Scottish & Southern Electricity Networks

# Standard Network Capacity Methodology and Assumptions

WS1B P5

August 2021

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## 1 Context

The Open Networks project is transforming the way the energy networks operate, preparing energy system stakeholders for change within the shift to a smart, flexible system. In this project, Standard Network Capacity Reporting (ON20-WS1B-P5) has been proposed by the Energy Networks Association as part of the new standard licence condition 25B for a Network Development Plan (NDP). This reporting has been proposed as a methodology to standardise reporting across DNOs in order to create more transparent identification of network capacity.

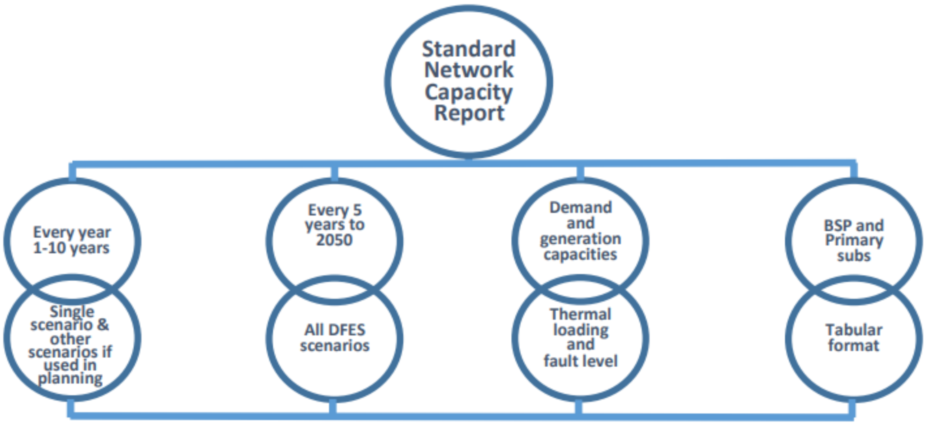


*Figure 1: Standard Network Capacity Methodology*

The audience for this report may include[1]:

- Industry stakeholders
- Developers
- Demand and generation customers connecting beyond the short-term future
- Regional Stakeholders including Local Authorities looking to understand infrastructure needs to support long term decarbonisation
- Innovators wanting to understand network issues to be resolved.

The Standard Network Capacity Report provides insights into future network headroom for our SEPD and SHEPD licence areas. This report builds on WS1B P2's standardised Distribution Future Energy Scenarios (DFES) and considers thermal and fault level constraints across multiple scenarios up to 2050. This will enable connections to locate in the most advantageous areas, identify when and where issues occur and develop targeted mitigations.

The Standard Network Capacity Report will be published in 2021 but will not become an enduring yearly report. The outputs and learnings from the standard network capacity report will be used to inform the development of the Network Development Plan.

The report takes the form of an excel dataset showing SEPD and SHEPD headroom capacity figures for Demand, Generation and Fault level when assessed against existing asset ratings. This accompanying word document outlines the methodology and assumptions behind the report.

[1] 'Proposed DNO Standard Network Capacity Report – WS1B P5 – Version 2.1, ENA November 2020

## 2 Definition

The Standardised Network Capacity Report is defined as follows:

| | |
|---|---|
| **Date range** | To 2050 |
| **Reporting granularity** | Every year for the first ten years and then every five years |
| **Forecast scenarios** | Distributed Future Energy Scenarios (DFES)[2] and other scenarios used in network planning |
| **Reported headroom/deficit** | Demand and generation |
| **Network coverage** | Distribution voltages down to the secondary voltage at primary substations (typically 11kV) |

*Table 1: Standard Network Capacity Reporting Requirements*

## 3 SSEN Methodology

### 3.1 Demand Headroom

This section describes the methodology behind the calculation of the available demand headroom at each Primary (33-22kV/11-6.6kV) and BSP (132-66kV/33-11kV) substation in the SEPD licence area and each Primary (33/11kV) substation in the SHEPD licence area. Please note that GSP substations (132/33kV) are not included in the SHEPD licence area as these are classified as Transmission substations.

Given the rapidly changing consumption patterns of new demand and storage technologies, it is becoming increasingly challenging to identify the single worst-case network condition that will determine the available demand headroom of a substation. Therefore, the demand headroom calculation is based on seasonal peak demand profiles with minimum coincident generation, both for the baseline substation demand and the forecasted demand and storage technologies.

The baseline peak demand profile of each Primary and BSP substation for each season (Winter, Summer, Spring and Autumn) was produced from 2019/20 measured data and consists of 48 half-hourly average readings, which represent a 24-hour period. These half-hourly readings correspond to the day where the peak demand of each substation occurred for each season.

