REPORT

Road to Power Tool Specification

Prepared for: National Grid Electricity Distribution

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Version History

Date	Version	Author(s)	Notes
27/11/2024	0.1	Louise Guthrie	First Draft for NGED
28/02/2025	0.2	Louise Guthrie	Updated document based on project progress, focus on definitions.
09/04/2025	0.3	Anosha Irshad	Updated document based on final proof of concept tool
05/05/2025	0.4	Louise Guthrie	Finalised document for review

Final Approval

Approval Type	Date	Version	EA Technology Issue Authority
Reviewer	20/05/2025	1.0	Ben Taylor

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1. Background and Introduction

The Road to Power project aims to develop a proof-of-concept tool for National Grid Electricity Distribution (NGED) to enable their customers looking to connect a site at HV (11kV) to be provided with options for connection types. The innovation this tool will deliver is the inclusion of assessments for flexible connections that are offered by NGED.

This proof-of-concept tool will include:

- Network model of one primary substation and its connected circuits.
- The prospective site energy profile.
- Customer site location specification, site boundary drawing and substation location.
- Connection options provided based on site information and the local network data.

These features and the related user journey features are described in greater detail in this specification.

As this project is funded through SIF and has Alpha funding, the final product is limited by the six-month project completion deadline. Throughout development, new features may be discussed but may not be implemented within the scope/time limits. These have been included in this specification to be captured and included when the tool is developed further.

This document focuses on the listing and description of features within the proof-of-concept tool and discusses future features that could be included in a final connections tool. Other documents will be provided that describe:

- The user journey through the tool
- The high-level red/amber/green (RAG) status for initial connection options on the map
- The specifications relating to the requirements for the HV network data to be used in the load flow assessment and for display on the map.

This specification will be updated periodically throughout the project where features are added or adapted. Features being added will be in response to queries from NGED or if the EA Technology team believes they are practical and a necessary addition to the tool within the time and scope of the Alpha phase of the project. In the case of feature adaptation, this will likely be due to user feedback in the testing stage of the tool and will be highlighted in the relevant section.

This document will show the most up-to-date features in the tool as it is a working document until the project closedown. This is due to the nature of software development projects and the Agile nature through which they are delivered.

2. Definitions

This section is used to define both abbreviations and significant terminology for the project. This page will be updated continuously during the project until the final version of the tool specification is decided at project closedown.

ANM	Active Network Management. In constrained areas of the network these systems will be implemented to allow customer connections to be made that would otherwise require prohibitively costly network reinforcement, or to accelerate connections where reinforcement has a long lead time. For the purposes of implementing ANM, the network is divided into ANM Zones, each Zone comprising a Grid Supply Point (GSP) or GSP group depending on network complexity.
Curtailable Connection	A connection within an ANM zone that has been provided with a curtailment assessment.
GSP	Grid Supply Point
Time Profiled Standard Connection	A connection with a variable maximum demand based on available network capacity.
HV	For this specification, HV refers to the 11 kV network.
NGED	National Grid Electricity Distribution

3. Functional Specification

This tool will:

- Capture project identifying details:
    - Unique name for connection project
    - Site location – Grid reference, post code or latitude and longitude
    - Maximum required connection capacity, in kW
    - Connection start date
    - Whether the connection is a temporary connection or permanent
        - Connection end date, if temporary
- Offer users the option of being assessed for a non-standard connection alongside their standard connection assessment.
- Have input options for:
    - Maximum demand during each month
    - Times of peak demand on the site
- Show the capacity available on the map using visual cues before a connection location is decided.
- Provide three different connection options depending on the user's site requirements:
    - Standard Connection.
    - Time Profiled Standard Connection
    - Curtailable Connection

4. Tool Features

This section describes the features of the proof-of-concept tool, with the sub-sections describing what features exist on each page of the tool. These sections will be expanded where necessary and will include visuals where it is possible to provide as much contextual information to the reader.

There may be some further pages or features added, as previously discussed, to ensure the concept tool works. These features may be made obsolete or be heavily changed when the tool is implemented in a business as usual (BAU) environment.

Upon accessing the tool, the user is prompted with a login pop-up so that each user can access their HV connection applications in one place. New users will also have the option to create an account.

