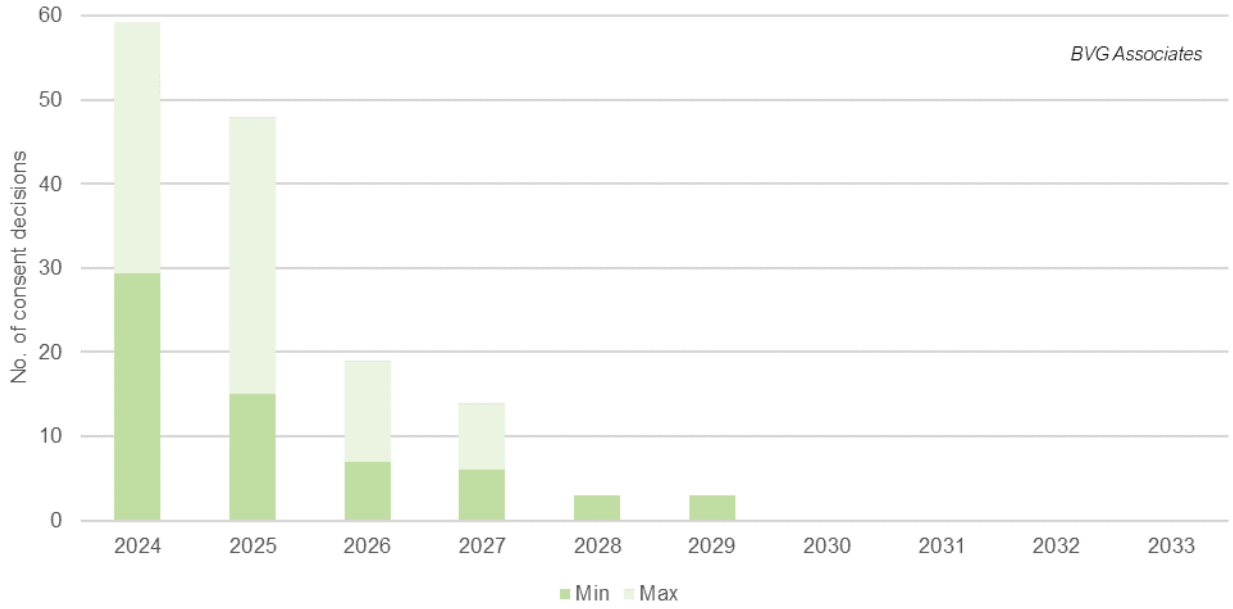

Figure 32 Minimum and maximum number of consent decisions required at LPA level for Scenario 3.