SSEN's 2020 DFES analysis produced scenario forecasts for the connected capacity of storage and low carbon demand technologies, as well as projections for new housing growth and new commercial and industrial developments at each Primary Substation up to 2050, for both licence areas. More specifically, the key demand and storage technologies which were utilised by SSEN to produce the forecasted peak demand profiles for each substation are as follows:

- Electric Vehicle Chargers (Domestic off-street, Domestic on-street, Workplace, Fleet, En-route local, Destination, Car park)
- Domestic Heat Pumps (Hybrid, Non-Hybrid)
- Domestic Direct Electric Heating
- New Developments (Domestic, Factory and Warehouse, Hospital, Hotel, Medical, Office, Restaurant, Retail, School & College, Sport & Leisure, University, Data Centres, other)
- Air Conditioning

[2] Please see Appendix for more details

- Battery Storage (Standalone Grid Services).

A seasonal half-hourly demand profile was produced for each demand and storage category listed above. These profiles were combined with the installed capacity projections for demand and storage at each substation. The aggregated power profiles of the projected installed capacity of demand and storage were combined with the baseline peak demand profile of each substation to create its forecasted peak demand profile for each season, for each year to 2050 under all DFES scenarios.

The peak value of the demand profile of each substation was then compared with its firm capacity in order to identify the available demand headroom or deficit. Based on the above, the demand headroom is defined, per substation, per year (from 2020 – 2050) as follows:

**Demand Headroom = Substation Firm Capacity – Forecasted Maximum Demand**

It should be notes that this exercise mainly focuses on the available demand headroom at the substation level only. Within this analysis, the methodology has considered potential circuit limitations for radial circuits since this is considered within the published firm capacity values. For highly interconnected ring networks however, there is a possibility that the methodology would provide an overestimate of the available headroom, as this might be reduced by circuit limitations. To account for some of the upstream circuit limitations or interconnected networks, the headroom methodology considers any upstream circuit constraints for substation groups which were identified to require reinforcements within the RIIO-ED2 period (2023 – 2028), as seen in Appendix Section 5.2.

Potential voltage constraints and upstream transmission constraints have not been considered within the analysis.

Furthermore, the demand headroom at each substation is calculated by considering the diversity between its baseline peak demand profile and the power profiles for each demand and storage technology projected to connect to this specific substation. This means that the analysis is less onerous than a ‘traditional’ demand connection assessment utilising absolute maximum demand value, for both existing and proposed load.

It should be noted that the demand values within the dataset are the Winter Season Average Cold Spell (ACS) baseline demand with the addition of Winter DFES forecasts. This may not be the worst case for all, as an example some of the Primary’s and Bulk Supply Points have higher Summer demands although this represents the worst case for the majority of the SSEN’s substations. For SEPD, the firm capacities used within the report are the Winter season values for Non-CER transformers. This firm capacity may decrease depending on season and load curve. It is possible that additional factors might limit the available demand headroom at each substation, which would be identified as part of a formal connection assessment carried out by SSEN.

It must be noted that the above demand headroom calculation methodology might lead to different headroom capacity results when compared with the network assessment methodology which was used to identify the required network reinforcements included in the RIIO ED2 Business Plan. The network assessment methodology used for the formulation of the ED2 Business Plan includes detailed network analysis using the PSSE system and its purpose is to identify the areas of the network where intervention is required, thus driving SSEN’s capital expenditure program. The purpose of this exercise is to provide high-level information to stakeholders by indicating the areas of the SSEN network where capacity is likely to be available.

### 3.1.1 Data

| Component | Dataset | Description | Assumptions |
|---|---|---|---|
| Demand | Demand Forecast | Demand projection per substation for the 4 Distributed Future Energy Scenarios (DFES) | Half-hourly profiles for both the baseline peak demand and the forecasted demand and storage technologies |
| Capacity | Firm Capacity | Current firm capacity per substation taken from the Long-Term Development Statement (LTDS) | The base firm capacity per year per substation is added to any additional capacity that is planned to become available within the ED2 Period (2023-2028) |
| | Planned Released Capacity | New firm capacity which is expected to become available per substation within the ED2 period (2023-2028) | |
| | Transformer Nameplate Rating | The transformer nameplate rating taken from the SSEN Generation Heatmap dataset | For a number of substations without firm capacity data, the Transformer Nameplate Rating was used as a substitute for Firm Capacity in the Demand Headroom calculation given above.<br>The Heatmap dataset has been used in this analysis as it will be familiar to stakeholders. |



## 3.2 Generation Headroom

This section describes the methodology behind the calculation of the available generation headroom at each Primary (33-22kV/11-6.6kV) and BSP (132-66kV/33-11kV) substation in the SEPD licence area and each Primary (33/11kV) substation in the SHEPD licence area. Note that GSP substations (132/33kV) are not included in the SHEPD licence area as these are classed as Transmission substations.

