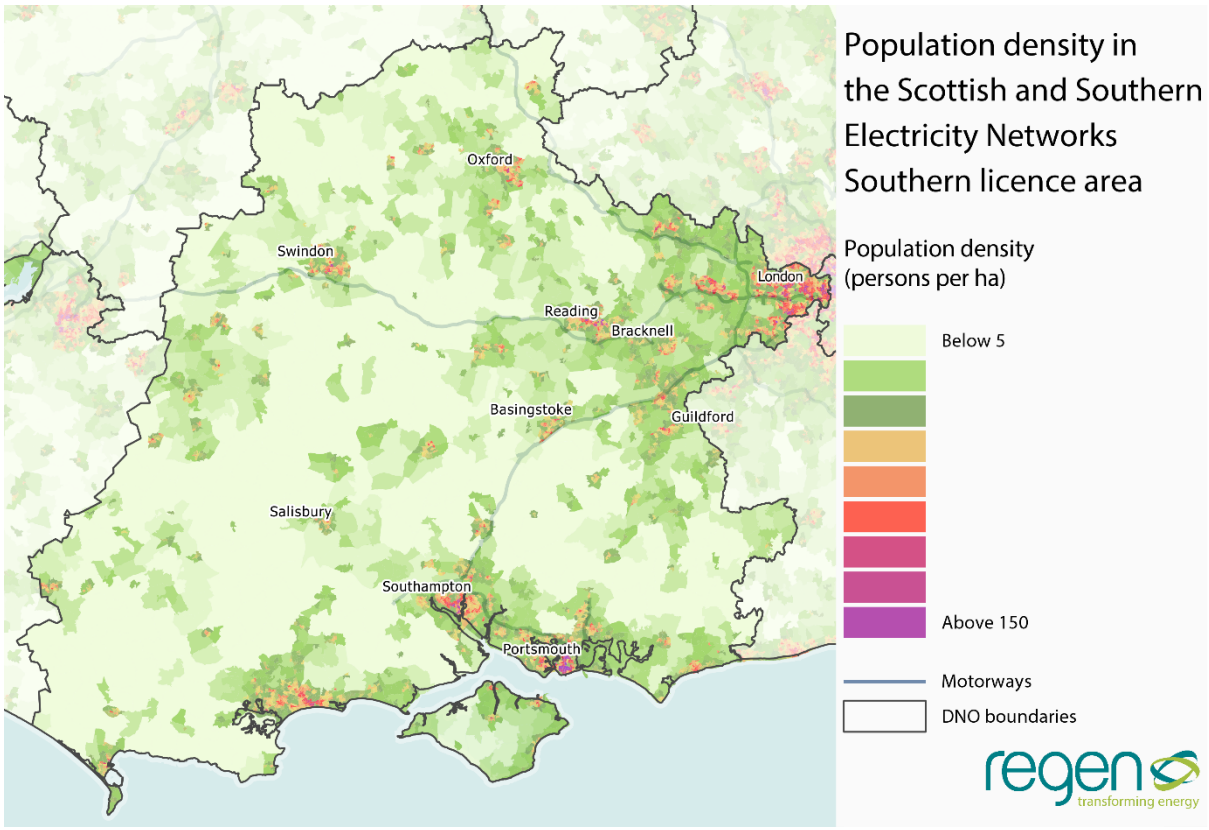
Distributed generation, demand and storage scenarios to 2035

Assumptions and methodology report

Scottish and Southern Electricity Networks

SEPD Southern Distribution Network



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Introduction

Regen has completed an analysis to project the capacity of generation and new demand that might be expected to connect to SSEN's Southern licence area under various decarbonisation scenarios between 2020 and 2035.

This study updates and extends a 2032 scenarios study completed for SSEN by Regen in 2018. This study, however, does not update electric vehicles and heat pumps in this version as they have been covered in greater detail in a separate analysis which looked at installations at a more granular feeder level. Details of that study can be found here: https://www.ssen.co.uk/Innovation/.

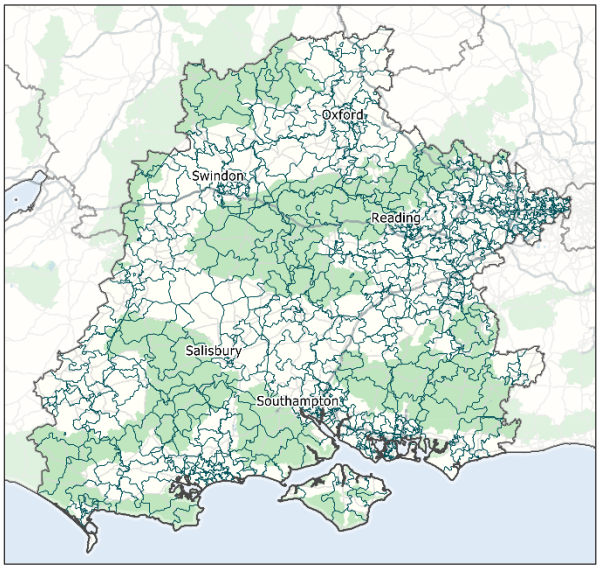
The main output of the analysis is a dataset where the capacity of each technology or new demand is projected by Electricity Supply Area (ESA), year and scenario.

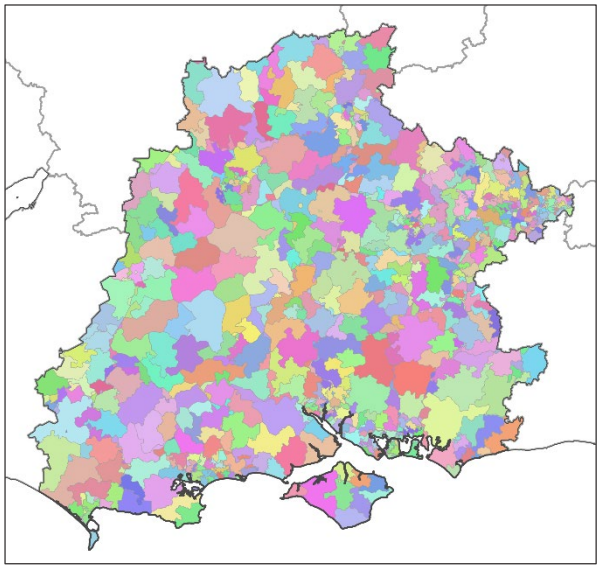
This document accompanies the dataset and summarises the methodology, approach and outputs for each technology or demand area projected in the analysis.

Electricity Supply Areas (ESAs)

ESAs are defined as geographic areas served by the same upstream network infrastructure. These have been created by mapping data on primary substations and the upstream network using Geographic Information System software.

There are 434 geographic ESAs in the licence area, each corresponding to a primary substation. These were then split by local authority boundaries so that the output data can be aggregated to local authority level. The maps below show the resulting 915 ESAs.





Connections data

The first step in the scenarios analysis is understanding what generation and demand technologies are currently connected at distribution level in the licence area and in what ESA they are connected.

The table below is an extract of the connections database compiled by Regen containing, the SSEN 'Connected' (baseline) and 'Accepted' (pipeline) sites. There are 565 entries in total. The 'ESA name' for each site was determined using the 'PRIMARY' name as the main preference, and for the entries that did not have a primary name, the geographic location was used to determine the closest substation and thus the ESA it is in.

GSP	BSP	PRIMARY	POST CODE	CAPACITY (MW)	CONNECTION DATE	ACCEPTANCE DATE	Regen technology	Regen Sub-technology	ESA name	Local Authority	Substation name	ESA category
MINETY	GALILEO	*N/A	SN5 3NY	10.00	31/07/2020	31/10/2017	Battery storage	Grid services	WOOTTON BASSETT_Wiltsh	Wiltshire	Wootton Bassett	11 kV ESA
MANNINGTON GSP	LYTCHETT	HOLES BAY	BH15 2AL	7.50	01/01/2020	05/02/2016	Battery storage	Grid services	HOLES BAY_Poole	Poole	Holes Bay	11 kV ESA
MELKSHAM	CHIPPENHAM	CALNE	SN11 9BS	7.50		02/03/2018	Gas	Reciprocating engin	CALNE_Wiltshire	Wiltshire	Calne	11 kV ESA
BRAMLEY (BASI)	BASINGSTOKE T1	OVERTON	RG25 3JG	7.20	15/06/1995		Gas	OCGT	OVERTON_Basingstoke and	Basingstoke and Dean	OVERTON	11 kV ESA
COWLEY	HEADINGTON	ARNCOTT	OX25 1NX	7.20	28/03/2015	18/06/2015	Solar PV	>= 1 MW	ARNCOTT_Cherwell	Cherwell	Arncott	11 kV ESA
AMERSHAM	LOUDWATER	WELL END	SL8 5PS	7.20	31/05/2019	16/03/2018	Battery storage	Grid services	WELL END_Wycombe	Wycombe	WELL END	11 kV ESA
LOVEDEAN	CHICHESTER & HUI	CHICHESTER	PO20 2GP	7.00	18/11/1998		Gas	OCGT	CHICHESTER_Chichester	Chichester	Chichester	11 kV ESA
LALEHAM	EAST BEDFONT A	ASHFORD COMMON	TW17 0SR	6.00	01/06/2012		Diesel		ASHFORD COMMON_Custon	Spelthorne	Ashford Common	Customer ESA
NURSLING	WINCHESTER	*N/A		10.00	31/10/2020	25/09/2017	Battery storage	Grid services	WINCHESTER_BSP ESA	-	WINCHESTER BSP	33/66/132 kV ESA

Additional ESAs

There are 21 sites in the connections database that do not have an associated 11 kV ESA. This is either because the customer is connected at a higher voltage level, or they are connected to a primary with a single customer connection.