Abnormal loads

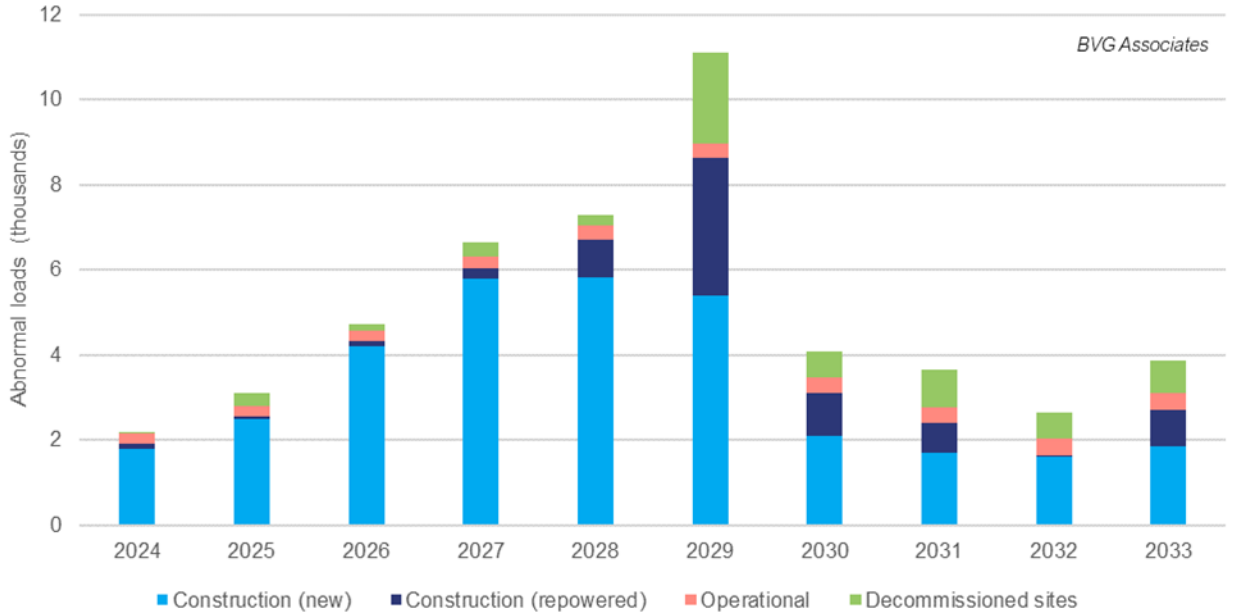

Figure 33 Number of abnormal loads required by project stage for Scenario 3.

Community benefit

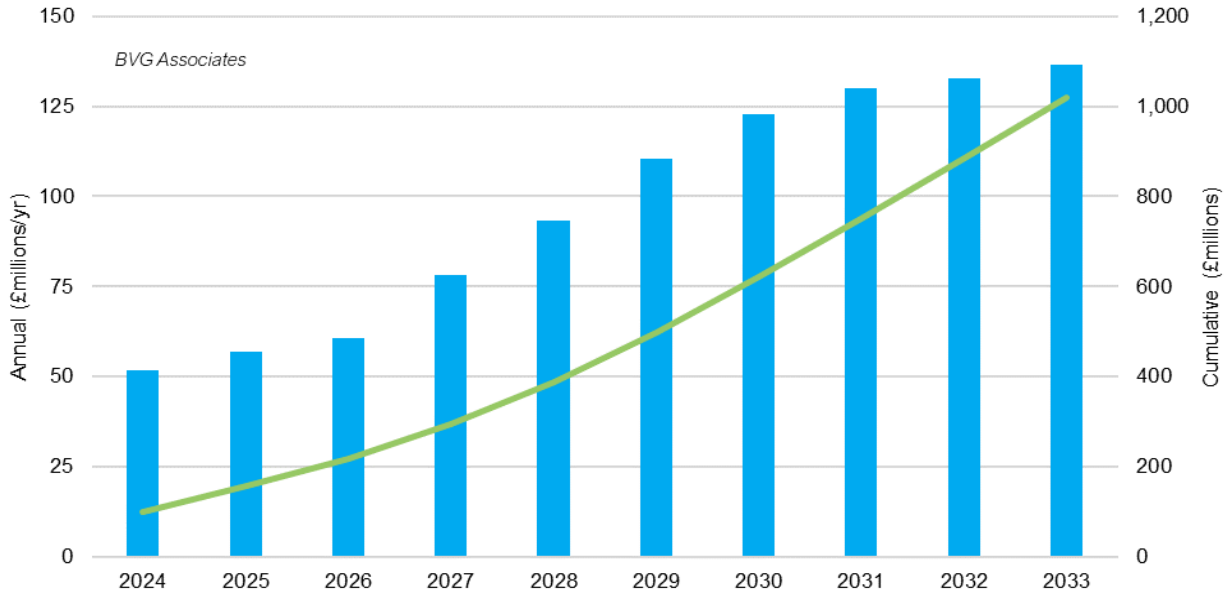

Figure 34 Community benefit achieved yearly and cumulatively for Scenario 3.

CfD allocation

Table 7 Capacity eligible for and target capacity required for future CfD rounds for Scenario 3.