Given the rapidly changing generation patterns of new distributed generation and storage technologies, it is becoming increasingly difficult to identify the single worst-case network condition that will determine the available generation headroom of a substation. Therefore, the generation headroom calculation is based on seasonal minimum demand profiles with maximum coincident generation, both for the baseline substation demand and for the forecasted distributed and storage technologies.

The baseline minimum demand profile of each Primary and BSP substation for each season (Winter, Summer, Spring and Autumn) was produced from 2019/20 measured data and consists of 48 half-hourly average readings, which represent a 24-hour period. These half-hourly readings correspond to the day where the absolute minimum demand of each substation occurred for each season.

SSEN's 2020 DFES analysis produced scenario forecasts for the connected capacity of distributed generation and storage at each Primary Substation up to 2050, for both licence areas. More specifically, the key distributed generation and storage technologies which were utilised by SSEN to produce the forecasted net flow profiles for each substation are the following:

- Renewable Energy Generation technologies including:
    - Solar PV
    - Onshore and Offshore Wind
    - Hydropower

    - Marine.
- Waste and Bio-Resource electricity generation including:
    - Biomass
    - Sewage and Landfill Gas
    - Anaerobic Digestion
    - Energy from Waste.
- Fossil Fuel Electricity Generation technologies including:
    - Diesel
    - Natural Gas.
- Battery Storage.

A seasonal half-hourly generation profile was produced for each distributed generation and storage category listed above. These profiles were combined with the installed capacity forecasts for distributed generation and storage at each substation. The baseline net flow profile for each substation was calculated using the forecasted maximum generation and minimum demand at each substation in year 2019/20.

The aggregated generation profiles of the projected installed capacity of distributed generation and storage were combined with the baseline net flow profile of each substation to create its forecasted net flow profile for each season, for each year to 2050 under all DFES scenarios. The net flow through the transformers of a substation can be either forward (negative/demand) or reverse (positive/reverse power flow).

The maximum value of the net flow profile of each substation was then compared with its transformer nameplate rating in order to identify the available generation headroom or deficit. Based on the above, the generation headroom is defined, per substation and per year (from 2020 – 2050), as follows:

**Generation Headroom = Transformer Nameplate Rating – Forecasted Maximum Net Flow**

This exercise mainly focuses on the available generation headroom at the substation level only. Within this analysis, the methodology has considered potential circuit limitations for radial circuits since this is considered within the published transformer nameplate ratings. For highly interconnected ring networks however, there is a possibility that the methodology would provide an overestimate of the available headroom, as this might be reduced by circuit limitations. To account for some of the upstream circuit limitations or interconnected networks, the headroom methodology considers any upstream circuit constraints for substation groups which were identified to require reinforcements within the RIIO-ED2 period (2023 – 2028), as seen in Appendix Section 5.2.

Potential voltage constraints and upstream transmission constraints have not been considered within the analysis.

The generation headroom at each substation is calculated considering the diversity between its baseline minimum demand profile and the seasonal generation profiles for each distributed generation and storage technology, which is projected to connect to this specific substation. This means that this analysis is less onerous than a ‘traditional’ generation connection assessment, which utilises absolute minimum demand values and maximum existing and forecasted generation output. Therefore, the total generation headroom identified for each substation also includes the available headroom for flexible generation connections.

All the above means that it possible that additional factors might limit the available generation headroom at each substation, which would be identified as part of a formal connection assessment carried out by SSEN.

The above generation headroom calculation methodology might lead to different headroom capacity results when compared with the network assessment methodology which was used to identify the required network reinforcements included in the RIIO ED2 Business Plan. The network assessment methodology used for the formulation of the ED2 Business Plan includes detailed network analysis using the PSSE system and its purpose is to identify the areas of the network where intervention is required, thus driving SSEN's capital expenditure program. The purpose of this exercise is to provide high-level information to stakeholders by indicating the areas of the SSEN network where capacity is likely to be available.

