Specification Document Detailing Visualisation of DNO Datasets and Metadata Requirements

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1 Introduction

This document outlines the approach for visualising National Grid Electricity Distribution's Network Capacity (Network Opportunity Maps) and Distribution Future Energy Scenarios data within the LAEP+ platform – delivering the visualisation within the platform was a part of PRIDE beta project as work package 2, deliverable D2.2. Datasets in this report include:

Dataset	**Source**	**How often updated**
Bulk Supply Point (BSP) Substation Supply Areas	National Grid Electricity Distribution	Biannually
BSP Substations	National Grid Electricity Distribution	Ad hoc
Primary Substation Supply Areas	National Grid Electricity Distribution	Biannually
Primary Substations	National Grid Electricity Distribution	Ad hoc
Secondary Substation Supply Areas	National Grid Electricity Distribution	Biannually
Secondary Substations	National Grid Electricity Distribution	Ah hoc
LCT connections - Primary	National Grid Electricity Distribution	Biannually
LCT Connections - Secondary	National Grid Electricity Distribution	Biannually
DFES Volume Projections By Electricity Supply Area	National Grid Electricity Distribution	Annually
DFES Volume Projections by Local Authority	National Grid Electricity Distribution	Annually
Network Topology Data	National Grid Electricity Distribution	Ad hoc
Embedded Capacity Register	National Grid Electricity Distribution	Biannually

2 Substation Supply Areas

Purpose

The objective of these datasets is to visualise where there are electricity distribution headroom and opportunities across an area - the substation supply areas in LAEP+ reflect the Network Opportunity Maps as visualised by NGED. Users would need to know if there is capacity to connect to the network at varying supply points when planning future energy projects. This could be at the larger scale (primary substation areas and bulk supply points) or at the smaller scale (secondary supply points). Where projects are planned and there is limited headroom capacity, the network would need to be notified early as part of the connections process. Seeing where projects might be more viable because of indicative available capacity can help local authorities and LAEP+ users more quickly determine where to locate energy projects.

Metadata, ingestion and permissions

National Grid Electricity Distribution creates and publishes these datasets. They have been ingested to LAEP+ at different voltage levels including:

- Bulk Supply Point
- Primary Substation
- Secondary Substation

At all levels, the data shows the properties of the substations; including the area supplied by the substation, the maximum amount of capacity that the substation can accommodate, and the available capacity - note that generation headroom capacity will only be shown for primary substations. Available capacity data includes data from statistical models, so should be used for indicative purposes only.

Advanced Infrastructure gets the data from National Grid via their Open Data Portal. The process to ingest and visualise the data is then as follows:

1. Download datasets from source (e.g. relevant open data portal page)
2. Pre-process the data to align with required LAEP+ format
3. Ingest the dataset via the LAEP+ Extract, Transform and Load (ETL) pipeline to the development environment, including dataset configurations, metadata and other relevant supporting information
4. Quality assure (QA) check the data to ensure it matches expected appearance, permissions, metadata and content
5. If the data passes all QA steps, the dataset will then be released to production

Metadata is clear, structured in line with Dublin Core Metadata standards, and easily accessible to ensure users know the source, update frequency and other key metadata items (image 2). The data is available under an open data license.

Additional steps with Network Capacity Maps data

Due to inconsistencies and gaps between newer and older datasets, we included additional steps ahead of data ingestion. Newer datasets use network analysis to calculate a variety of constrains, whereas the older data applies a simpler calculation of subtracting load from capacity. However, the newer datasets were missing data for around 80,000 substations leaving significant gaps in coverage across the region.

To work around this, for primary and secondary substations, AITL has used the new headroom data where possible, and kept the old headroom data where there is missing information in the newer datasets. In instances where there is no data for substations in either dataset, it is assumed that the data has been intentionally removed for having too few customers connected to that substation and is therefore in breach of GDPR guidance.

Where data is missing at Bulk Supply Points (BSPs) it may be because many areas on NGED's network skip BSP level. This happens in instances where there are 132/11kV transformers. In the older dataset it would list the primary and a BSP with the same name, when in reality it is one primary site. In the newer datasets it doesn't list the BSP. For this instance AITL will continue to show the BSP in grey if there is no data, but make a note in LAEP+ so that users understand why.

Styling and visualisation

The map styling adopts a Red/Amber/Green (RAG) colour scheme to indicate areas where there is available substation capacity (green), some substation capacity (amber) or limited substation capacity (red). Colour blind friendly colours can also be selected in the Map > Layers feature to ensure accessibility.

We defined the RED, AMBER and GREEN to depict the polygons available headroom according to the following rule:

- High (Green): >20% total site capacity available
- Medium (Amber): 10% -20% total site capacity available
- Low (Red): <10% total site capacity available