CfD Allocation round	CfD year	Eligible (GW)	Target allocation (GW)
5	2023	5.5	0.8 (1.7 actual)
6	2024	7.6	3.5
7	2025	10.9	3.1
8	2026	9.2	3.5
9	2027	7.4	3.2
10	2028	3.2	0.9
11	2029	2.7	0.6
12	2030	2.5	0.7

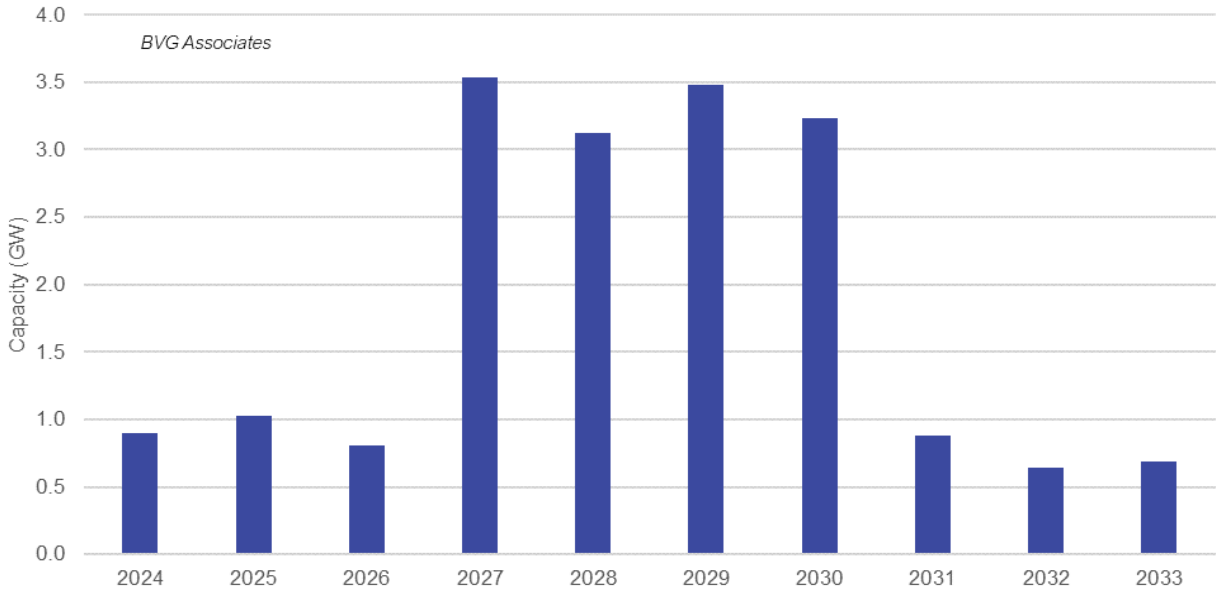

Figure 35 Capacity requiring grid connection per year for Scenario 3.

Appendix D Local authority data

Scenario 2

Table 8 Projects in planning (ECU) for Scenario 2.