#### 3.2.1 Data

| Component | Dataset | Description | Assumptions |
|---|---|---|---|
| Generation | Generation Forecast | Generation projection per substation for the 4 Distributed Future Energy Scenarios (DFES) | Half-hourly profiles for the forecasted distributed generation and storage technologies |
| Capacity | Transformer Nameplate Rating | The transformer nameplate rating taken from the SSEN Generation Heatmap dataset<br>The Heatmap dataset has been used in this analysis as it will be familiar to stakeholders. | Enhanced emergency transformer ratings were not considered as part of this analysis |

### 3.3 Fault Level Headroom (Make and break)

This section describes the methodology behind the calculation of the available fault level headroom at each Primary (33-22kV/11-6.6kV) and BSP (132-66kV/33-11kV) substation in the SEPD licence area and each Primary (33/11kV) substation in the SHEPD licence area. Note that GSP substations (132/33kV) are not included in the SHEPD licence area as these are classed as Transmission substations. The fault level headroom is calculated at each substation, as follows:

- **Fault Level Headroom (Make) kA = Circuit Breaker Ratings (Make) kA – Projected Fault Levels (Make) kA**
- **Fault Level Headroom (Break) kA = Circuit Breaker Ratings (Break) kA – Projected Fault Levels (Break) kA**

#### 3.3.1 Fault level rating at substations

Calculated three phase fault level data at 33kV and 11kV substation nodes under normal running arrangements is provided as part of this analysis. Normally there will be more than one circuit breaker at a substation site; the make and break ratings shown relate to the existing circuit breakers. At most sites, not all circuit breakers would be subject to the fault currents given.

Fault currents given include contributions from all transmission and distribution networks and generation included in SSEN's study model. The break current will be dependent on the break time. Current make values include contributions from induction motors as per Engineering Recommendation G74. As a rule, break and make fault currents will not be allowed to exceed switchgear ratings.

##### *3.3.1.1 SEPD*

The Peak Make value has been calculated at a time of 10ms and includes both the AC and DC component of the fault current.

Break current values given as part of this analysis are decremented symmetrical RMS values at 50ms.

##### *3.3.1.2 SHEPD*

The Peak Make value has been calculated at a time of 10ms and includes both the AC and DC component of the fault current.

Break current values given as part of this analysis are decremented symmetrical RMS values at 60ms.

### 3.3.2 Projected fault levels at substations in DFES scenarios

The projected fault levels at SSEN's substations due to generation growth under the Consumer Transformation DFES scenario, SSEN's best view, is simulated within power flow analysis software, PSSE. The output fault levels make up the projected fault level values for each substation. Typical impedance values are assumed for the different types of distributed generation and storage technologies which have been included in this analysis. Note that the forecasted generation is connected to different voltage levels as per the below rules:

#### *3.3.2.1 SEPD*

As part of the analysis undertaken for the SEPD area, the forecasted generation of each Primary substation is aggregated per technology type at the associated BSP substation level. More specifically, for the purposes of power systems modelling, each generation and storage technology type is represented by an equivalent generator connected at the 33kV busbar of the associated BSP substation.

#### *3.3.2.2 SHEPD*

As part of the analysis undertaken for the SHEPD area, the connection point of the forecasted generation of each Primary substation is dependent on its value. More specifically, the following rules are applied:

- Forecasted generation value not exceeding **4MVA**: technology type represented by an equivalent generator connected at the 11kV busbar of the associated Primary substation
- Forecasted generation exceeding **4MVA** but not exceeding **15MVA**: technology type represented by an equivalent generator connected at the 33kV side of the associated Primary substation.

Forecasted generation exceeding **15MVA**: technology type represented by an equivalent generator connected at the 33kV busbar of the associated GSP substation.

### 3.3.3 Data

| Component | Dataset | Description | Assumptions |
|---|---|---|---|
| Circuit Breaker Ratings | Circuit Breaker Ratings | Existing circuit breaker ratings, including both make and break ratings (kA), taken from the Long-Term Development Statement (LTDS). | The fault level rating of each substation is equal to the rating of the lowest rated circuit breaker. |
| Projected Fault levels | Projected fault levels at SSEN substations | Fault level studies undertaken for both SEPD and SHEPD areas for the Consumer Transformation scenario; with the projected make and break fault levels provided at each Primary and BSP substation | Typical impedance values are assumed for each generation and storage technology type |

## 4 Methodology Assumptions

### 4.1 Overall methodology assumptions

- Available Demand and Generation headroom was calculated at the substation level only
- Within this analysis, the methodology has considered potential circuit limitations for radial circuits since this is considered within the published firm capacity values. For highly interconnected ring networks however, there is a possibility that the methodology would provide an overestimate of the

headroom as circuit limitations may reduce the headroom at substations. To account for some of the upstream circuit limitations:

- The headroom methodology considers any upstream circuit constraints for substation groups which were identified to require reinforcements within the RIIO-ED2 period (2023 – 2028), please see Appendix Section 5.2
- This is done by adjusting the generation and demand capacity, as well as generation and demand at affected substations, to produce an illustrative headroom which incorporates upstream circuit limitations
- This analysis for this data source was undertaken to identify reinforcements and investment required to maintain sufficient capacity under SSEN's ex-ante baseline load investment scenario under RIIO-ED2
- Ex-ante baseline funding provides for the minimum investment required under all scenarios – as determined by the System Transformation (ST) scenario, plus the amount required to ensure that no future pathway is foreclosed, by including funding aligned with the Consumer Transformer (CT) scenarios for years 1 & 2 of the ED2 Period.

- No upstream network voltage constraints were considered during this analysis
- No upstream transmission constraints were considered during this analysis
- When firm capacity was not available, the transformer nameplate rating was utilised for the calculation of the demand headroom
- The combination of half-hourly baseline demand profiles and half-hourly power profiles for each demand, distributed generation and storage technology were used to calculate the available demand and generation headroom at each substation
- Regarding the fault level calculations, it must be highlighted that at most sites, not all circuit breakers would be subject to the fault currents provided.

### 4.2 Limitations

As stated in the assumptions above, the available demand and generation headroom was calculated at the substation level only.

Upstream thermal capacity limitations have been considered by adjustments to generation and demand capacities as well as demand and generation for any substations requiring investment in the RIIO-ED2 period under SSEN's ex-ante baseline load investment scenario. This baseline load investment scenario is determined as a hybrid of the System Transformation and Consumer Transformation scenarios.

Voltage constraints and upstream transmission constraints have not been considered within the analysis.

Additionally, the headroom calculations considered the diversity between substation baseline demand profiles and the half-hourly profiles for each demand, distributed generation, and storage technology, making this analysis less onerous than a 'traditional' connection assessment. Based on the above, especially for the generation headroom, the values calculated also include the headroom for flexible generation connections.

Given the points raised above, it is highly likely that additional factors might limit the available demand and generation headroom at each substation, which would be identified as part of a formal connection assessment carried out by SSEN.

# 5 Appendices

## 5.1 Substations to be upgraded during the ED2 period (2023 - 2028)

This section provides information on the substations that have been identified as needing reinforcement due to their loading within the ED2 period (2023-28). The information includes the capacity to be released as well as the forecasted reinforcement completion date.

The list of identified reinforcements is aligned with the draft ED2 Business plan submission and may be subject to change prior to the final submission to Ofgem.

**SHEPD Licence Area**

| Substation Name | Primary/Secondary Voltage (kV) | Existing Firm Capacity (MVA) | Updated Firm Capacity (MVA) | Forecasted Completion Date |
|---|---|---|---|---|
| Kilninver | EHV/HV | 0 | 2.5 | 2025/26 |
| Skulamus | EHV/HV | 0 | 6 | 2024/25 |
| St Mary's | EHV/HV | 0 | 4 | 2024/25 |
| Bridge of Don | EHV/HV | 22.9 | 38.1 | 2026/27 |
| Culloden | EHV/HV | 15 | 24 | 2026/27 |
| Ellon | EHV/HV | 12.5 | 24 | 2026/27 |
| Insch | EHV/HV | 9.1 | 15 | 2023/24 |
| New Pitsligo | EHV/HV | 3.3 | 6.3 | 2023/24 |

**SEPD Licence Area**

| Substation Name | Primary/Secondary Voltage (kV) | Existing Firm Capacity (MVA) | Updated Firm Capacity (MVA) | Forecasted Completion Date |
|---|---|---|---|---|
| East Bedfont a | 132 kV/EHV | 76 | 95 | 2026/27 |
| Frome | 132 kV/EHV | 114.3 | 214 | 2024/25 |
| Loudwater | 132 kV/EHV | 114 | 228 | 2025/26 |
| Netley Common | 132 kV/EHV | 114 | 178 | 2025/26 |
| Oxford (Osney) | 132 kV/EHV | 102 | 157 | 2024/25 |
| Portsmouth | 132 kV/EHV | 117 | 234 | 2026/27 |
| Yeovil | 132 kV/EHV | 129 | 140 | 2024/25 |
| Alderton | EHV/HV | 3.9 | 13 | 2025/26 |
| Alresford | EHV/HV | 13 | 26 | 2025/26 |