4.1 Creating Site Profile

The 'Create Site Profile' section is the first step in setting up a new HV connection application. Users are required to enter a unique name for the site, which acts as an identifier for tracking and future reference.

4.1.1 Site Location Type

The tool provides flexibility in specifying the site location type by offering a dropdown with three options: Postcode, Grid Reference, or Latitude & Longitude.

4.1.2 Site Location

After selecting the location type, the user must enter the specific location value (e.g., a valid UK postcode). The tool will ensure the connection request is linked to the correct site. This postcode provides input to the map service on the fourth page.

4.1.3 Maximum Site Load

Users are required to input the maximum load they expect to draw from the network in kVA. This value is subject to validation to fall within the permitted range.

4.2 Energy Profile – Connection Details

This section captures essential information about the operational duration and type of HV connection. The user is prompted to indicate whether the connection is temporary via a simple Yes/No toggle. Users are also required to specify whether the site requires a non-standard connection.

The tooltips provide contextual help to guide the user and are especially helpful in defining key connection terms, such as temporary connection, non-standard connection.

4.2.1 Connection Start and End Date

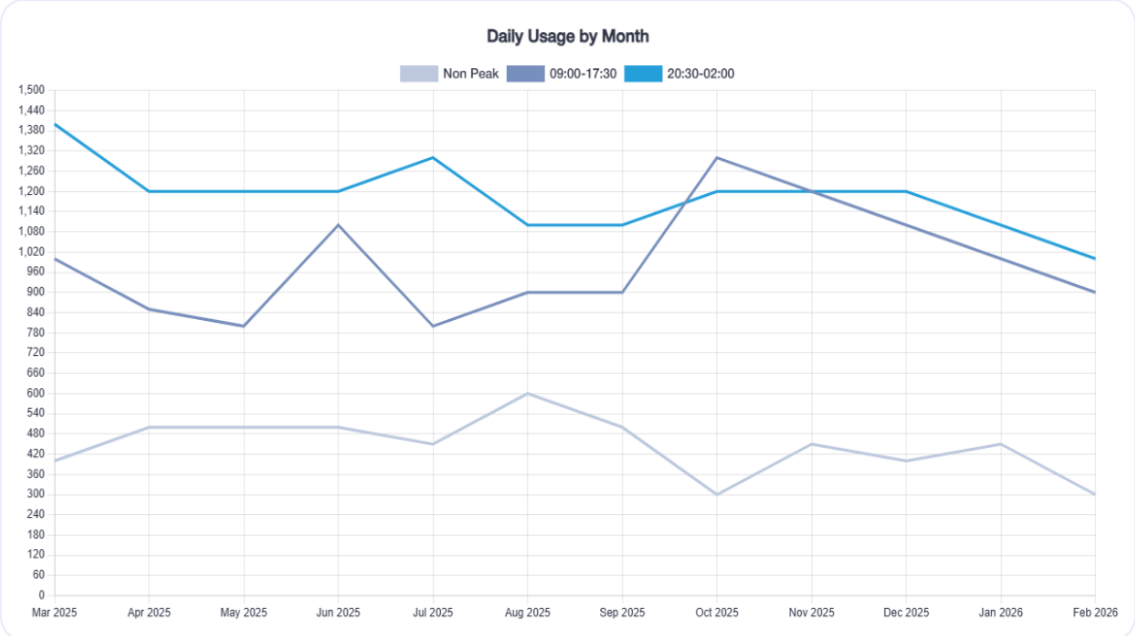
Users should provide the start and end date of the work, which helps in defining the project timeline to NGED. This is administrative information for the proof-of-concept tool, however in the full version, this will enable live network reinforcement updates to be included when the tool is calculating options.

4.2.2 Daily Load Profile

Once the user enters the connection details, they are taken to the Daily Load Profile section where they are asked whether they want to assess a daily load profile. If the user chooses Yes, the tool allows them to define specific periods of the day when their site is expected to experience peak energy demand. For example, a user may specify 09:00–17:30 as a daytime peak period and 20:30–02:00 as an overnight peak.