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
Aberdeen City Council	0	0	0	0	0	0	0	0	0	0	0
Aberdeenshire Council	3	3	4	2	1	0	0	0	0	0	13
Angus Council	0	0	0	0	0	0	0	0	0	0	0
Argyll and Bute Council	14	24	18	10	9	1	1	0	0	0	77
City of Edinburgh	0	0	0	0	0	0	0	0	0	0	0
Clackmannanshire Council	0	0	0	0	0	0	0	0	0	0	0
Dumfries & Galloway Council	19	16	13	7	6	0	0	0	0	0	61
Dundee City Council	0	0	0	0	0	0	0	0	0	0	0
East Ayrshire Council	8	6	4	0	0	0	0	0	0	0	18
East Dunbartonshire Council	0	0	0	0	0	0	0	0	0	0	0
East Lothian Council	1	1	0	0	0	0	0	0	0	0	2
East Renfrewshire Council	0	0	0	0	0	0	0	0	0	0	0
Falkirk Council	0	0	0	0	0	0	0	0	0	0	0
Fife Council	0	0	0	0	0	0	0	0	0	0	0
Glasgow City Council	0	0	0	0	0	0	0	0	0	0	0
Highland Council	30	35	36	23	12	2	0	0	0	0	138
Inverclyde Council	0	0	0	0	0	0	0	0	0	0	0
Midlothian Council	1	0	0	0	0	0	0	0	0	0	1
Moray Council	4	4	3	3	0	0	0	0	0	0	14
Western Isles Council / Comhairle nan Eilan Siar	2	2	0	0	0	0	0	0	0	0	4
North Ayrshire Council	0	2	2	2	2	0	0	0	0	0	8
North Lanarkshire Council	0	1	1	1	0	0	0	0	0	0	3
Orkney Islands Council	0	0	0	0	0	0	0	0	0	0	0
Perth & Kinross Council	1	4	4	4	3	0	0	0	0	0	16
Renfrewshire Council	0	0	0	0	0	0	0	0	0	0	0
Scottish Borders Council	12	13	10	4	3	0	0	0	0	0	42
Shetland Islands Council	0	0	0	0	1	1	0	0	0	0	2
South Ayrshire Council	5	3	1	1	1	1	1	1	0	0	14
South Lanarkshire Council	4	4	1	3	2	0	0	0	0	0	14
Stirling Council	1	0	0	0	0	0	0	0	0	0	1
West Dunbartonshire Council	1	1	1	0	0	0	0	0	0	0	3
West Lothian Council	0	0	0	0	0	0	0	0	0	0	0
Unknown	3	13	17	19	16	3	9	9	9	9	107
Total	109	132	115	79	56	8	11	10	9	9	

Table 9 Projects in planning (LPA) for Scenario 2.

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
Aberdeen City Council	1	1	1	1	0	0	0	0	0	0	4
Aberdeenshire Council	11	10	10	2	0	0	0	0	0	0	33
Angus Council	1	0	0	0	0	0	0	0	0	0	1
Argyll and Bute Council	3	3	2	2	0	0	0	0	0	0	10
City of Edinburgh	0	0	0	0	0	0	0	0	0	0	0
Clackmannanshire Council	0	1	1	1	1	0	0	0	0	0	4
Dumfries & Galloway Council	12	9	7	6	2	0	0	0	0	0	36
Dundee City Council	0	0	0	0	0	0	0	0	0	0	0
East Ayrshire Council	7	7	7	5	0	0	0	0	0	0	26
East Dunbartonshire Council	0	0	0	0	0	0	0	0	0	0	0
East Lothian Council	0	0	0	0	0	0	0	0	0	0	0
East Renfrewshire Council	2	1	1	0	0	0	0	0	0	0	4
Falkirk Council	0	0	0	0	0	0	0	0	0	0	0
Fife Council	0	2	2	2	2	0	0	0	0	0	8
Glasgow City Council	0	0	0	0	0	0	0	0	0	0	0
Highland Council	16	19	15	11	6	2	0	0	0	0	69
Inverclyde Council	0	0	0	0	0	0	0	0	0	0	0
Midlothian Council	0	0	0	0	0	0	0	0	0	0	0
Moray Council	2	1	1	1	0	0	0	0	0	0	5
Western Isles Council / Comhairle nan Eilan Siar	0	1	1	1	1	0	0	0	0	0	4
North Ayrshire Council	1	1	2	1	1	1	0	0	0	0	7
North Lanarkshire Council	6	8	8	5	2	0	0	0	0	0	29
Orkney Islands Council	3	4	3	2	1	0	0	0	0	0	13
Perth & Kinross Council	2	4	4	3	2	0	0	0	0	0	15
Renfrewshire Council	0	0	0	0	0	0	0	0	0	0	0
Scottish Borders Council	7	7	4	2	1	0	0	0	0	0	21
Shetland Islands Council	3	2	2	1	0	0	0	0	0	0	8
South Ayrshire Council	3	3	2	2	1	0	0	0	0	0	11
South Lanarkshire Council	18	20	13	11	3	0	0	0	0	0	65
Stirling Council	0	0	0	0	0	0	0	0	0	0	0
West Dunbartonshire Council	0	0	0	0	0	0	0	0	0	0	0
West Lothian Council	4	4	3	1	0	0	0	0	0	0	12
Unknown	0	0	3	5	5	3	0	0	0	0	16
Total	102	108	92	65	28	6	0	0	0	0	