As a result, 18 new non-geographical ESAs were formed, increasing the total number of ESAs to 933. The ESAs are categorised as:

- 11 kV ESA - geographic ESAs created from the primary substation's area
- 33/66/132 kV ESA - non-geographic ESA assigned to customers connected at a higher voltage level
- Customer ESA - non-geographic ESA assigned to single customers with their own primary substation
- Data Centre ESA - non-geographic ESA assigned to data centres with their own primary substation

Stakeholder engagement

Stakeholder engagement is a core element of the DFES methodology and is integral to the scenarios to help build a bottom-up and locally informed analysis. The stakeholder engagement conducted for this study included:

- **Local Authorities.** The 54 local authorities in the licence area were contacted to collect information on the location, size and type of strategic new developments which would be expected to have an impact on electricity demand and take-up of new low carbon technologies. Questions were also asked about the energy plans for those developments.
- **Developers and projects in the pipeline**. To project near term growth of some key technologies such as battery storage or renewable generation, Regen spoke to developers and project owners about progress and plans for pipeline connections and when they might be expected to connect.

There was no additional wider stakeholder engagement events conducted for this updated study, however Regen used feedback from stakeholders collected from an earlier stakeholder event held in Reading to inform the analysis.

Future Energy Scenarios and Net Zero

This study uses as its framework the Future Energy Scenarios (FES) 2019[1], developed by National Grid Electricity System Operator, along with a Net Zero sensitivity.

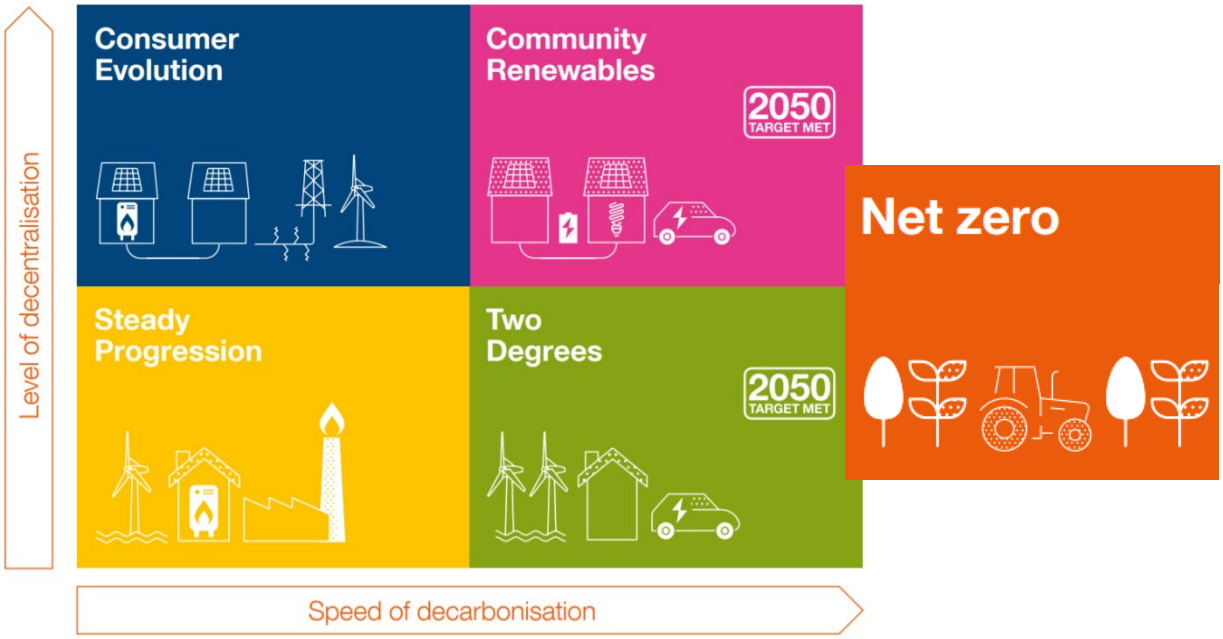
The FES 2019 framework aligns future scenarios to two key axes: speed of decarbonisation and level of decentralisation. Two scenario pathways meet the UK's previous emissions reduction target of 80% by 2050 – Two Degrees and Community Renewables.

In 2019, National Grid added a Net Zero sensitivity analysis that examines how net zero carbon emissions can be met by 2050. This scenario builds on the Two Degrees scenario, and as such is broadly 'centralised'.

This report uses the information available from the FES 2019 sensitivity, along with other sources, including the Committee on Climate Change, to understand how a net zero goal by 2050 may impact technology projections to 2035 in Regen's 'Net Zero' scenario.

Not all technologies are expected to have a different trajectory within this timeframe, and therefore in some technologies Net Zero is similar or equal to either Community Renewables or Two Degrees.

In others, such as renewable generation, the Net Zero scenario is ahead of the other scenarios. This is due to more emphasis being put on maximising the licence area's resource potential ahead of factors that might have prevented capacity growth in the past, such as planning constraints.



[1] http://fes.nationalgrid.com/fes-document/ the assumptions underpinning the FES 2019 scenarios, including a net zero sensitivity, are published by National Grid in a workbook.

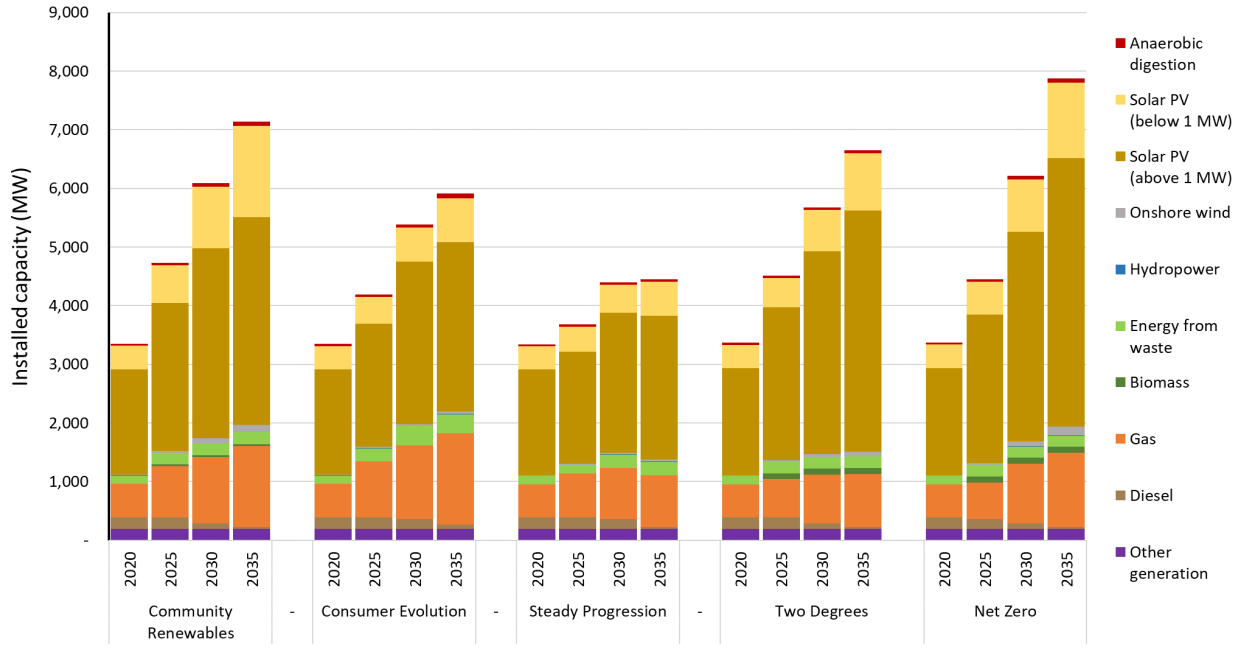
Scenario summaries of total distributed generation capacity in SSEN southern licence area

The baseline installed distributed generation capacity in the SSEN Southern licence area is 3,285 MW. This figure is projected to more than double in the higher growth scenarios.