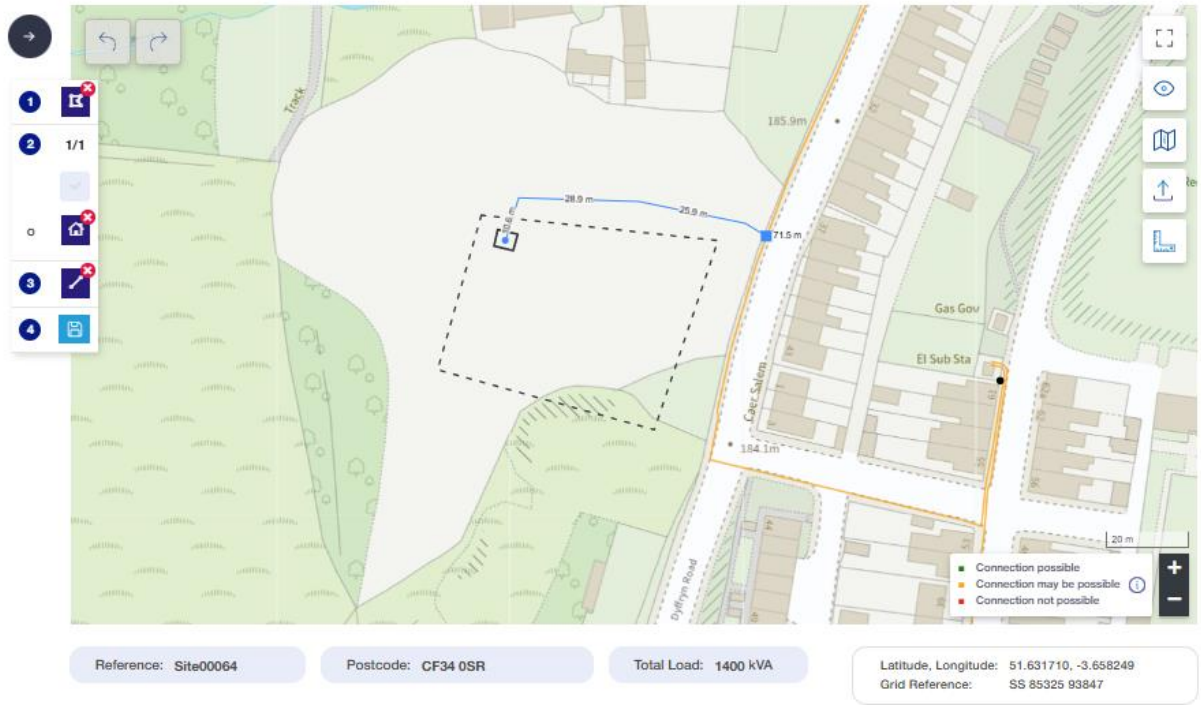
4.2.3 Monthly Load Profile

In this section, a user enters the average monthly usage data for the defined daily load periods. The user inputs expected kVA usage across the year, segmented into non-peak and user-defined peak period. Input fields are validated to ensure the usage falls between 11 kVA and 1400 kVA. An integrated line graph dynamically plots the monthly usage across time blocks to provide users with a visual representation of their load forecast.



4.3 Site Boundaries Input

This part of the tool aligns with other VisNet Modelling tools to ensure consistency across products.



4.3.1 User Indicates Connection Site Boundaries on Map

Users will use an interactive map to visually mark the boundaries of their project site. This interactive mapping tool enables users to spatially define the layout of their connection site. The map displays the postcode, grid reference, coordinates, and total site load in real time.

4.3.2 User Indicates Proposed Transformer Location on Map

Users can specify the preferred location for the transformer within the site boundaries. The user can place the substation premises, marking the point of supply, and tracing the cable route between the site and the network. This input will help in designing the connection layout and evaluating the feasibility of the proposed setup.

4.4 Summary Page

After completing all required steps, the user is taken to the Summary Page. This page provides a complete overview of all data entered across the Site Profile, Energy Profile, Load Profile, and Site Location sections. Each section of the Summary Page includes an Edit or Change button, which enables users to navigate back to the corresponding step and modify any previously entered values. The Summary Page also includes validation flags to highlight any incomplete or incorrectly formatted entries. Users cannot proceed to the final connection offer stage unless all mandatory fields across all sections have been properly completed.