Table 10 Abnormal load movements for Scenario 2.

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
Aberdeen City Council	0	0	0	0	0	0	0	0	0	0	3
Aberdeenshire Council	22	104	149	359	192	165	704	73	113	132	2,013
Angus Council	2	2	2	2	2	2	2	2	2	2	21
Argyll and Bute Council	15	87	169	615	691	2,160	180	247	650	455	5,269
City of Edinburgh	0	0	0	0	0	0	0	0	0	0	0
Clackmannanshire Council	1	1	1	1	1	1	1	1	1	1	12
Dumfries & Galloway Council	179	602	1,000	1,136	663	463	568	448	382	400	5,839
Dundee City Council	0	0	0	0	0	0	0	12	0	0	13
East Ayrshire Council	338	352	373	526	894	2,111	406	58	29	23	5,110
East Dunbartonshire Council	0	0	0	0	0	0	0	0	0	0	0
East Lothian Council	3	3	33	54	25	4	4	4	4	4	138
East Renfrewshire Council	1	1	13	1	1	1	1	1	1	1	23
Falkirk Council	1	1	1	1	1	1	1	1	1	1	14
Fife Council	4	4	4	4	4	4	4	4	4	4	39
Glasgow City Council	0	0	0	0	0	0	0	0	0	0	1
Highland Council	250	542	981	1,299	1,238	1,055	745	874	917	687	8,587
Inverclyde Council	1	1	1	1	1	1	1	1	1	1	9
Midlothian Council	0	0	0	9	52	48	1	1	1	1	114
Moray Council	18	304	442	264	54	84	270	330	88	15	1,869
Western Isles Council / Comhairle nan Eilan Siar	5	7	3	110	228	119	101	4	22	4	604
North Ayrshire Council	5	3	3	3	3	5	9	61	132	115	337
North Lanarkshire Council	7	3	3	3	3	340	315	10	18	12	711
Orkney Islands Council	8	8	2	8	12	38	34	26	20	2	155
Perth & Kinross Council	79	48	9	9	9	171	321	142	112	140	1,040
Renfrewshire Council	0	0	0	0	0	0	0	0	0	0	0
Scottish Borders Council	103	350	366	179	345	746	543	424	470	437	3,963
Shetland Islands Council	192	47	198	222	60	8	8	8	33	38	814
South Ayrshire Council	144	274	110	196	115	46	14	369	90	657	2,016
South Lanarkshire Council	330	430	189	144	216	477	187	162	329	338	2,804
Stirling Council	4	109	15	4	4	4	4	4	220	2	372
West Dunbartonshire Council	0	0	0	0	28	30	3	0	0	0	61
West Lothian Council	4	79	19	4	10	27	25	8	4	4	186
Unknown	0	0	0	0	0	6	1,469	980	2,647	1,010	6,111
Total	1,715	3,363	4,086	5,156	4,851	8,118	5,922	4,256	6,292	4,488	

Table 11 Community benefit (£M) for Scenario 2.