Scenario	2035 generation capacity (MW)	2035 storage capacity (MW)
Two Degrees	6,650	1,383
Community Renewables	7,138	1,641
Consumer Evolution	5,910	1,053
Steady Progression	4,451	653
Net Zero	7,870	1,658

The chart below shows the growth of installed distributed generation capacity per scenario out to 2035. By 2035 it was projected that a Net Zero trajectory would have slightly higher levels of renewable generation than scenarios that were compliant with an 80% by 2050 target.

Projected generation summary for the SSEN Southern licence area by scenario and technology



Air conditioning scenarios

SSEN Southern licence area

Baseline

Baseline (2019)	Total
Numbers of air con units	35865
% of households with air con	1.30%

There is no data available to create a domestic air conditioning baseline. In the FES 2019, just over 1% of domestic properties in the UK have one air conditioning unit.
The numbers of domestic units in the FES 2019 scenarios has been used to estimate numbers in SSEN Southern licence area but they have adjusted to reflect the warmer climate and higher affluence levels compared to the rest of the UK.

Pipeline

There is no pipeline data available for air conditioning units

Scenarios

Percentage of homes with air con	Baseline (2019)	2025	2030	2035
Two Degrees	1.3%	1.3%	1.3%	1.3%
Community Renewab		1.9%	3.2%	4.6%
Consumer Evolution		2.8%	5.5%	10.7%
Steady Progression		2.8%	5.5%	10.7%
Net Zero		1.3%	1.3%	1.3%

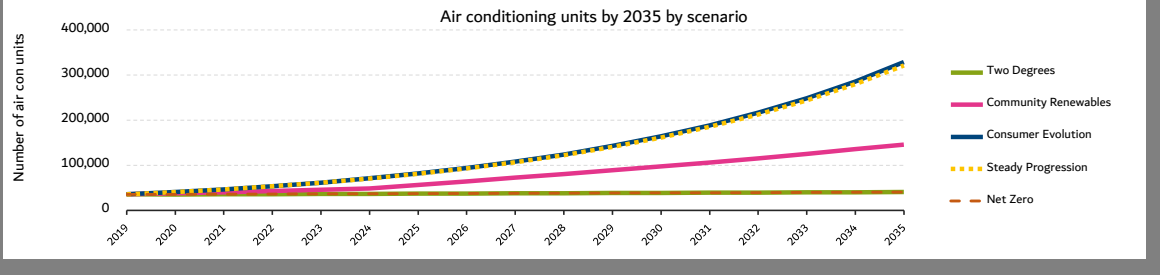
Number of installations	Baseline (2019)	2025	2030	2035
Two Degrees	35,865	37,405	39,137	40,764
Community Renewables		56,602	97,810	146,187
Consumer Evolution		82,002	164,083	328,588
Steady Progression		81,274	161,620	321,292
Net Zero		37,405	39,137	40,764

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Infrastructure and government support					
Building regulations on cooling	Strong regulations driving passive cooling	Strong regulations driving passive cooling	Some regulation on standards	No regulation	Strong regulations driving passive cooling
Technology cost and performance					
Unit and running costs	High unit and running costs	High unit and medium running costs (local solar)	High unit and running costs	Low unit cost and high running cost	High unit and running costs
Consumer factors					
Affluence	Capital available to invest in passive systems	Capital available to buy air con or repurpose heat pumps	Low economic growth constrains demand	Low economic growth constrains demand	Capital available to invest in passive systems
Resource factors					
Climate and temperature rise	Temperature rise minimised	Temperature rise minimised	Temperature increases significantly	Temperature increases significantly	Temperature rise minimised

Scenario description
Air conditioning growth is related to FES 2019 with up to 10% of homes having one unit operating by 2035 in Steady Progression. Conversely, current low levels are maintained in Two Degrees.
Air conditioning in Net Zero has been matched to the minimal growth in Two Degrees where strong regulations limit uptake.

Comparison to National Grid Future Energy Scenarios and previous study
The scenarios are consistent with FES however there is a small amount of additional growth. In addition, there are more units in Community Renewables due to its high number of heat pumps which, in some conditions, can be adjusted to run as cooling units.

Distribution
The distribution of air conditioning is related to housing densitiy to reflect the impact of heat islands in high density urban areas and has been weighted by affluence .



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Anaerobic digestion scenarios

SSEN Southern licence area

regen transforming energy

Baseline

Baseline year	Capacity (MW)	Number of projects
2015	30	32
2016	34	41
2017	34	41
2018	34	41
2019	34	41

There is 34 MW of anaerobic digestion (AD) capacity connected in the SSEN Southern licence area.

20 of the 41 baseline projects connected between 2014 and 2016 in response to the beneficial rates of the Feed-In Tariff (FIT). No new projects have connected since 2016.

These existing plants are either using livestock farming manure, energy crops, crop waste or collected food waste as feedstocks.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)
Sites with expired planning permission	3	5
Sites with connection agreement	1	5
Total pipeline	**4**	**10**

There are four sites in the AD pipeline although only one, a 5 MW site is expected to go ahead in the scenarios. Three sites that were identified in the renewable energy planning database (REPD) have no recent activity and expired planning permission. They are not expected to go ahead in any scenario.

The 5 MW pipeline project was given a connection offer by SSEN in 2019. There is no online evidence about plans for this 5 MW site, which is expected to connect near Christchurch. Given this is a recent application, it is expected to connect in all scenarios except Steady Progression.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*34*				
Two Degrees	34	34	39	49	54
Community Renewables	34	34	42	54	67
Consumer Evolution	34	34	42	58	75
Steady Progression	34	34	35	39	45
Net Zero	34	34	42	54	67

Capacity (MW)	Total increase	Percentage growth
2020 - 2035		
Two Degrees	20	58%
Community Renewables	33	95%
Consumer Evolution	41	120%
Steady Progression	11	31%
Net Zero	33	95%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
Smart Export Guarantee available for AD electricity generation	Low subsidy for electricity post-2019	Subsidies or support provided to incentivise new AD	No subsidy for electricity post-2019	No subsidy for electricity post-2019	Subsidies or support provided to incentivise new AD
Local authority food waste collection targets	Requirement to collect food waste by 2030	Requirement to collect food waste by late 2020s	No change to present	No change to present	All to collect food waste by late 2020s
Local and community factors					
Subsidy incentive for heat and biomethane AD plants	High, with support extended after 2021. Focus is on biomethane and heat plants.	High, with support extended after 2021. Focus is on biomethane and heat plants.	No further support after 2021.	No further support after 2021.	High, with support extended after 2021. Focus is on biomethane and heat plants.
Transport subsidy – renewable transport fuel obligation	Strict transport emissions regulation incentivises production of biomethane	Strict transport emissions regulation incentivises production of biomethane	Limited incentive to use AD for road fuels, focus remains on electricity generation	Limited incentive to use AD for road fuels.	Strict transport emissions regulation incentivises production of biomethane
Market and technology factors					
Availability of food waste	Medium resource availability: High levels of food waste collection offset by achievement of waste reduction targets	Medium resource availability: High levels of food waste collection offset by achievement of waste reduction targets	High resource availability: High levels of food waste collection continue but waste reduction target is missed.	Medium resource availability: Lower levels of food waste collection and waste reduction targets missed.	Medium resource availability: High levels of food waste collection offset by achievement of waste reduction targets
Agricultural waste projects	Higher resource availability and availability of finance	Higher resource availability and availability of finance	Higher resource but lower finance	Higher resource but limited finance	Higher resource availability and availability of finance

Scenario description

Feedstock from waste is a critical factor in future capacity growth. Despite the lack of new connections in the last three years, the licence area still has good potential for AD as a result of both high agricultural production, as well as dense population areas where food waste is not yet collected, for example across both Hampshire and Wiltshire.