| Substation Name | Primary/Secondary Voltage (kV) | Existing Firm Capacity (MVA) | Updated Firm Capacity (MVA) | Forecasted Completion Date |
|---|---|---|---|---|
| Ashling Road | EHV/HV | 26 | 38 | 2026/27 |
| Ashton Park | EHV/HV | 23.5 | 30 | 2025/26 |
| Birdham | EHV/HV | 13 | 26 | 2024/25 |
| Egham | EHV/HV | 28 | 56 | 2026/27 |
| Faringdon | EHV/HV | 13.6 | 26 | 2024/25 |
| Harvard Lane | EHV/HV | 26.6 | 36.5 | 2026/27 |
| Shipton Oliffe | EHV/HV | 3.9 | 13 | 2027/28 |
| Standlake | EHV/HV | 6.5 | 19 | 2024/25 |
| Stokenchurch | EHV/HV | 9.8 | 19.5 | 2024/25 |
| Wareham Town | EHV/HV | 13.9 | 15 | 2026/27 |
| Warfield | EHV/HV | 22.1 | 30 | 2025/26 |
| Wimborne | EHV/HV | 19.5 | 27.2 | 2025/26 |
| Beaconsfield New | EHV/HV | 0 | 22.8 | 2025/26 |

### 5.2 Substation groups with planned interventions during the ED2 period (2023 - 2028)

This section provides information on the substation groups that have been identified as needing reinforcement due to their loading within the ED2 period (2023-28). Note that the reported headroom for the below substations may be lower than that reported due to constraints in the upstream circuits within these groups.

The list of identified reinforcements is aligned with the draft ED2 Business plan submission and may be subject to change prior to the final submission to Ofgem.

**SHEPD License area**

| Substation Name | Primary/Secondary Voltage | Existing Firm Capacity | Updated Firm Capacity | Forecasted Completion Date |
|---|---|---|---|---|
| Keith - Cullen - Buckie - Fochabers | EHV/HV | 16.9 | 27.5 | 2023/24 |
| Port Ann - Lochgilphead | EHV/HV | 22.7 | 41.1 | 2025/26 |
| Abernethy - Milnathort - Glendevon | EHV/HV | 16.9 | 25.5 | 2023/24 |
| Burghmuir - Inveralmond | EHV/HV | 17.8 | 29.3 | 2025/26 |
| Elgin - Lhanbryde | EHV/HV | 16.9 | 22.3 | 2027/28 |
| Inverness - Culloden | EHV/HV | 17.8 | 22.3 | 2024/25 |
| Inverness - Raigmore - Culloden | EHV/HV | 12.9 | 16.9 | 2024/25 |

| Substation Name | Primary/Secondary Voltage | Existing Firm Capacity | Updated Firm Capacity | Forecasted Completion Date |
|---|---|---|---|---|
| Thurso South - Scorradale | EHV/HV | 23.5 | 30 | 2025/26 |
| Tullich - Oban | EHV/HV | 16.9 | 24 | 2023/24 |
| Elgin - Lossiemouth | EHV/HV | 11 | 15 | 2023/24 |
| Keith - Rothes - Aberlour - Duf | EHV/HV | 16.9 | 19.5 | 2023/24 |
| Ardmore - Harris | EHV/HV | 29.3 | 35.4 | 2025/26 |
| Strichen - Mintlaw | EHV/HV | 16.9 | 20.8 | 2026/27 |

**SEPD License area**

| Substation Name | Primary/Secondary Voltage | Existing Firm Capacity | Updated Firm Capacity | Forecasted Completion Date |
|---|---|---|---|---|
| Fleet - Alton - Fernhurst interconnected network (Alton 132/33kV, Fernhurst 132/33kV substations) | 132kV/EHV | 200 | 293 | 2023/24 |
| Mannington 132/33 kV substation (P) / Mill Lane 33/11 kV substation (S) (New Street, Mill Lane, Fordingbridge, Rockbourne, Verwood) | EHV/HV | 22.9 | 58.6 | 2023/24 |
| Amesbury 132 kV isolator (S) / Salisbury 132 kV circuit breaker bay (P)(Salisbury, Shaftesbury, Poole, Hamworthy, Wareham, Winfirth Heath, Lytchett) | 132kV | 350 | 390 | 2024/25 |
| Denham - Chalfont Lane (HS2) | 132kV/EHV | 126 | 189 | 2024/25 |
| Goring - Cholsey | EHV/HV | 15.7 | 24.4 | 2024/25 |
| Norrington - Calne - Chippenham | EHV/HV | 23 | 30 | 2024/25 |
| Thatcham - Yattendon | EHV/HV | 21 | 30 | 2024/25 |
| Charlbury - Woodstock | EHV/HV | 23 | 40 | 2023/24 |
| Frome - Westbury | EHV/HV | 26.5 | 40 | 2025/26 |
| Stokenchurch Ring | EHV/HV | 27.2 | 37.5 | 2024/25 |
| Upton Switching Station | 132kV | 124 | 248 | 2024/25 |
| Berinsfield - Wallingford | EHV/HV | 30.7 | 41.5 | 2025/26 |
| Alresford - Preston Candover | EHV/HV | 19.1 | 30.7 | 2027/28 |
| Bourton - Gillingham | EHV/HV | 19.1 | 30.7 | 2024/25 |
| Bruton - Castlecary | EHV/HV | 13 | 22.7 | 2024/25 |
| Bishopstoke - Hedge End | EHV/HV | 17.4 | 28 | 2026/27 |