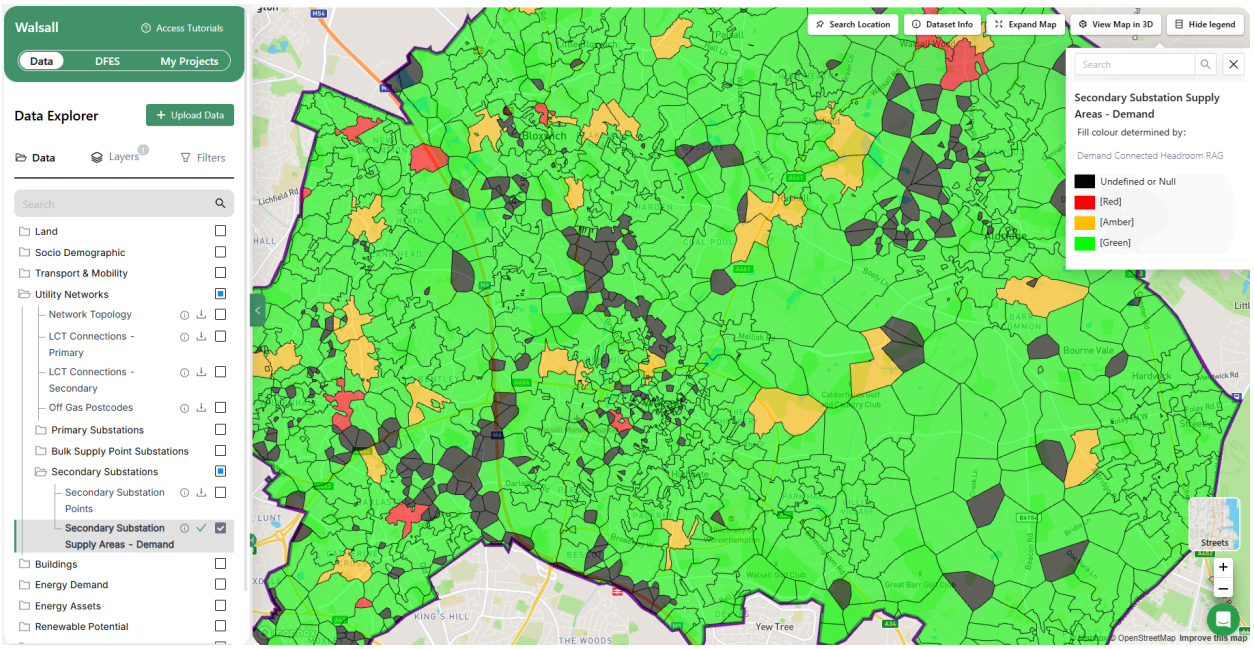
This is in line with how the RAG rating is visualised on National Grid Electricity Distribution's network opportunity maps.

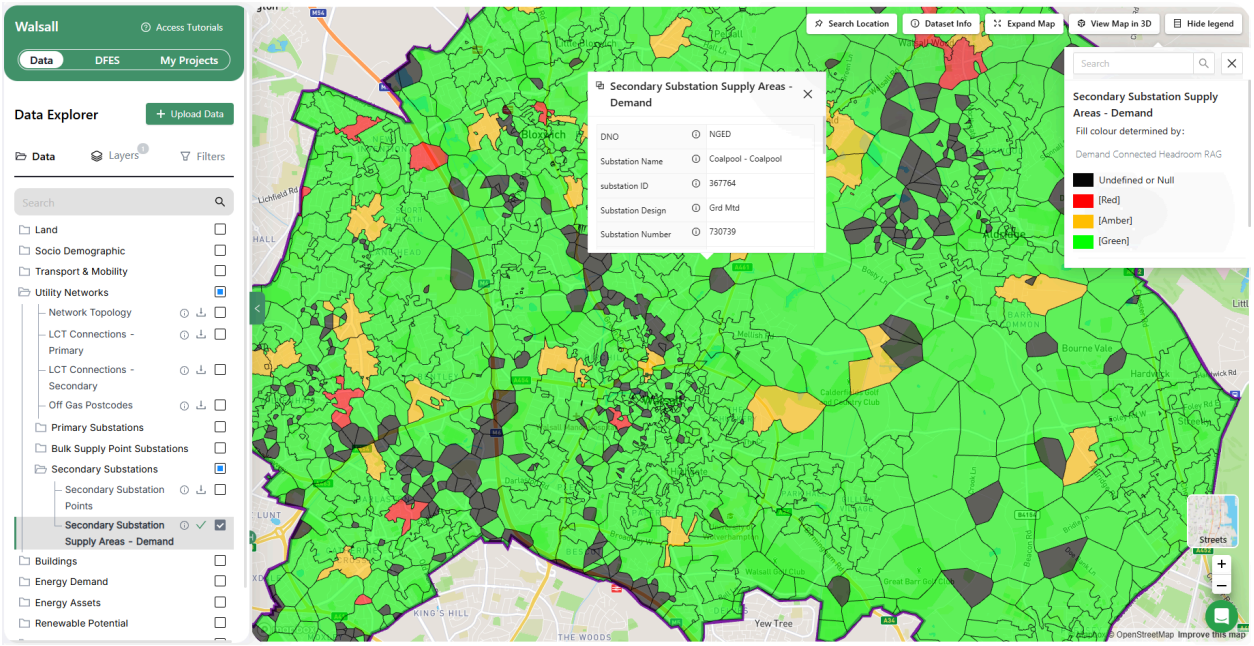
The maps visualise demand headroom at secondary, primary and bulk supply substation level. The demand headroom data supports the planning of technologies like Electric Vehicle charger, heat pumps

and heat networks. The maps also visualise the generation headroom capacity at primary substation level only. The generation headroom data supports the planning of technologies like solar PV and onshore wind.