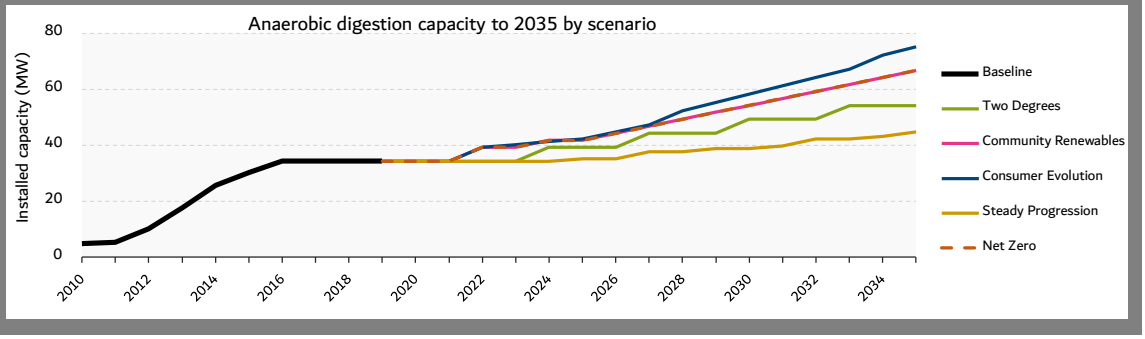
Growth of AD capacity is in line with the FES and is expected to double during the study period under Community Renewables where local authorities are required to start collecting food waste in the 2020s. There are relatively high increases in all scenarios apart from Steady Progression, where capacity only increases 31% over time. Net Zero is expected to be similar to Community Renewables, maximising both large and small scale potential but with reductions in the amount of waste produced.

Comparison to National Grid Future Energy Scenarios and previous 2018 study

The study is broadly comparable to FES 2019 where capacity was reduced to reflect increasing emphasis on biomethane injection rather than electricity generation. As a result the projections are c. 10% lower than the 2018 study.

Distribution

Future AD is expected to be located in peri-urban ESAs without existing plants and close to both potential new streams of food waste from dense population areas. Smaller plants were distributed to areas with high agricultural output but without existing AD plant.



Battery storage scenarios
SSEN Southern licence area

Baseline

The baseline for battery storage in the SSEN Southern licence area has not changed since the previous study completed in 2018.

The two baseline sites, totalling 5.2 MW, are co-located with solar PV projects and both connected in 2018.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)
Grid services	40	1271
Co-location	9	105
Total pipeline	**49**	**1376**

There are 49 battery storage sites with accepted connection offers in the SSEN Southern licence area, totalling nearly 1.4 GW. 40 of these are stand-alone battery projects and 9 of these are projects co-located solar PV generation. Within this pipeline are four 100 MW projects, each of which would be amongst the largest individual battery projects globally.

After analysis of these projects' activity in the Capacity Market and research on local planning portals, this pipeline was significantly reduced to 30 sites, totalling 820 MW. Of the remaining projects 27 are stand-alone batteries and 3 sites are co-location. All of the 100 MW sites are included in the remaining pipeline but have been reduced to 50 MW in some scenarios due to evidence from planning applications.

Since 2018, the SSEN pipeline has gone down from 1.6 GW to 1.4 GW. However, the total capacity with evidence of either planning or CM activity has gone up from 400 MW to 800 MW.

Scenario	Pipeline allocation logic
Two Degrees	Projects that have won or pre-qualified for Capacity Market (CM) go ahead in the CM delivery year. Projects with planning permission, or evidence of planning applications, go ahead later in the plan period depending on the application date. Projects with no evidence of planning or CM activity do not go ahead in any scenario.
Community Renewables	Projects that have won or pre-qualified for CM go ahead in the CM delivery year. Projects with planning permission, or evidence of planning, go ahead later in the plan period depending on the application date. Projects with no evidence of planning or CM activity do not go ahead in any scenario.
Consumer Evolution	Projects with activity in the CM go ahead three years after the delivery date. Projects with recent evidence of planning also go ahead later in the plan period.
Steady Progression	Only projects that have positive CM activity and have planning permission go ahead. They connect four years after the CM delivery year.
Net Zero	Projects that have won or pre-qualified for CM go ahead in the CM delivery year. Projects with planning permission or evidence of planning go ahead later in the plan period depending on the application date. Projects with no evidence of planning or CM activity do not go ahead in any scenario.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Two Degrees	5	17	711	1,089	1,383
Community Renewables	5	17	717	1,092	1,641
Consumer Evolution	5	17	414	768	1,053
Steady Progression	5	17	66	453	653
Net Zero	5	17	717	1,093	1,658

Growth factors	Two Degrees	Community Renewables	Steady Progression	Consumer Evolution	Net Zero
Government policy and support					
Planning policy supportive of batteries	Supportive planning policy and business rates for storage of all scales ratified by 2020	Supportive planning policy and business rates for storage of all scales ratified by 2020	Neutral planning policy for storage by mid 2020s and no change to business rates	Supportive planning policy for storage ratified by mid 2020s no change to business rates	Supportive planning policy and business rates for storage of all scales ratified by 2020
Full storage definition and classification in energy policy and regulation	Storage defined in primary legislation in early 2020s	Storage defined in primary legislation in early 2020s	Storage remains subset of generation in until late 2020s	Storage remains subset of generation in until mid-late 2020s	Storage defined in primary legislation in early 2020s
Overarching support for renewable energy and the need for system flexibility that storage can provide	Renewables increase significantly and flexibility need in system is high	Renewables increase significantly and flexibility need in system is high	Renewables less supported and flexibility need in system is very low	Renewables moderately supported and flexibility need in system is low	Renewables increase significantly and flexibility need in system is high
Technology and costs					

Scenario description

The scenarios are driven by the pipeline projects in the short and medium term. Longer term they are driven by different storage business models including the amount of renewable generation installed in the licence area, the level of rooftop solar PV for domestic storage and the level of commercial demand likely to install behind-the-meter storage. These are guided by the expected FES 2019 growth trajectories and scenario projections from this study.

Net Zero is equivalent to Community Renewables but has slightly lower domestic storage (as a result of less rooftop solar) and higher co-location of batteries (as a result of more ground-mounted solar).

Comparison to National Grid Future Energy Scenarios and previous 2018 study

Due to the large pipeline, the scenarios diverge away from FES projections from the outset. By 2032, the total capacity is approximately 450 MW above the regional FES in all scenarios.

The licence areas accounts for c. 15% of GB storage in 2035 in the Community Renewables scenario. This is in line with the significant activity seen in the licence area pipeline.

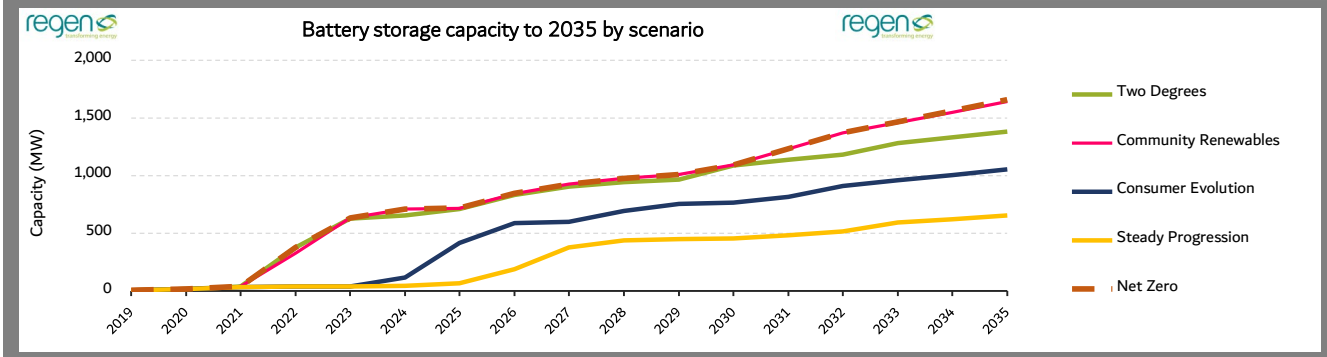
Battery storage scenarios
SSEN Southern licence area

Battery technology cost reductions	Continues to fall as predicted	Continues to fall as predicted	Cost reduction slows significantly	Cost reduction is less than predicted	Continues to fall as predicted
Longer duration storage economics	Become viable within 2020s	Become viable within 2020s	Do not become viable until late 2020s	Become viable in mid 2020s	Become viable within 2020s
Consumer factors					
Batteries provide flexibility savings for high energy users	Viable investment case in early 2020s	Viable investment case in early 2020s	Viable investment case in mid 2020s	Viable investment case in late 2020s	Viable investment case in early 2020s
PV/renewable generation and battery co-location business case	Co-location model viable in early 2020s	Co-location model viable in early 2020s	Co-location model viable in mid 2020s	Co-location model viable in late 2020s	Co-location model viable in early 2020s
Market factors					
Storage ability to participate in network services	Rapid response storage achieves high value contracts	Rapid response storage achieves high value contracts	Storage has some success in winning network services contracts	Storage is not successful in winning network service contracts	Rapid response storage achieves high value contracts

Distribution:
Domestic batteries have been weighted among existing homes towards households projected to have rooftop PV across the period.

Co-located batteries have been weighted towards existing and projected wind and solar PV capacity.