| Substation Name | Primary/Secondary Voltage | Existing Firm Capacity | Updated Firm Capacity | Forecasted Completion Date |
|---|---|---|---|---|
| Fleet and new Bramley GSP Group | 132kV | 1500 | 2010 | 2027/28 |
| Fulscot - Cholsey | EHV/HV | 24.5 | 39.4 | 2025/26 |

## 5.3 Distributed Future Energy Scenarios

SSEN DFES 2020 analysis produces granular scenario projections for the increase (or reduction) in electricity distribution network connected capacity of electricity generation, storage, and low carbon demand technologies. The SSEN DFES 2020 analysis also includes projections for new housing growth and new commercial and industrial developments.

As a framework, the DFES uses a set of four national energy scenarios based on the National Grid ESO Future Energy Scenarios (ESO FES) 2020 publication, each driven by different societal change and speed of decarbonisation.

The DFES projections are, however, heavily influenced by input from local and regional stakeholders, including local authorities, regional growth factors and a detailed analysis of the pipeline of projects and developments within SSEN's licence areas. The DFES therefore provides a more granular and "bottom-up" assessment of the impact of changes to the energy system and the transition to net zero.

DFES scenario projections represent a range of potential outcomes which, subject to a number of uncertainties, can be expected to change over time. By completing annual reviews of the DFES, and through extensive stakeholder engagement, energy networks can build up a picture of how energy consumption, generation, and the uptake of new low carbon technologies is changing as the UK transitions to net zero energy system. SSEN regards the Consumer Transformation (CT) scenario as the current "best view" and most likely scenario outturn.

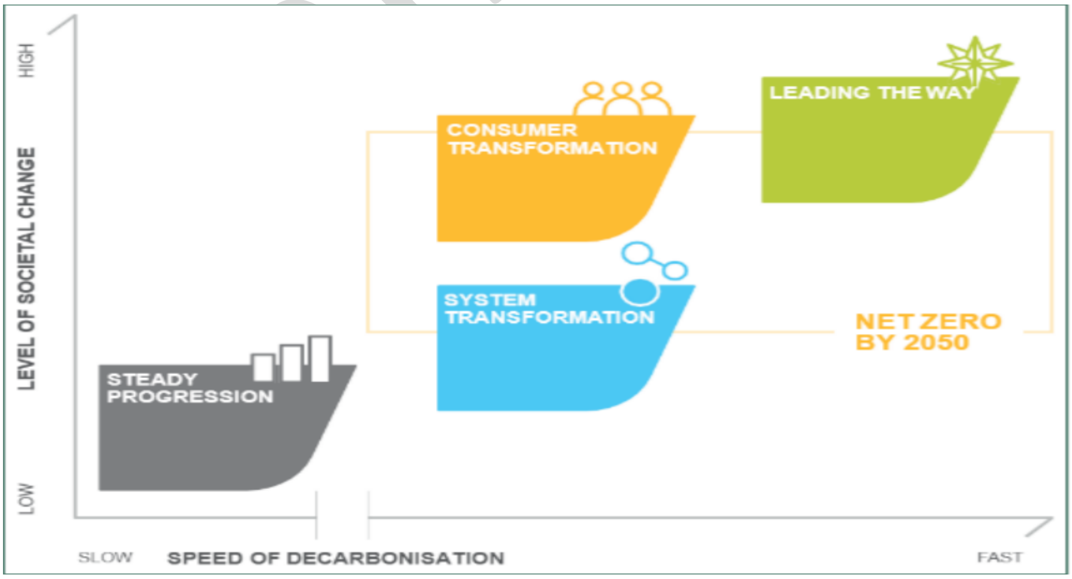


*Figure 2: National Grid ESO Future Energy Scenarios 2020 scenario framework*

The SSEN DFES analysis follows a four-stage process where, for each of the technologies in scope, the following steps are carried out:

1. Determine the historic deployment and establish the existing baseline of operational or connected projects.
2. Assess the near-term development pipeline, recording and reviewing projects with connection offers or planning applications. For technologies with a high degree of pipeline evidence the range of outcomes between the scenarios may be quite narrow.
3. Develop medium and long-term projections out to 2050.
4. Geographically distribute these annual, scenario-specific projections across the licence areas. The distributed generation, demand and storage projections have been distributed down to Electricity Supply Areas (ESAS), which have, in the main, been defined at the 11kV primary substation level.

Further information on the Distributed Future Energy Scenarios 2020 can be found in the reports that were published by SSEN in December 2020 for both SEPD and SHEPD licence areas. The full reports are available at:

https://www.regen.co.uk/publications/scottish-and-southern-electricity-networks-dfes-2020-reports/

## 5.4 Flexibility reinforcements

SSEN adopts an approach of 'Flexibility First'. To date, SSEN has contracted in excess of 468MW of flexibility services for the management of network constraints and fault support, which has delivered an operational cost saving of £251k and avoided 3,250t$CO_2$.

Where reinforcements are required in the network, investment decisions across a range of reinforcement options are considered. This is affected by (but not limited to) – the rate of demand growth, which determines the duration of opportunity for a flexible solution; the level of uncertainty, which determines the value of avoiding a long-run investment decision; and the cost and availability of flexibility services.

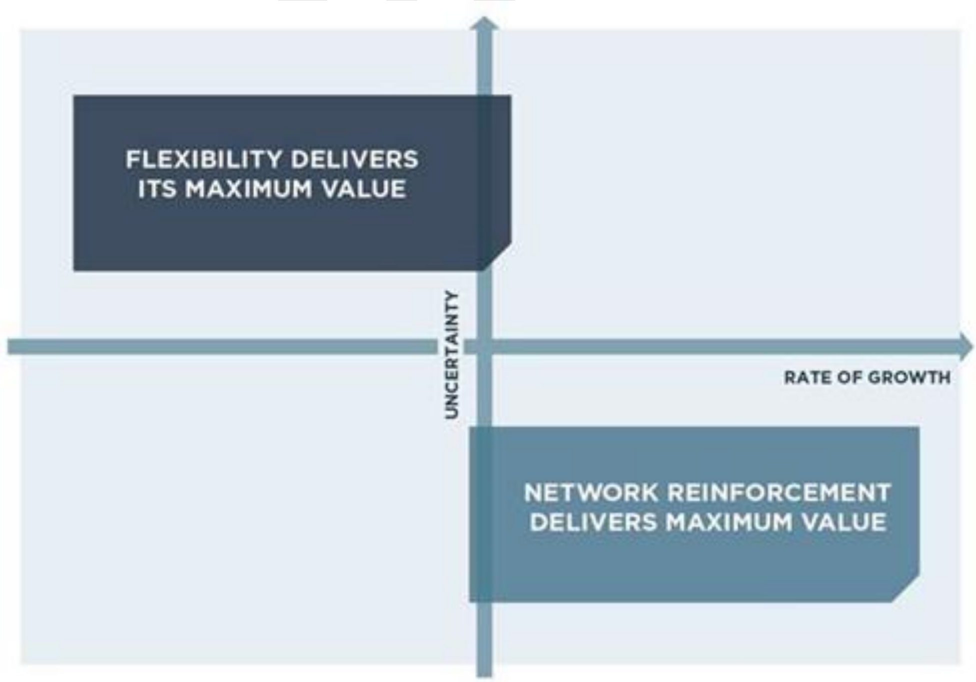


*Figure 3: Flexibility value and value of conventional network reinforcement against rate of growth and uncertainty*

SSEN's best view of the Future Energy Scenarios is Consumer Transformation (CT) and offers a baseline scenario which drives near-term investment decisions and planning. In this scenario, the capacity requirement is driven by a rapid uptake of Low Carbon Technology (LCT) with relatively high demand growth in the next 5 – 10 years. As such, within investment analysis, this favours the selection of more conventional and hybridised flexibility services/ conventional interventions as the predominant solution for delivery of optimal customer value.

SSEN will continue to contract flexible services in order to capture significant option value if a low demand growth scenario outturns rather than CT. This strategy will allow for the rapid deployment of flexibility services, irrespective of which scenario outturns in future years.