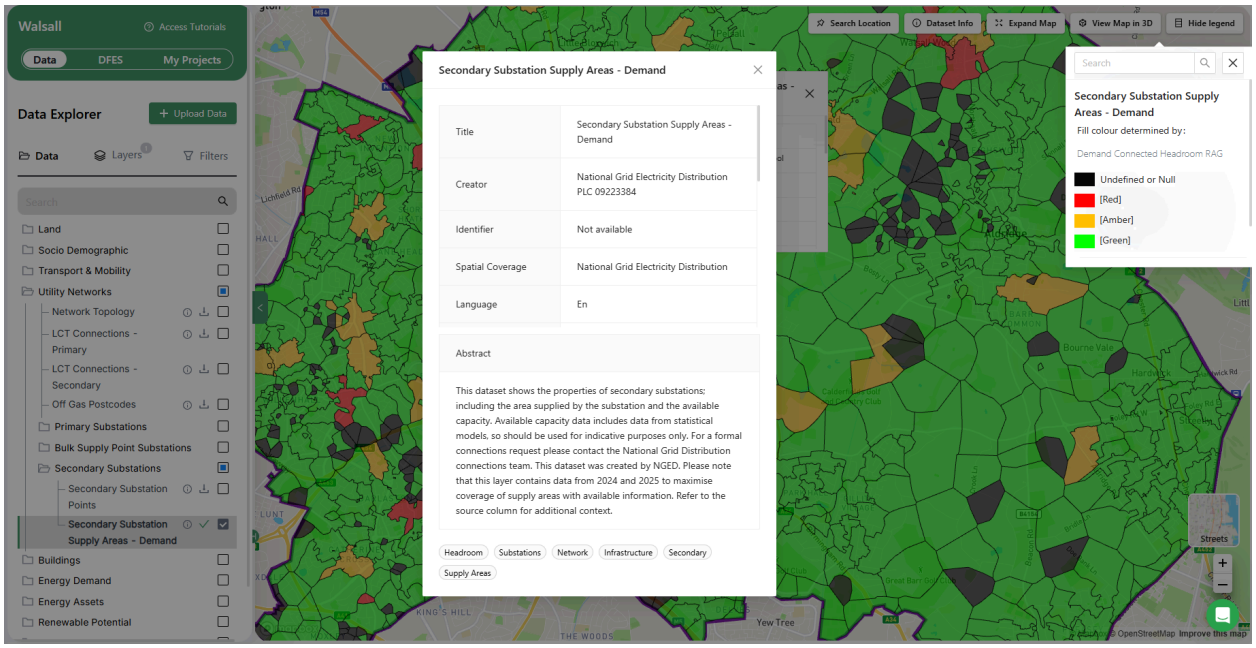
Demand capacity maps

Images 1 and 2: Sample Data: Secondary Substation Supply Areas with RAG status for demand headroom capacity

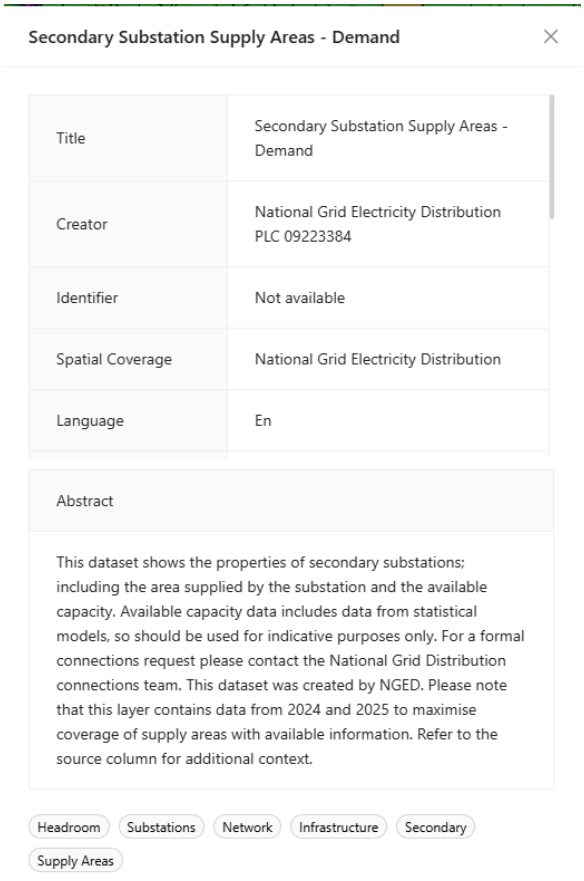




Images 3 and 4 show the information about the Substation Supply Area data which is available for users. Users access the metadata by clicking the 'i' button next to the download button in the left hand menu.



Sample metadata fields: Secondary Substation Supply Areas - demand



Demand data attributes

For the **Secondary Substation Supply Areas**, users can expect to see the following data in the attributes.

Attribute	Description
DNO	Distribution Network Operator
Substation Name	Name of substation
Substation ID	Unique identification number for the substation
Substation Design	Design (e.g. ground mounted vs pole mounted)
Substation Number	Unique identification number for the substation
BSP	Bulk Supply Point substation
GSP	Grid Supply Point substation
Capacity Rating	The rated capacity of the substation in kVA
Source	Source of data
Primary	Primary supply point
RAG Status	The red, amber or green status of the substation
Demand connected headroom RAG	Demand Connected Headroom RAG
Headroom	The headroom of the substation in kVA
Capacity rating	The rated capacity of the substation in kVA
Lattitude	Latitude of the substation
Longitude	Longitude of the substation
Percentage Headroom	The headroom of the substation during the season of highest demand

For the **Primary Substation Supply Areas**, users can expect to see the following data in the attributes.

Attribute	Description
DNO	Distribution Network Operator
Primary site	Primary site ID
Substation Name	Name of substation
Substation ID	Unique identification number for the substation
NGED Demand Connected Headroom RAG	NGED Demand Connected Headroom RAG
Demand Contracted Headroom RAG	Demand Contracted Headroom RAG
BSP	Bulk Supply Point substation
GSP	Grid Supply Point substation
Source	Source of data
Headroom RAG	The current RAG status of the substation
Demand headroom [actual]	The available headroom to connect load assets to the substation considering the network constraints, in MVA
Demand contracted headroom [actual]	Demand Contracted Headroom [Actual]
Demand connected headroom %	The percentage headroom available at the substation
Lattitude	Latitude of the substation
Longitude	Longitude of the substation

For the **Bulk Supply Point Areas**, users can expect to see the following data in the attributes.