Storage for high energy users has been weighted using Ordnance Survey Addressbase data to industrial or commercial properties most likely to have a need for storage in the licence area.



Biomass scenarios

SSEN Southern licence area

Baseline

There is no biomass baseline

Pipeline

There is no biomass pipeline

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	-				
Two Degrees	-	-	100	100	100
Community Renewables	-	-	30	30	30
Consumer Evolution	-	-	-	-	-
Steady Progression	-	-	-	-	-
Net Zero	-	-	100	100	100

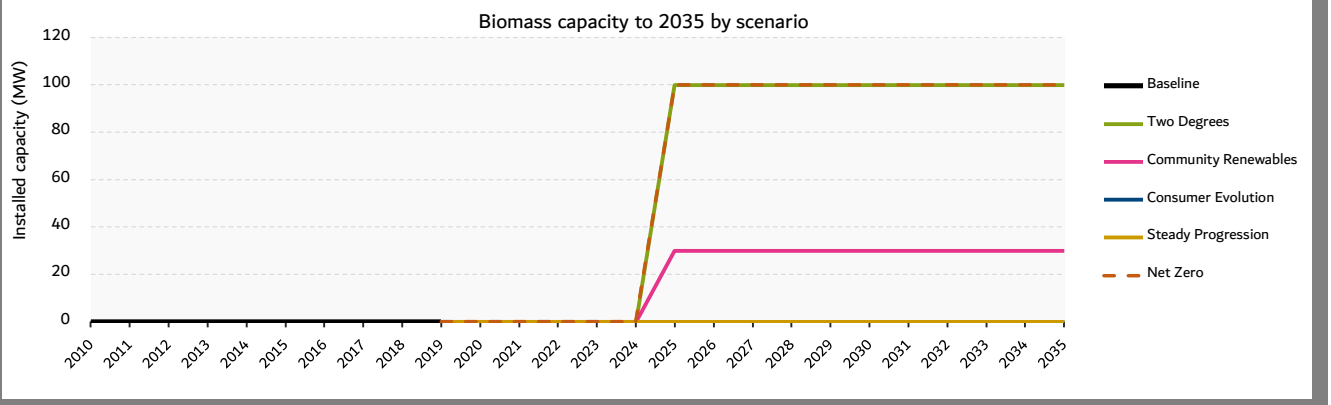
Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
Subsidy support for projects meeting sustainability standards	Subsidy support for biomass projects that meet sustainability standards until late 2020s	Subsidy support for biomass projects that meet sustainability standards until late 2020s	No subsidy support	No subsidy support	Subsidy support for biomass projects that meet sustainability standards until late 2020s
Planning permission					
Planning environment	Strategic approach to planning enables larger scale projects to gain permission	Local approach to planning means projects that can demonstrate strong environmental credentials are supported	Higher level of projects rejected	Lack of centralised support for decarbonisation means biomass projects less likely to get permission	Strategic approach to planning enables larger scale projects to gain permission

Scenario description
There is currently no dedicated biomass electricity generation in the licence area, though schemes have been suggested in locations such as Southampton. In the Two Degrees and Net Zero scenarios, a 100 MW plant could be developed in Southampton potentially to support the heat network development in the city, with a smaller 30 MW plant developed in Consumer Renewables by 2035.

No biomass plants are built under Consumer Evolution or Steady Progression.

Comparison to National Grid Future Energy Scenarios and 2018 study
The FES 2019 recognised the limitations on biomass electricity deployment. It includes a role for biomass electricity generation with CHP that increases until 2030 and then reduces again as further decarbonisation is required and biomass generation no longer provides sufficient carbon savings.

Distribution
The site that may be developed in some scenarios is the shelved Southampton biomass CHP. This 100 MW site was withdrawn previously due to financial issues.



Diesel generation scenarios

SSEN Southern licence area

Baseline

Baseline year	Capacity (MW)	Number of new projects
2015	62	16
2016	131	22
2017	139	24
2018	160	26
2019	200	28

The SSEN Southern licence area has a very high baseline of diesel generation compared to other areas of the country. There are seven diesel generators of c. 20 MW which connected since 2015 and make up the majority of the baseline capacity. The remaining 21 units are much smaller, with an average capacity of 3 MW.

The baseline has seen a net decrease of 30 MW since the previous study. This reflects two new 20 MW sites in 2019 counteracted by four plants, totalling 70 MW, coming offline in the same period.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)
Diesel generators	9	48

There are nine diesel pipeline projects in the SSEN Southern licence area totalling 48 MW. However, none of these sites are expected to go ahead in the scenarios. This is because none have evidence of planning permission or planning applications. In addition the project with the most recent connection offer from SSEN in 2018 was unsuccessful in the T-4 2016 Capacity Market auction. No diesel sites are expected to go ahead unless they have secured a capacity market contract.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*200*				
Two Degrees	200	198	196	96	26
Community Renewables	200	198	196	96	26
Consumer Evolution	200	200	198	163	68
Steady Progression	200	200	198	163	28
Net Zero	200	200	164	89	25

Capacity (MW)	Total increase (2020 - 2035)	Percentage growth
Two Degrees	-174	-87%
Community Renewables	-174	-87%
Consumer Evolution	-132	-66%
Steady Progression	-172	-86%
Net Zero	-175	-87%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Technology cost and performance					
Diesel competition with gas, storage and DSR	Flexibility and peaking services mainly provided by interconnectors, gas and large-scale battery storage	Small gas plants provide the most cost-effective flexibility as the rest of the system decarbonises quickly	Small gas plants provide the most cost-effective flexibility as new technologies are explored	Gas plant still used for peaking, but lowest level of all scenarios	Flexibility and peaking services mainly provided by interconnectors, gas and large-scale battery storage
Infrastructure and government support					
Tightening air quality standards and emission limits	MCPD tightened substantially by 2032	MCPD emission limits tightened slowly	Existing MCPD limits only	Existing MCPD limits only	MCPD tightened substantially by 2030
Assumed diesel unit operating life	14 years	15 years	17 years	16 years	13 years

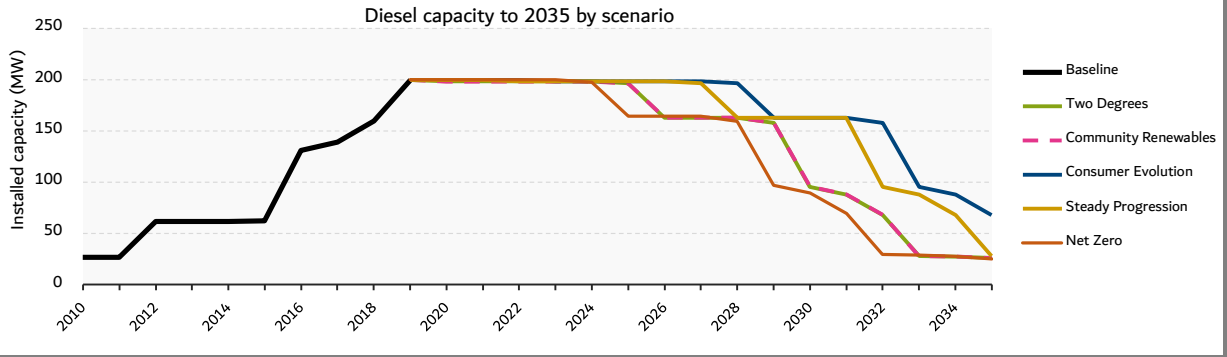
Scenario description

Despite relatively high growth in the last few years, there is no new diesel capacity expected from 2020 onward. This is primarily because its operation as peaking generation is overtaken by competing cleaner technologies not impacted by medium combustion plant directive (MCPD) higher air quality standards.

The staggered negative growth of diesel comes from modelled decommissioning of baseline sites based on the connection date and the primary use of the generator. The age of the asset when it is decommissioned is varied across the scenarios, with Consumer Evolution being the longest and Net Zero being the shortest, as a result of tightening standards and emergence of viable alternatives.

Comparison to National Grid Future Energy Scenarios and previous 2018 study

The National Grid FES 2019 shows an overall decline in diesel capacity to 2035. Consumer Evolution and Steady Progression show some increase out to 2025, but then rapidly decrease to 2030. Due to the lack of activity of the pipeline projects in the Capacity Market and in planning, we do no project any new connections in any scenario.



Energy from waste scenarios

SSEN Southern licence area

Baseline

Energy from waste capacity (MW)

Baseline year	Incineration	ACT
2016	139	0
2017	139	0
2018	139	0
2019	139	0

There is a baseline of 139 MW from nine energy from waste incineration plants in the SSEN Southern licence area. The baseline is dominated by medium-sized plants operated for local authorities to process residual waste. The most recent connection was a 26 MW plant in Ardley which connected in 2013. A small site was completed on the Isle of Wight in 2019 though the connection date is 2012. The largest site is the 45 MW Lakeside ERF near Slough. No new sites have connected since 2013.