5. Tool Logic

The following logic is used when assessing connection requests to provide the connections options to the user.

Existing connections processes are translated into the tool environment.

The tool processes can be split into the following:

- Network Assessment.
    - This is used to provide RAG status against the network in the mapping tool.
    - For the proof-of-concept tool this is a static network assessment.
    - In future iterations this will be a live network assessment that is updated based on real-time network data.
- Connection Assessment against Network Parameters.
    - The user inputs to the tool are assessed against the network parameters.
    - Time of demand on site will be accounted for with regards to non-standard options.
    - A fixed connection option will be provided in line with the existing connections policy.

A more detailed overview of the tool logic and assessment process is provided in EA29844-TR02 Tool Connections Offer Journey and EA29844-TR03 RAG Logic.

6. Future Development Features

This section discusses Beta phase tool features that exist outside the present scope of the tool but should be considered in future iterations of the tool.

6.1 Contextualising Constraints

Within the Alpha concept tool, the primary is assumed to have enough capacity for new connections and the constraints primarily lie down the feeders. This was to prove the concept of connecting a flexible connection, a second primary being modelled to have no capacity would not have demonstrated much additional functionality.

In a future iteration of the tool, it may be valuable to provide context as to where the constraints are derived from, for example, a Curtailable connection that is used to alleviate constraints at higher voltage levels. Time Profiled Standard connections are currently used to manage capacity along a feeder, so the tool could highlight why some of the time frames are constrained.

6.2 Carbon Accounting Associated with Profile

When provided with connection options, the user will see counterfactual carbon costs associated with each option. This should enable a user to understand some of the environmental costs of their connection work. As the tool is anticipated to be accessed from early project development until the connection request occurs, there may be an aspect of optioneering associated with this output. If a site connection has a large scope of emissions, even if it is a good connection option, it might not be suitable for the project.

Output options will also highlight associated carbon emissions and potential energy savings, aligning with the stakeholder input.

6.3 Customer Selection of Primary/Feeder before Work Site

Some users may not have strict site location requirements. In these cases, a user may prioritise a connection and the time of that connection over the location of a connection. Alternatively, the user may have multiple possible locations, and they would like to use the tool to narrow them down. In these cases, a user wants to use the tool as a method of optioneering and only needs to connect in the vicinity of a region, so providing a list of primaries/feeders with the most available capacity may be another option. Some users would prefer to avoid the possibility of a flexible connection.

6.4 Default Site/Charge Profiles

During the SIF Show and Tell for the project, a stakeholder suggested that a key user feature could be to include a selection option for the types of vehicles on sites and they most likely charging times. That was an option explored at the outset of the Alpha phase however there were a few barriers to implementation.

1. Limited availability of charging profiles for electric non-road mobile machinery. As they are new technology, there are limited examples of charge profiles and use cases for the machinery which could be implemented on these sites.
2. Calculation of profiles across the year. When a construction plan has been more fully developed, or there is a substantial baseline plan, it will be easier to forecast volumes of charge profiles required during each month of the year.

It was decided during the Alpha phase that asking users to estimate the site peak and non-peak demands would be suitable for the testing of the logic. However, the charge profile integration is a clearly valuable user case that should be explored.

6.5 Real-time Loading Capacity

As suggested by stakeholders, the tool may incorporate real-time loading capacity data into the connection application process, enabling users to make more informed decisions. However, this is likely to require a significant amount of integration with other data systems within NGED, which may be out of scope for a Beta phase. It may be part of the continuous service associated with the connections product.

6.6 Early-Stage Integration

Users will be able to utilise the tool during the early stages of project development, such as during pricing and tendering, depending on the project phase. The tool will provide preliminary connection options and estimates tailored for these early stages.

6.7 Cost Estimation and Budgeting

Based on the stakeholder input, Users will be able to generate cost estimates based on connection types and regional variations. This feature will help teams budget more accurately during the planning process. This should be broken down into a Bill of Materials to provide clarity to the user on the types of assets and services that are included in the assessment.