Attribute	Description
DNO	Distribution Network Operator
Substation ID	Unique identification number for the substation
Substation Name	Name of substation
NGED Demand Connected Headroom RAG	NGED Demand Connected Headroom RAG
Demand Contracted Headroom RAG	Demand Contracted Headroom RAG
GSP	Grid Supply Point substation
Source	Source of data
Headroom RAG	The current RAG status of the substation
Demand Contracted Headroom RAG	Demand Contracted Headroom RAG
Firm capacity [winter]	The available capacity on the network with a single feed on outage, in MVA
Demand headroom [actual]	The available headroom to connect load assets to the substation considering the network constraints, in MVA
Demand connected headroom [actual]	Demand Contracted Headroom [Actual]
Lattitude	Latitude of the substation
Longitude	Longitude of the substation
Demand headroom %	The percentage headroom available at the substation

Generation capacity maps

Image 5: Sample data: Primary Substation Supply Area with RAG status for generation headroom capacity

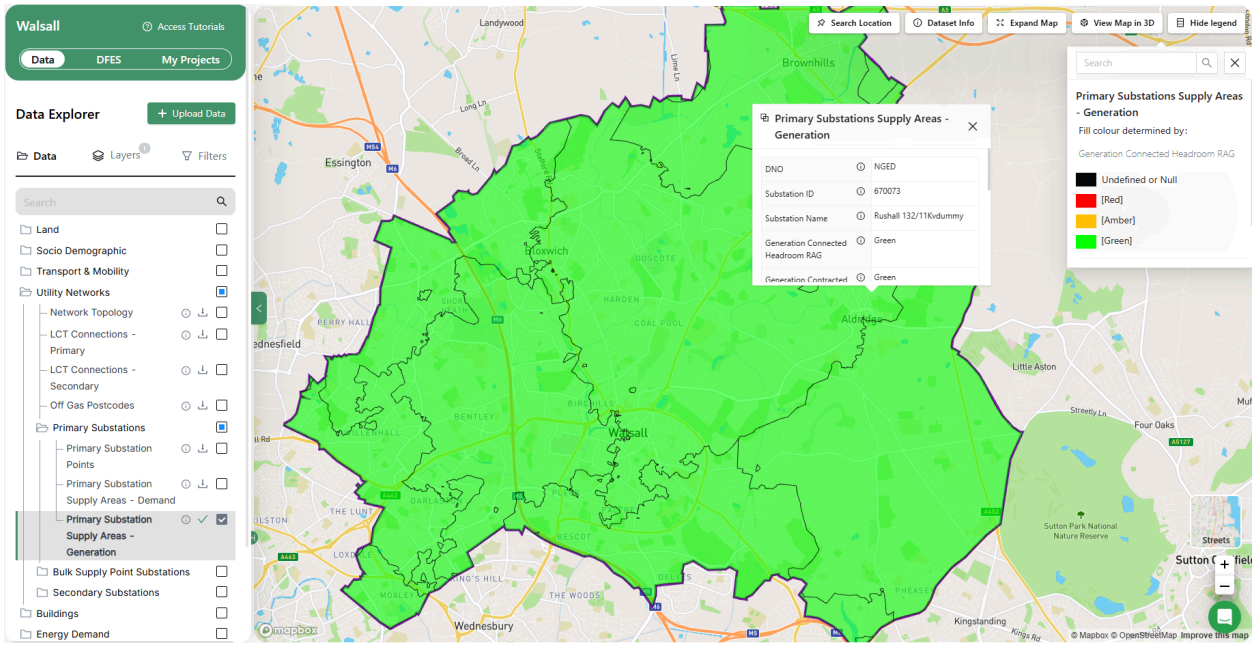


Image 6: Sample data: Primary Substation Supply Area with RAG status for generation headroom capacity showing metadata