Pipeline

Pipeline summary	Project numbers	Total capacity (MW)	Average capacity (MW)
Incineration	5	138	28
ACT	6	76	13
Total pipeline	**11**	**214**	**19**

There are twelve energy from waste plants in the pipeline taken from REPD and SSEN connection database. Seven are Advanced Conversion Technology (ACT) plants where waste is gasified before use, providing a cleaner way to deal with residual waste.
Only four sites have a connection agreement from SSEN, of which two are ACT plants which are both expected to go ahead in all scenarios. Three sites without recent activity are not expected to go ahead in any scenario. Smaller sites connect in decentralised scenarios, and in Community Renewables the new connections are the smaller ACT plants only.

ESA	Capacity (MW)	SSEN connection	Planning	Technology	Recent activity	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
BARTON STACEY_Test Valley	56	Yes	No	Incineration	Yes			2027		
FARNHAM ROYAL_Slough	50	Yes	Yes	Incineration	Yes			2025	2026	
HAWKERIDGE_Wiltshire	27	Yes	Yes	ACT	Yes	2023	2024	2025	2026	2023
PORTLAND_Weymouth and Portland	15	No	No	Incineration	Yes			2028		
STANTON FITZWARREN_Swindon	14.5	No	Yes	ACT	Yes	2024	2025	2026		2024
BILSHAM_Arun	14	No	Yes	Incineration	Yes			2026	2027	
EASTLEIGH NORTH_Eastleigh	12	No	No	ACT	No		2027			
WINFRITH HEATH_Purbeck	10	No	Yes	ACT	No	2024	2025	2026		2024
MINETY VILLAGE_Wiltshire	6	No	No	ACT	No					
COTTISFORD_Cherwell	6	No	No	ACT	No					
SUNBURY CROSS_Spelthorne	3.7	Yes	Yes	ACT	Yes	2020	2020	2020	2020	2020
MINETY VILLAGE_Wiltshire	3	No	No	Incineration	No					

Energy from waste scenarios

SSEN Southern licence area

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*140*				
Two Degrees	140	144	195	195	195
Community Renewables	140	144	195	207	207
Consumer Evolution	140	144	220	329	329
Steady Progression	140	144	144	234	234
Net Zero	140	144	195	195	195

Capacity (MW)	Total increase (2020 - 2035)	Percentage growth
Two Degrees	55	39%
Community Renewables	67	48%
Consumer Evolution	189	135%
Steady Progression	94	67%
Net Zero	55	39%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
Government introduces tax on incineration of waste	Incineration tax introduced from early 2020s	Incineration tax introduced from early 2020s	No incineration tax	No incineration tax	Incineration tax introduced from early 2020s
Competition for resource availability	Low waste resource availability: High recycling rates and lower waste production.	Low waste resource availability: High recycling rates and lower waste production.	Medium waste resource availability: high recycling rates but lack of government policy	High waste resource availability: Low recycling rates and lack of government waste policy	Low waste resource availability: High recycling rates and lower waste production.
Local and community factors					
Planning environment	Centralised, strategic approach to planning enables larger-scale projects to gain planning permission.	Projects that demonstrate local support and eco credentials i.e. ACT producing biomethane and heat	Less engaged population with decarbonisation leads to higher level of projects being rejected at planning	Centralised, strategic approach to planning enables larger-scale projects to gain planning permission.	Centralised, strategic approach to planning enables larger-scale projects to gain planning permission.
Technology cost and performance					
ACT development	Investment in R&D leads to development of reliable ACT technology	Investment in R&D leads to development of ACT tech, inc. small-scale plants	Lack of investment leads to slow progress in developing ACT	Lack of investment leads to slow progress in developing ACT	Investment in R&D leads to development of reliable ACT technology

Scenario description

Incineration and ACT are treated separately in the scenarios as they are subject to different incentives. ACT is classified as a renewable technology that is able to access subsidies through the price support scheme Contracts for Difference (CfD).

The growth in the capacity of both of the technologies is based solely on the pipeline and planned sites. No growth is expected outside of this pipeline within the scenario period.

The Net Zero scenario has been linked to Two Degrees to reflect the FES 2019 sensitivity which favours larger centralised projects and ACTs over incineration.

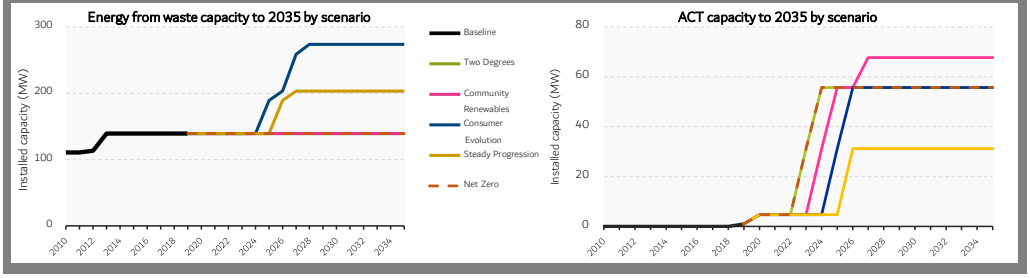
Comparison to National Grid Future Energy Scenarios and previous 2018 study

Proportionally, the total capacity and growth in SSEN South is above the FES 2019 due to the high number of potential projects in the area and the relatively dense population which leads to significant amount of residual waste.

The projections are similar to the 2018 study, though higher in Steady Progression and Consumer Evolution due to changes to the pipeline.

Distribution

The sites are distributed according to locational data for pipeline



Gas generation scenarios

SSEN Southern licence area

Baseline

Baseline year	Capacity (MW) Gas	Gas CHP
2015	408	27
2016	490	30
2017	491	35
2018	516	35
2019	516	35

The baseline for gas differentiates between small-scale gas combined heat and power (CHP) and larger-scale, non-CHP gas power plants. The SSEN Southern licence area has four gas fired power stations above 40 MW, with the largest being 100 MW. This capacity has increased by 50 MW since the last study.

Only two gas fired power stations above 40 MW have been built since 2000, a 100 MW plant in 2012 and a 70 MW plant in 2004. However, smaller units (averaging 7 MW) have continued to connect since 2010, with 140 MW of capacity being added in small scale projects.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)
Gas	29	530
Gas CHP	12	35
Total pipeline	**41**	**564**

The pipeline for gas and gas CHP has increased c. 150 MW since 2018. The pipeline has increased from 410 MW in the 2018 study to 564 MW in early 2020. Significant additions to the pipeline include two 100 MW gas reciprocating engines, as well as 15 other smaller gas and gas CHP projects.

Only one of the sites from the old study has since been built (16 MW, Basingstoke), and a number of others no longer have a connection agreement.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*551*				
Two Degrees	551	558	648	828	909
Community Renewables	551	563	874	1,126	1,382
Consumer Evolution	551	563	954	1,256	1,558
Steady Progression	551	558	749	871	883
Net Zero	551	558	625	1,021	1,271

Capacity (MW)	Total increase (2020 - 2035)	Percentage growth
Two Degrees	358	65%
Community Renewables	831	151%
Consumer Evolution	1007	183%
Steady Progression	332	60%
Net Zero	720	131%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Technology cost and performance					
Gas competition with storage and DSR	Flexibility and peaking services mainly provided by interconnectors and large-scale battery storage	Small gas plants provide the most cost-effective flexibility as the rest of the system decarbonises quickly	Small gas plants provide the most cost-effective flexibility as new technologies are explored	Gas plant still used for peaking, but lowest level of all scenarios	Flexibility and peaking services mainly provided by interconnectors and large-scale battery storage
Infrastructure and government support					
Role of flexible, distributed peaking plant in the UK	Greater emphasis on large scale (transmission connected) generation and balancing	High demand for small peaking plant.	High demand for small peaking plant, particularly gas and battery generation technologies	Greater emphasis on large scale (transmission connected) generation and balancing	High demand for small peaking plant, particularly gas and battery generation technologies
Tightening air quality standards and emission limits	MCPD tightened substantially by 2032	MCPD emission limits tightened slowly	MCPD only	MCPD only	MCPD tightened substantially by 2030
Consumer factors					
Commercial and Industrial customers investing in onsite fossil generation	Limited financial value in onsite flexibility. Small-scale units increase in cost as demand drops	Energy decentralisation drives uptake of owner-operated gas, and CAPEX costs fall, even as gas prices rise	Energy decentralisation drives uptake of owner-operated gas, and CAPEX costs fall, even as gas prices rise	Improvements in gas technology continue to make medium scale units cost effective	Limited financial value in onsite flexibility. Small-scale units increase in cost as demand drops

Scenario description

With a large baseline of gas generation in comparison to other licence areas, gas capacity is expected to more than double in the highest scenarios by 2035. Community Renewables sees large numbers of decentralised gas power plants running at relatively low capacity factors, in Consumer Evolution this capacity factor will be higher.