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
Aberdeen City Council	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Aberdeenshire Council	2.6	2.6	2.9	3.2	4.2	4.6	4.8	4.8	4.7	5.1	39.4
Angus Council	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9
Argyll and Bute Council	2.1	2.1	2.0	2.2	4.1	6.5	6.7	6.9	7.5	9.0	49.2
City of Edinburgh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clackmannanshire Council	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.5
Dumfries & Galloway Council	6.0	6.6	7.4	12.1	13.4	16.1	16.5	17.7	18.1	18.8	132.7
Dundee City Council	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
East Ayrshire Council	4.4	5.6	5.8	7.7	8.0	11.4	8.8	9.0	9.1	9.1	78.8
East Dunbartonshire Council	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East Lothian Council	0.7	0.7	0.7	0.7	1.1	1.1	1.1	1.1	1.1	1.1	9.5
East Renfrewshire Council	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.8
Falkirk Council	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.1
Fife Council	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.5
Glasgow City Council	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Highland Council	10.8	11.3	12.2	16.0	19.2	20.8	23.8	24.4	25.8	27.4	191.8
Inverclyde Council	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.3
Midlothian Council	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	1.7
Moray Council	2.5	2.5	2.9	5.0	5.1	5.2	5.7	5.4	5.9	5.9	46.3
Western Isles Council / Comhairle nan Eilan Siar	0.2	0.2	0.3	0.3	0.7	0.7	1.7	1.7	1.7	1.7	9.0
North Ayrshire Council	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6	1.3	7.0
North Lanarkshire Council	0.6	0.6	0.6	0.6	0.6	0.6	1.8	1.9	1.9	1.9	11.2
Orkney Islands Council	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.4	0.3	2.5
Perth & Kinross Council	1.5	1.7	1.7	1.7	1.7	1.7	2.3	2.5	2.5	3.2	20.6
Renfrewshire Council	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scottish Borders Council	4.1	4.3	4.6	4.4	5.3	6.5	7.4	7.6	8.8	10.5	63.5
Shetland Islands Council	2.3	2.3	2.3	2.5	3.5	3.5	3.5	3.5	3.5	3.5	30.2
South Ayrshire Council	2.2	2.6	3.0	3.3	3.9	4.3	4.3	4.3	3.8	4.1	35.7
South Lanarkshire Council	7.6	9.1	9.3	9.9	9.9	10.7	11.0	10.9	11.5	12.3	102.3
Stirling Council	0.8	0.8	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.8	10.3
West Dunbartonshire Council	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.8
West Lothian Council	0.9	1.0	1.1	1.1	1.1	1.1	1.2	1.3	1.3	1.3	11.6
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	3.3	8.6	12.7
Total	51.5	56.3	60.3	74.1	85.2	98.4	104.7	107.3	114.6	127.8	

Appendix E Timeline analysis of rUK EPDB

In planning to COD

Operational projects over 20 MW were used to determine average time spent at each project stage.

Projects over 20 MW were selected as these represent a large proportion of the capacity in the pipeline while not considering a large number of projects with small capacity which have low impact on overall capacity. This is summarised in Table 12 which considers all projects in rUK's EPDB yet to reach commercial operation.

Table 12 Representation of pipeline projects in analysing only projects with > 20 MW capacity

	All projects	Projects > 20 MW
Number of projects	524	265
Percentage of all projects	N/A	51%
Overall capacity (GW)	21.5	20.6
Percentage of overall capacity	N/A	96%

In total there are 524 projects yet to reach commercial operation with an overall capacity of 21.5 GW in rUK's EPDB.[xii] Projects with a capacity of over 20 MW comprise 96% of this overall capacity (20.6 GW) but only 51% of the number of projects. Analysing timelines for such projects means that average timelines for future projects are representative of future capacity in the pipeline and are not underestimated due to small scale projects which have shorter timelines due to their comparable simplicity.

Operational projects were selected as these have complete timelines. In total there are 837 projects which have reached commercial operation with an overall capacity of 9.5 GW in rUKs EPDB. A total of 137 of these projects have a capacity over 20 MW and these represent 83% of overall capacity (7.9 GW).