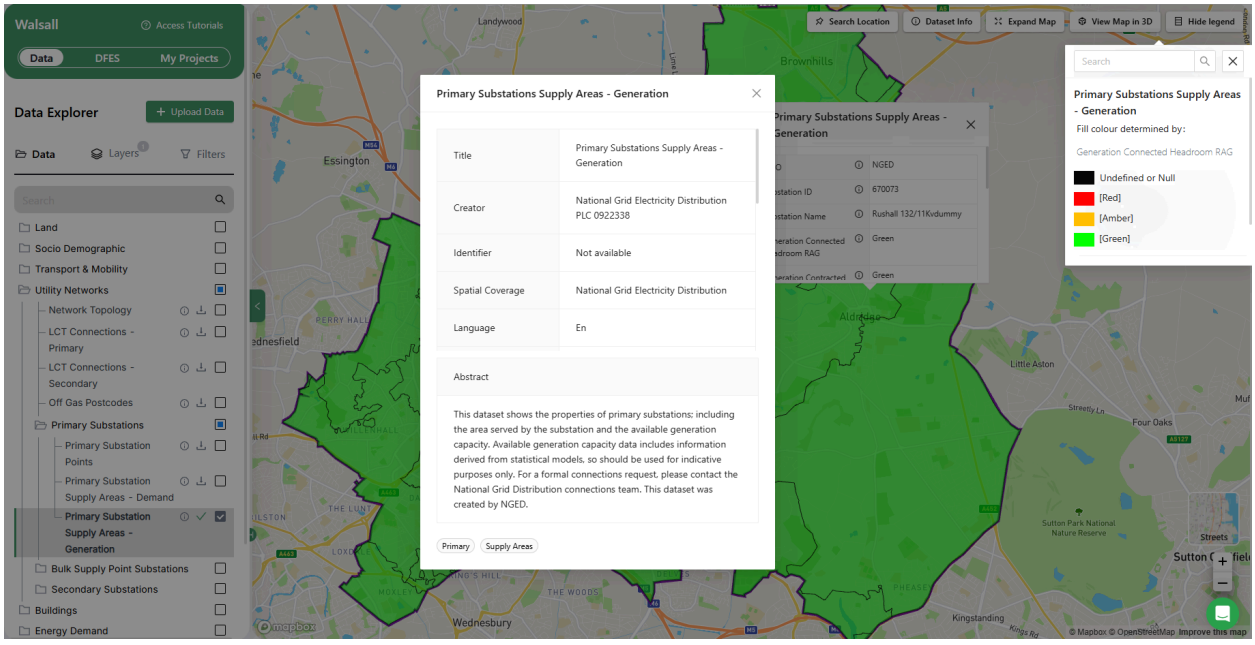
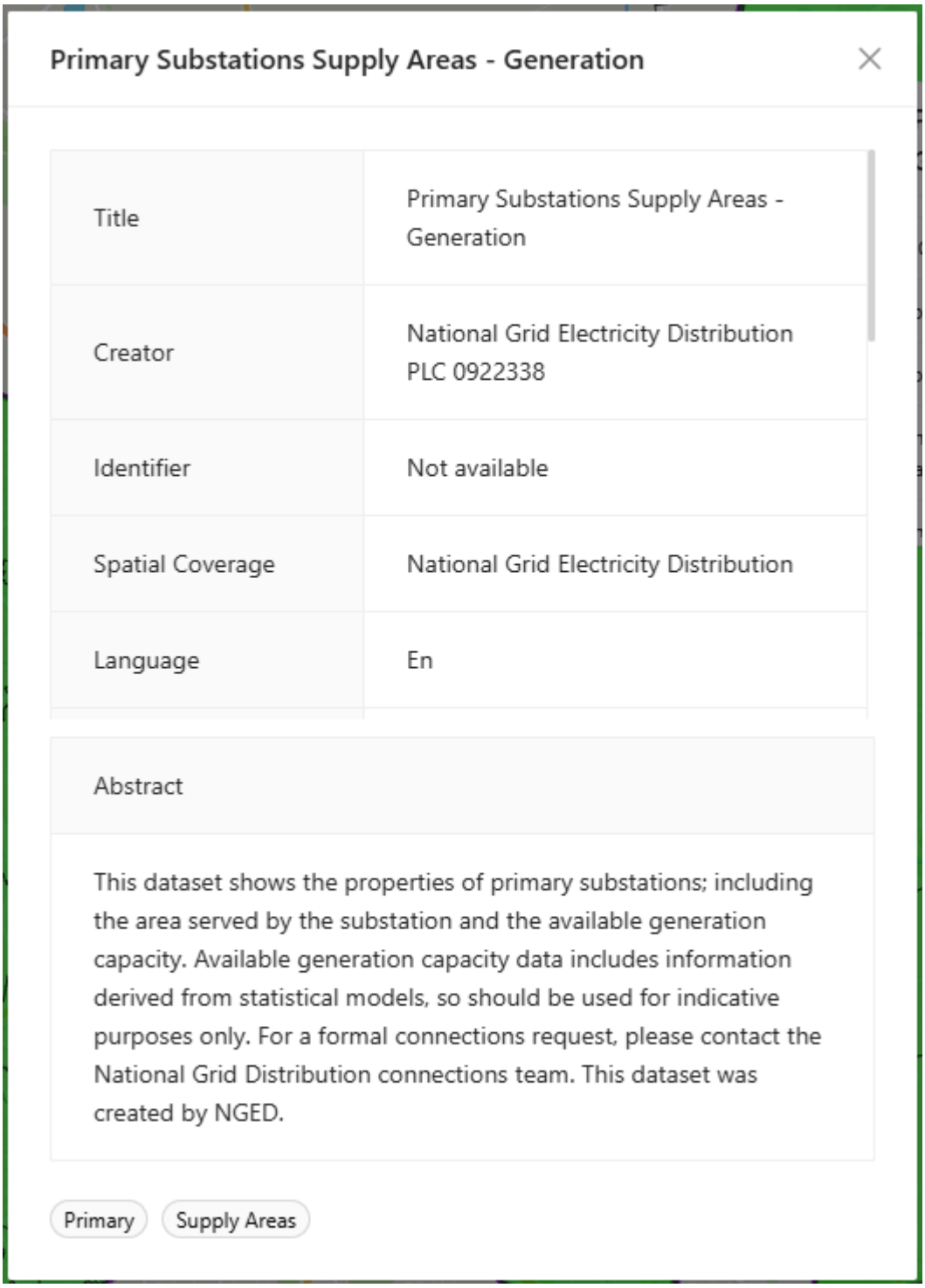


Image 7: Sample metadata fields: Primary Substation Supply Areas - generation



For the **Primary Substation Supply Areas**, users can expect to see the following data in the attributes.

Attribute	Description
DNO	Distribution Network Operator
Substation ID	Unique identification number for the substation
Substation Name	Name of substation
Generation Connected Headroom RAG	Generation Connected Headroom RAG
Generation Contracted Headroom RAG	Generation Contracted Headroom RAG
BSP	Bulk Supply Point substation
GSP	Grid Supply Point substation
Source	Source of data
Generation RAG	The current RAG status of the substation
Firm capacity	The available capacity on the network with a single feed on outage, in MVA
Generation connected headroom %	Generation Connected Headroom [Actual]
Generation contracted headroom [actual]	Generation Contracted Headroom [Actual]
Generation total capacity	Generation Total Capacity
Generation quoted capacity	Generation Quoted Capacity
Generation headroom %	The percentage headroom available at the substation
Lattitude	Latitude of the substation
Longitude	Longitude of the substation

Generation capacity is shown at primary substation level only and so there are no attributes for generation capacity at other substation levels (primary or BSP)

3 Distribution Future Energy Scenarios

Purpose

The DFES shows the range of future scenarios and technology adoptions that would deliver net zero by 2050 across National Grid Electricity Distribution's network area (with one counterfactual scenario that does not meet net zero by 2050). They project the uptake and distribution of low carbon technologies across the National Grid Electricity Distribution area and are an important dataset for networks as they help determine what technologies to expect where, and when. This helps determine future investment plans.