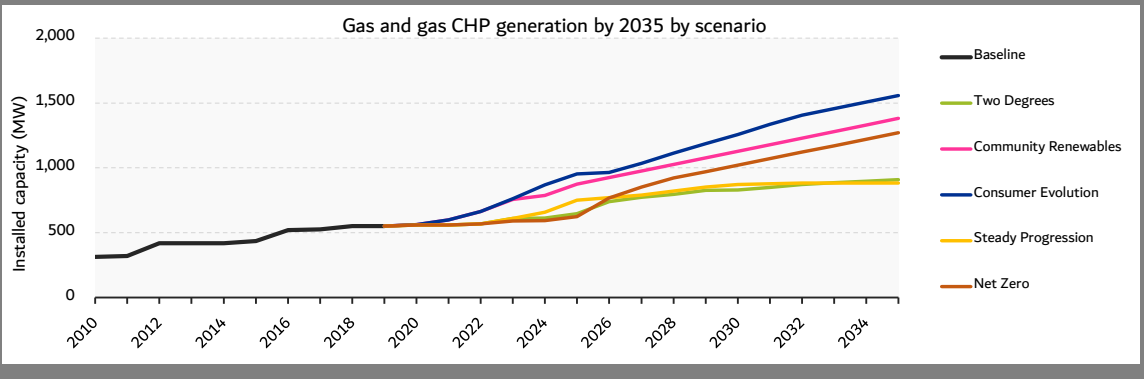
The Net Zero scenario is a combination of Community Renewables and Two Degrees where more flexible gas generation is needed to support a higher proportion of renewables in the system, but where larger-scale gas generation is connected at transmission level.

Comparison to National Grid Future Energy Scenarios and the previous 2018 study

The trends identified for the SSEN Southern licence area for gas generation are broadly in line with FES 2019 but below the study in 2018. This reflects the changing planning environment for gas at a local and national level.

Distribution

Factors that affect the distribution of gas generation sites include proximity to the gas and high voltage electricity network, as well as the availability of industrial, and brownfield sites, as evidenced by the spatial distribution of the baseline and pipeline sites.



Hydropower scenarios

SSEN Southern licence area

Baseline

Baseline year	Capacity (MW)	Number of new projects
2015	1.0	36
2016	1.6	42
2017	2.1	44
2018	2.1	44
2019	2.1	44

The baseline for hydropower has been created from Feed-In Tariff information. There are no hydro sites in SSEN connections data.

Of the existing 46 projects, only 9 projects are above 50 kW and the recent increases are largely attributed to projects in Vale of White Horse. The majority of the larger projects are around Oxfordshire and the north of the licence area. The smaller sites, c. 10-15 kW, are generally located in the south.

Pipeline

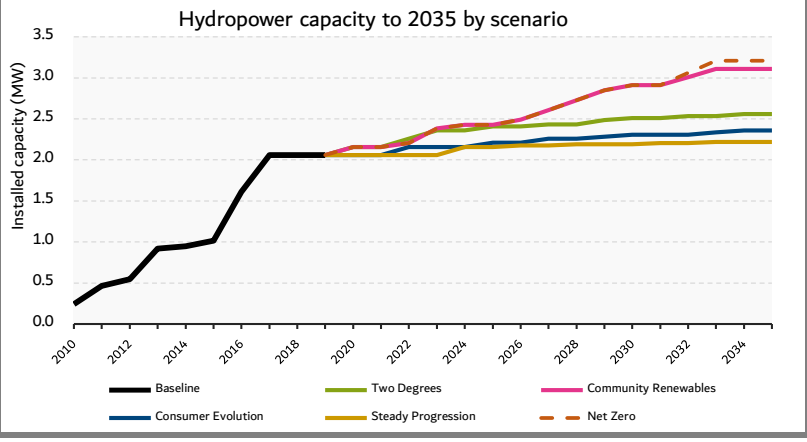
The pipeline consists of one site, a 96 kW site at Caversham Weir in Reading. The site has planning permission and is expected to start construction in summer 2020 and connect by the end of the year. The project is delayed to 2022 in Consumer Evolution and 2024 in Steady Progression.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*2.1*				
Two Degrees	2.1	2.2	2.4	2.5	2.6
Community Renewables	2.1	2.2	2.4	2.9	3.1
Consumer Evolution	2.1	2.1	2.2	2.3	2.4
Steady Progression	2.1	2.1	2.2	2.2	2.2
Net Zero	2.1	2.2	2.4	2.9	3.2

Capacity (MW)	Total increase	Percentage growth
2020 - 2035		
Two Degrees	0.5	24%
Community Renewables	1.1	51%
Consumer Evolution	0.3	15%
Steady Progression	0.2	8%
Net Zero	1.2	56%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
Smart Export Guarantee/government support available for hydro	SEG provides support for schemes but only a few are viable	New subsidies or support provided to incentivise new small scale hydro	SEG provides little support for new schemes	No subsidy post-2019	New subsidies or support provided to incentivise new small scale hydro
Planning permission					
Environmental permitting	Environmental improvement opportunities from hydropower recognised, and incentivised.	Environmental improvement opportunities from hydropower recognised, and incentivised.	Environmental improvement opportunities from hydropower recognised but not incentivised.	Current environmental permitting requirements are sustained.	Environmental improvement opportunities from hydropower recognised, and incentivised.
Flexibility and balancing revenues					
New business models – flexibility and balancing	Flexibility and balancing markets are developed for larger-capacity sites	Flexibility and balancing markets are developed helping viability of all sites	Changes slower to develop, and business models focused on power price	New business models fail to develop in scenario period.	Flexibility and balancing markets are developed helping viability of all sites



Scenario description

The licence area has relatively low hydro resource, particularly for larger sites, although there remains potential in small scale projects. However, with little policy support for hydropower and high cost of development including in planning, there is no significant growth expected in hydro capacity within the scenario period. Community Renewables has the highest growth and sees a small number of micro hydro schemes leading to a c. 50% increase in capacity by 2035.

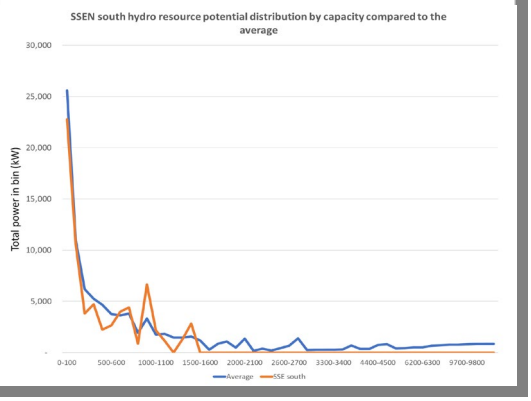
Net Zero scenario is slightly above Community Renewables to reflect the greater ambition for 'other renewable generation' in the 2019 FES sensitivity.

Comparison to National Grid Future Energy Scenarios and previous study

The scenarios are consistent with the expected growth in FES 2019 and the previous study based on licence area resource.

Distribution

Projections are distributed to areas of available hydro resource.



New developments

SSEN Southern licence area

Baseline

Baseline (2019)	Total
Average historic annual new build rate	21795 dwellings per year
Total households	2,754,094
Total non domestic floorspace	5810 ha

The SSEN Southern licence area has shown an average growth in household numbers of 1% a year since 2013. In 2019 there was a total housing stock of 2,754,094 households Recent shortfalls in house building, combined with government house building targets, result in an expected increase in housebuild rates in the near term in high-growth scenarios. Non-domestic buildings are expected to follow a similar trend.

Methodology

Provide local authority with new developments data from the previous study, request verification or update → Check new data against most recent local documents → Assign developments to ESAs (using locational data) → Assumptions applied to produce low, medium and high growth scenarios

Domestic new developments

Dwellings offset to later years	High growth		Medium growth		Low growth	
	% Planned sites built on schedule	% Planned sites delayed to later years	% Planned sites built on schedule	% Planned sites delayed to later years	% Planned sites built on schedule	% Planned sites delayed to later years
Imminent (Next year)	85%	15%	75%	25%	65%	35%
Short term (2-3 years)	80%	20%	55%	45%	40%	60%
Medium term (4 - 10 years)	65%	35%	40%	60%	20%	80%
Long term (11 - 15 years)	65%	35%	40%	60%	20%	80%

There is more certainty about the build rates of planned sites being built within the next three years. This certainty reduces over time.