These 137 projects were used to generate the average time spent at each project stage in Table 14. The project stages analysed are:

- In planning: time between submission for planning consent and final consent decision.[xiii]
- Consented: time between final consent decision and the start of construction.
- Construction: time between start of construction and start of commercial operation.

Additionally, the number of projects analysed and their average capacity is shown for each time period in Table 13.

Table 13 Number of projects and average capacity of operational projects of over 20 MW capacity used for timeline analysis.

	Commissioned year				
	Pre 2006	2006-2010	2011-2015	2016-2020	2021-2025
Number of projects	10	28	33	46	20
Average project capacity (MW)	41	54	65	58	57

[xii] Projects without nameplate capacity were not considered in this analysis.

[xiii] As projects analysed are all operational, all were ultimately granted consent, this time period may include appeal and/or judicial review.

Table 14 Average time in years at project stages by year of commissioning.

	Commissioned year				
	Pre 2006	2006-2010	2011-2015	2016-2020	2021-2025
In planning	1.3	2.3	3.3	3.4	2.7
Consented	0.8	1.1	2.5	2.6	3.8
Construction	0.9	1.4	1.8	1.8	1.6

It can be observed in Table 14 that time at each project status analysed increased over time up to 2020. The data for 2021 to 2025 suggests that time in planning and construction have reduced in comparison to the previous two 5 year periods, however, this dataset is incomplete as data is only available up to March 2024.

Using the above data we arrived at the following average times at each project status:

- In planning: 2 years, extending to 4 years for "challenged" projects, 50% of projects assumed to be "challenged" resulting in an average time in planning of 3 years.
- Consented: 3 years.
- Construction: 2 years.[xiv]

Other project stages

Considering the standard project timeline in Figure 2, two project statuses are missing from the above analysis, these are:

- Pre-submission: time between inception and submission for planning consent.
- Operational: time between the start of commercial operation and the projects end of life.

Pre-submission

rUK's EPDB has limited information available for pre-submission timings. Of 1,252 projects in EPDB which have surpassed the development stage, only 249 have datapoints which allow for calculation of time at this stage. If only operational projects with capacity greater than 20 MW were considered (as in the analysis above), this reduces to only 10 projects. All projects which have surpassed the development stage were therefore considered. This resulted in the following average time:

- Pre-submission: 2 years.

Operational

As few projects have reached end of life in Scotland, data for project lifetime is limited. Our assumption below is based on BVGA's expectation and response to developer engagement.

- Operational: 25 years.

[xiv] This is likely a conservative estimation based on data in Table 14.

Appendix F Model parameters fixed across all scenarios

The following user-defined parameters as per Model overview were consistent across all scenarios.

Drop-out parameters

- Projects exceeding 4 years at their current stage as per rUK's EPDB were assumed to be dormant and drop-out of the analysis.
- Projects with a maximum tip height of lower than 150 m are assumed to be unlikely to be built and therefore drop-out.
- Projects with a generator capacity of less than 3 MW are assumed to be unlikely to be built and therefore drop-out.
- A general progression rate of 60% is applied to projects yet to be granted consent, meaning that 40% of projects pre-consent decision will drop-out.

Developer parameters

- Developer timelines are included where provided.
- Developer advised future projects are included.

Model introduced project parameters

Repowering

- In Scenarios 1 and 2 no additional repower is added to the timeline.

Deficit

Where a deficit is incurred, the following is assumed:

- The average size of future turbines will be 4 MW.
- The average size of future projects will be 50 MW.

KPI parameters

- Community benefit of £5000 per MW per year will be achieved.
- The number of abnormal loads in construction is 10 per turbine and in decommissioning is 6 per turbine, with an additional 0.05 per turbine per year during operation. [xv]
- To estimate required capacity for onshore wind in future CFD rounds, it is assumed the time between FID and operation is 3 years.

[xv] See Section 6.3 for explanation.