For local authorities and users of LAEP+ it is also important to know what the network is expecting to connect, where and when, as these plans are both informed by local authorities and in turn can help inform local authority planning. For example, understanding when networks are expecting a large influx of EV chargers connecting to the network can help local authorities understand EV uptake across the area - this can also help understand wider insights like the need for EV charger installers across an area, and the need for public chargers, as well as private.

National Grid Electricity Distribution creates and publishes the DFES datasets. These have been ingested into LAEP+ so that these can be accessed within LAEP+.

Metadata, ingestion and permissions

National Grid Electricity Distribution creates and publishes the DFES datasets. They have been ingested to LAEP+ to show the DFES data at:

- Electricity Supply Area level - which reflects the same boundaries as primary substations.
- Local authority level -which shows the projections for the whole local authority area.
- Atomic area - which shows the spread of low carbon technology distribution across ESAs that cross local authority boundaries.

DFES datasets ingested by LAEP+ include:

Dataset	Source	How often updated
DFES Volume Projections by Electricity Supply Area	National Grid Electricity Distribution	Annually
DFES Volume Projections by Local Authority	National Grid Electricity Distribution	Annually

Advanced Infrastructure gets the data for DFES Volume Projections by Electricity Supply Area and DFES Volume Projections by Local Authority from National Grid via the Open Data Portal. The DFES by atomic area is shared by NGED directly with AITL. The process to ingest and visualise the data is then as follows:

1. Download datasets from source (e.g. relevant open data portal page or shared drive)
2. Pre-process the data to align with required LAEP+ format
3. Ingest the dataset via the LAEP+ Extract, Transform and Load (ETL) pipeline to the development environment, including dataset configurations, metadata and other relevant supporting information
4. Quality assure (QA) check the data to ensure it matches expected appearance, permissions, metadata and content
5. If the data passes all QA steps, the dataset will then be released to production

Metadata is clear, structured in line with Dublin Core Metadata standards, and easily accessible to ensure users know the source, update frequency and other key metadata items (image 2). The data is available under an open data license.

Styling and visualisations

The DFES map styling is a time series which allows users to toggle between different scenarios, technologies and years to explore potential futures. Users can also provide feedback on the DFES scenarios by selecting a ‘best fit’ scenario, i.e. the scenario that best aligns with their expectations or ambitions. This is intended to provide networks with a sense of how well different DFES scenarios reflect local authority ambition.

Image 8: Sample of Distribution Future Energy Scenarios showing projected electric vehicles by number across Electricity Supply Areas in Walsall in the Holistic Transition scenario. This image shows installed capacity in the year 2032.

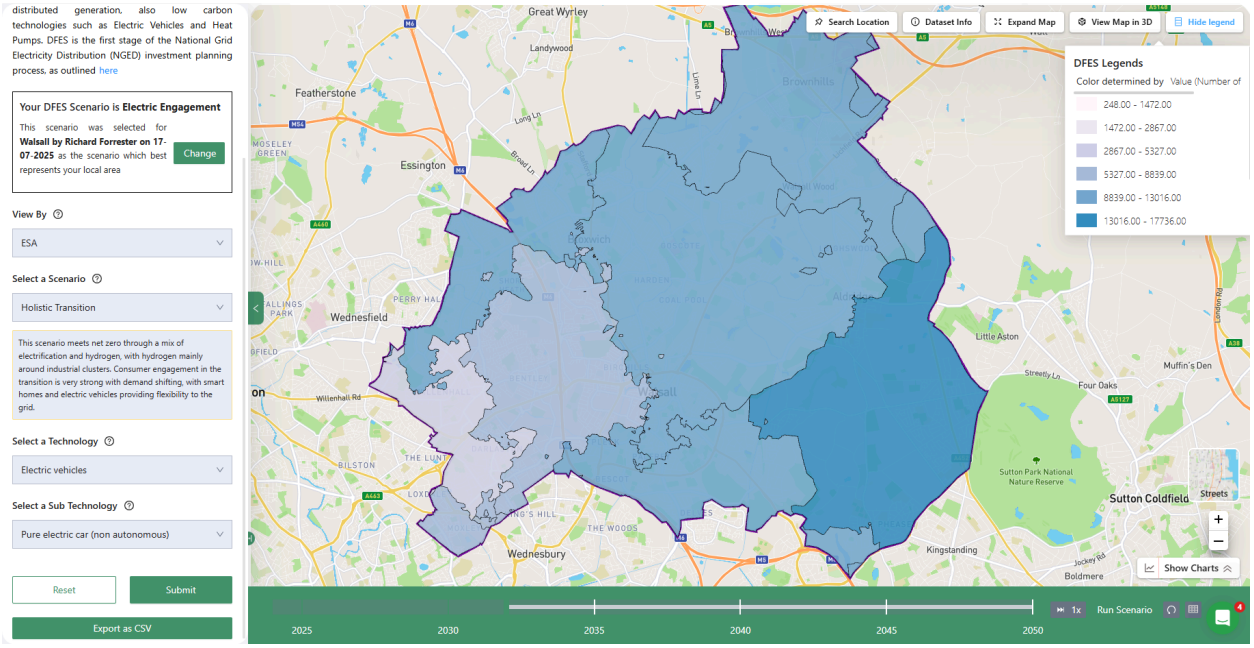
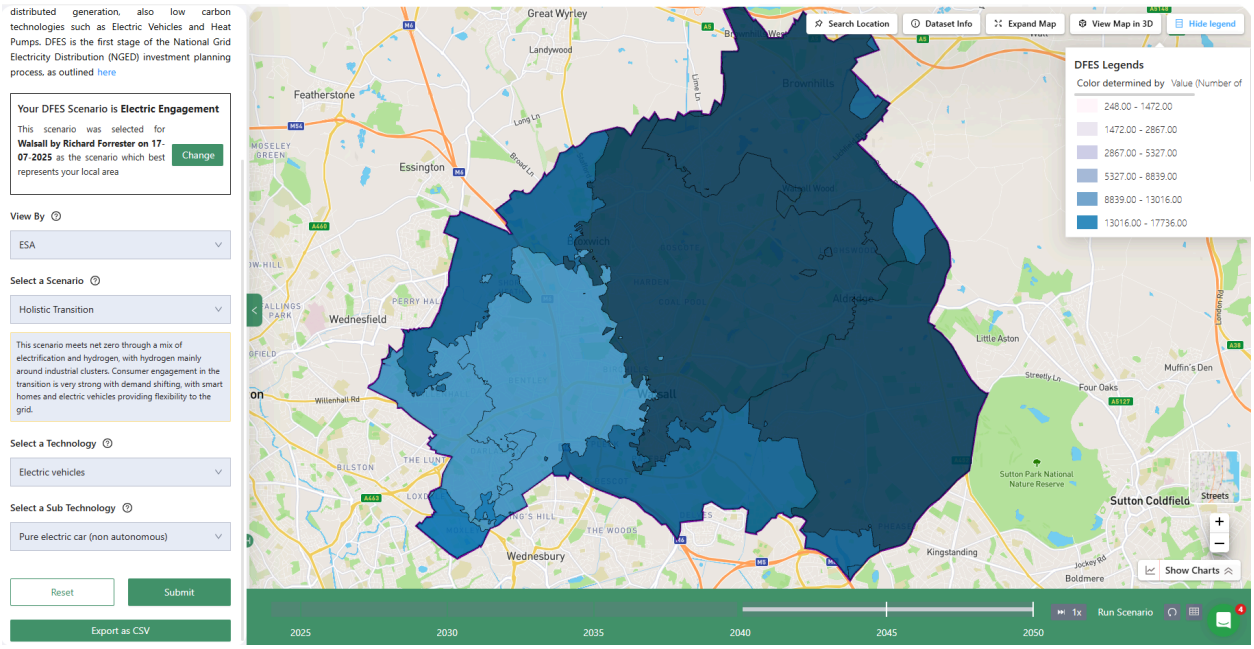


Image 9: Shows the same DFES scenario as image 6 but for the year 2040 - highlighting how the toggle feature works.

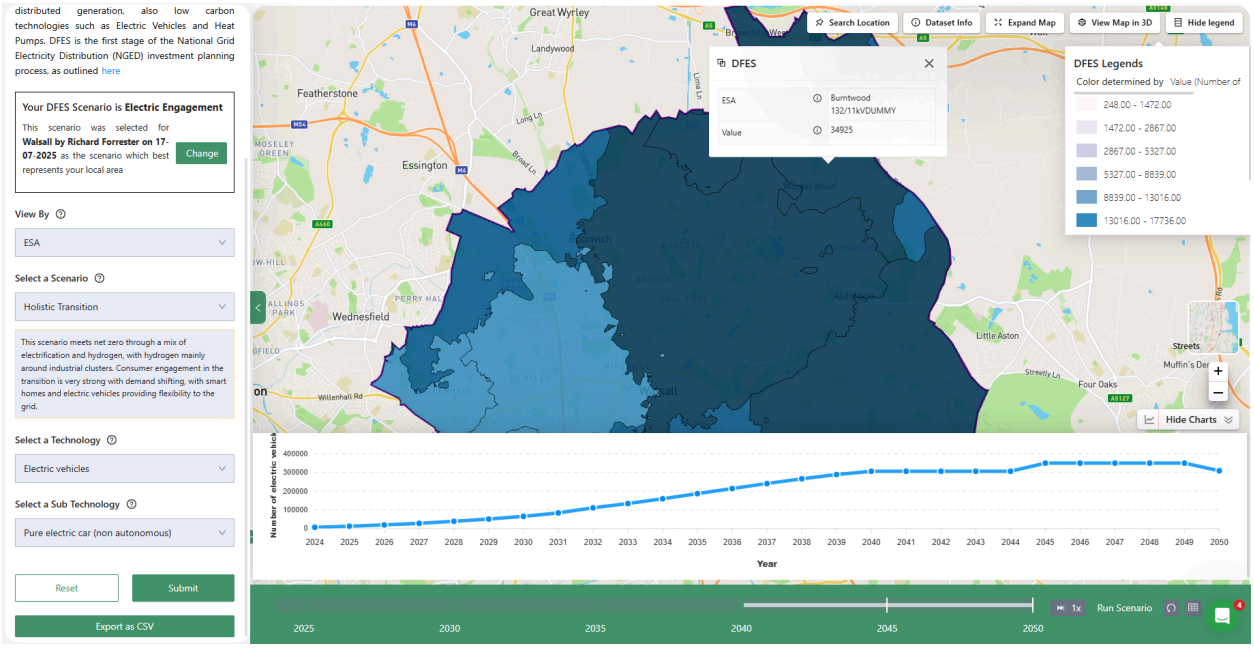


The DFES visualisation also has an option to show a chart which visualises the data over the whole time period in one place. The chart shows the aggregated data from the ESAs to cover the whole local authority area. In some cases, the ESA crosses local authority boundaries which can have a small impact on skewing the data where the data shows the total number of technologies connected (e.g. with number of electric vehicles). AITL also shows DFES by atomic area data which shows projected number of technologies per section of ESA contained within local authority boundaries. This avoids over representing the projected figure on the map in instances where the ESA is not entirely contained within the local authority.

Attributes given to the DFES data are shown by ESA and by the whole local authority area.

Attribute	Description
ESA	The Electricity Supply Area > which correlates with the Primary Substation Area
Value	The projected uptake of that technology in the year selected. This can be given in MW if measured in the capacity of that technology connected in the ESA or soon to be local authority (e.g. capacity of connected domestic off-street EV charge points), or by number of that technology (e.g. number of Electric Vehicles).

Image 10: Shows the attributes and chart visualisations of the DFES.



4 Network topology data

Purpose

The network topology data shows the physical topology of the underground and overhead wires that make up the physical distribution electricity network at the Low Voltage; the High Voltage (6.6 kV, 11KV) and Extra High Voltage (33kV, 66kV and 132kV. This data can help users understand where it might be able to connect low carbon technology assets based on distance to existing network cables. Distance from network cables can provide an indication of cost of a connection (the further from a cable, the greater cost because more cable is required to make the connection). This can be useful for users looking for indicative costs to support optioneering and net zero planning and decision making.

Metadata, ingestion and permissions

Advanced Infrastructure gets the data for High Voltage (HV), Extra High Voltage (eHV) and 132kv from National Grid via their Open Data Portal. The process to ingest and visualise the data is then as follows:

1. Download datasets from source (e.g. relevant open data portal page)
2. Pre-process the data to align with required LAEP+ format
3. Ingest the dataset via the LAEP+ Extract, Transform and Load (ETL) pipeline to the development environment, including dataset configurations, metadata and other relevant supporting information
4. Quality assure (QA) check the data to ensure it matches expected appearance, permissions, metadata and content
5. If the data passes all QA steps, the dataset will then be released to production

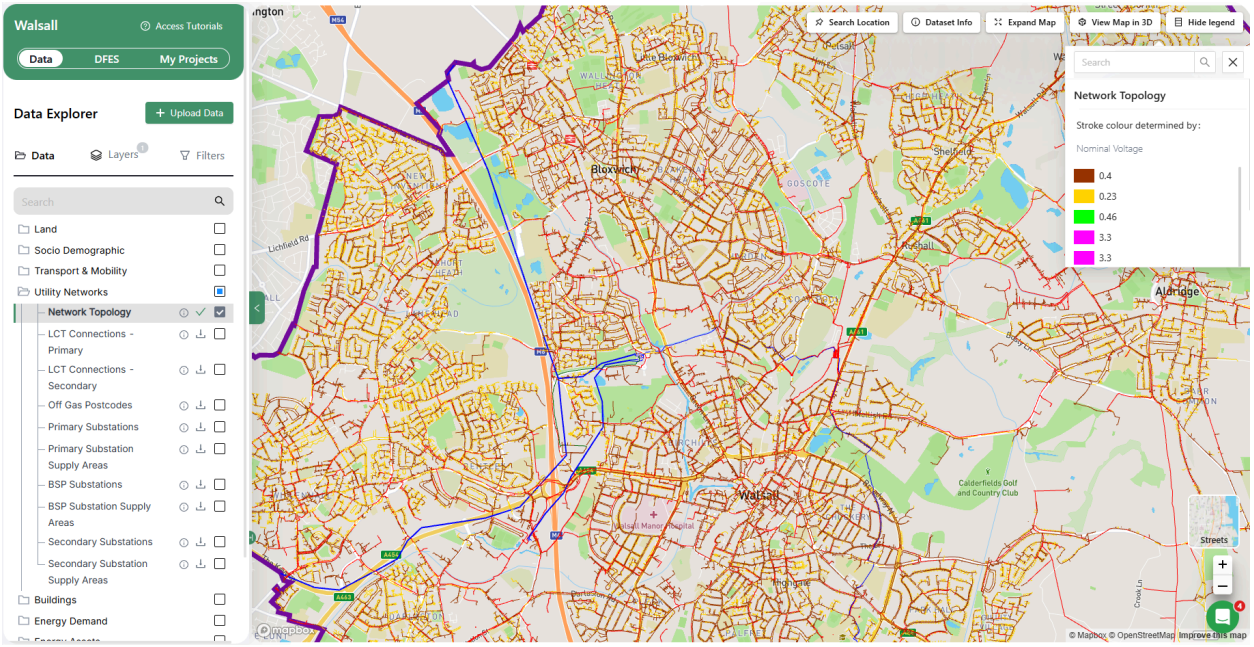
Metadata is clear, structured in line with Dublin Core Metadata standards, and easily accessible to ensure users know the source, update frequency and other key metadata items (image 2). The data is available under an open data license.

The Low Voltage (LV) Network Topology data is not open source and is shared directly with AITL by NGED. As such there are different permissions for users with the Network Topology data and it is set to ‘View Only’ so that users can see the data but not export it.

Styling and visualisation

The visualisation displays as lines on the map corresponding to where the cables are. There are different colours for HV and EHV cables. Currently the EHV cables appear the same colour as A-roads which we have identified as having potential to cause confusion and will change the colour.

Image 11: Shows the visual representation of the network topology data



Data attributes given to network topology data include:

Attribute	Description
DNO	The distribution network operator that the cables belong to
Type	The type of cable or line. In this case the options include HV or EHV
Mounting design	The status of the cable or line (Overhead/Underground)
Nominal voltage	The nominal voltage of the line in kV
Armouring	The protection around the cable
Source breaker	
Specification 1	Lines or Cables first conductor group's specification representing number of wires, material, voltage, etc.