High, medium and low growth trajectories are also projected with decreasing certainty, with their trajectories aligned to historical build rates.

Non domestic new developments

Phasing information	Floorspace (Ha)
Information provided by local authority.	**537**
No information available	**295**

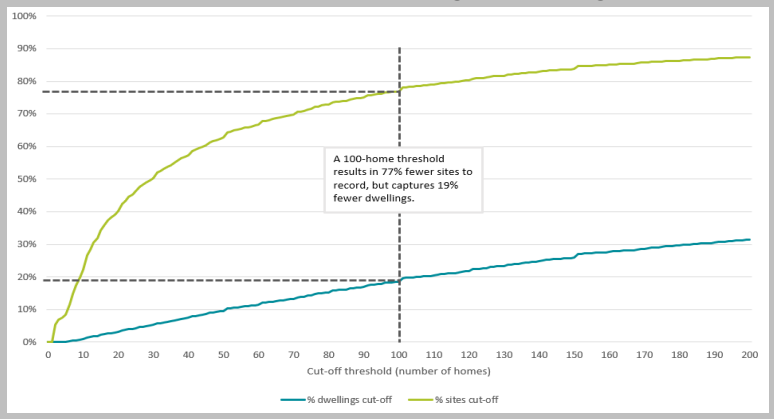
Much of the planned non-domestic new development does not have phasing information about what will be built and when. The non-domestic developments with unknown phasing are spread evenly across the plan period,in varying magnitudes depending on the growth scenario. High growth sees 95% of total unphased floorspace being built in the study period, in medium growth this is 65% and low growth this is 45%. These are lower build out percentages than the sites with known phasing as there is more uncertainty in whether the sites will go ahead by 2035.

Known trajectories - floorspace offset to later years	High growth		Medium growth		Low growth	
	% Planned sites built on schedule	% Planned sites delayed to later years	% Planned sites built on schedule	% Planned sites delayed to later years	% Planned sites built on schedule	% Planned sites delayed to later years
Imminent (Next year)	100%	0%	80%	20%	55%	45%
Short term (2-3 years)	80%	20%	55%	45%	30%	70%
Medium term (4 - 10 years)	70%	30%	40%	60%	15%	85%
Long term (11 - 15 years)	65%	35%	30%	70%	10%	90%

Similar to how domestic new builds have been delayed to produce the various scenarios, non-domestic developments are also more likely to go ahead in the short to medium term. Slower growth scenarios see fewer planned sites built each year, with more of them offset to later years.

To account for increased uncertainty in quantifying floorspace of non-domestic sites, the high and medium growth trajectories model a 10% total floorspace increase.

Distributing non-strategic domestic sites



The domestic new developments study looked at strategic sites only, defined as where there was expected to be over 100 new dwellings in a development. As a result there is a residual number of new homes that would be built in smaller non-strategic sites.

This chart shows the number of new homes that would be built within these strategic sites and shows that c. 80% of homes would be represented in the strategic sites.

The residual 20% of dwellings are distributed across ESAs using housing density and weighted to semi-urban areas.

Similar analysis and distribution of a remainder is not carried out for non-domestic sites due to uncertainty in the calculated floorspace values.

New developments

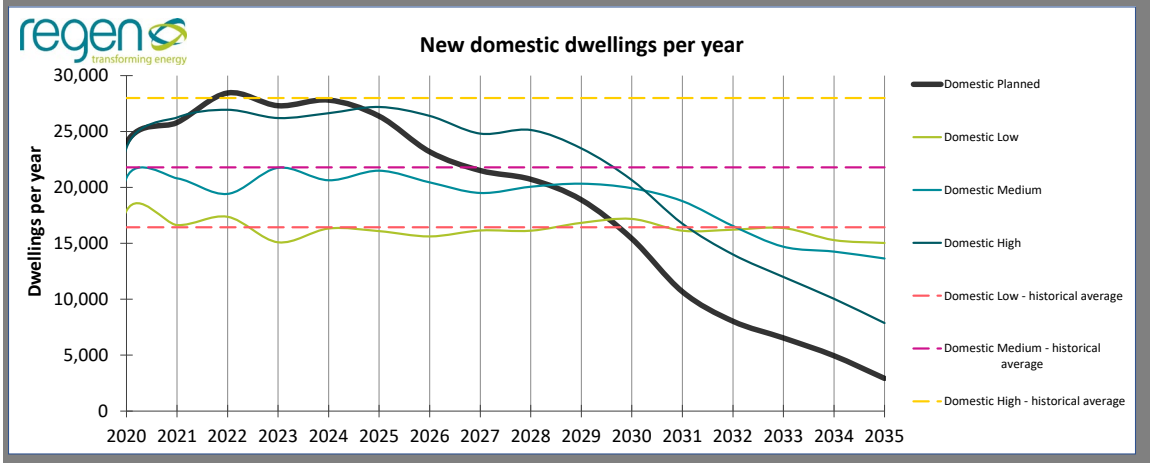
SSEN Southern licence area

Domestic development scenarios

Domestic - total dwellings	Baseline (2019)	2025	2030	2035
Two Degrees (HIGH)	2,754,094	2,910,857	3,031,351	3,092,030
Community Renewables (HIGH)		2,910,857	3,031,351	3,092,030
Consumer Evolution (MEDIUM)		2,879,076	2,979,363	3,057,300
Steady Progression (LOW)		2,853,529	2,935,446	3,014,492
Net Zero (HIGH)		2,910,857	3,031,351	3,092,030

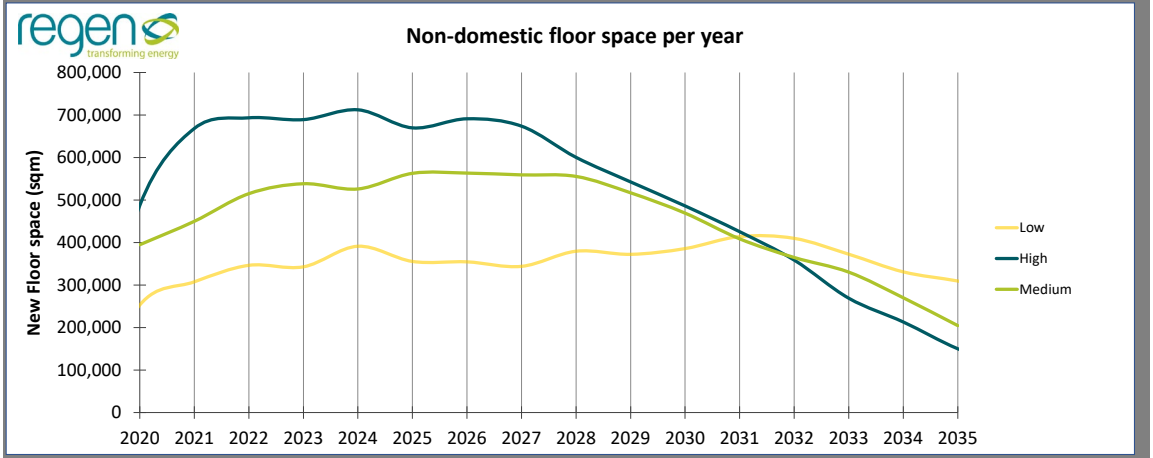
The 'Domestic Planned' trajectory reflects the number of new dwellings planned by local authorities. Naturally the level of planned building peaks in the next 5-10 years with less sites currently planned in the medium and longer term. This leads to the drop off in dwellings after 2027. In reality new sites would be planned for this period.

This planned trajectory has been adjusted by delaying developments by a number of years to reflect longer term building trends into low, medium and high growth scenarios. In the higher growth scenario the delay is minimal which means the planned numbers fall below the other scenarios towards the end of the period.



Non-domestic development scenarios

Non-domestic total floorspace (ha)	Baseline (2019)	2025	2030	2035
Two Degrees	5,825	6,217	6,516	6,658
Community Renewables		6,217	6,516	6,658
Consumer Evolution		6,124	6,390	6,548
Steady Progression		6,025	6,208	6,392
Net Zero		6,217	6,516	6,658



Onshore wind scenarios

SSEN Southern licence area

Baseline

Project size	Capacity (MW)	Number of projects
Under 1 MW	2.2	72
Over 1 MW	9.7	4

Despite the good resource in the licence area, there have been just two medium-scale projects built to date in the SSEN Southern licence area, a 6.5 MW and 2 MW project. There are a two further 500 kW projects connected and 70 small scale sites totalling 2.2 MW. No new sites have been built since 2013.

Pipeline

There is one site with planning permission which is expected to go ahead in all scenarios and this has not changed since 2018. The 9.2 MW Alaska wind farm near Wareham expects to connect four 2.3 MW turbines.

This onshore wind project is looking to share a connection agreement with a planned 20 MW solar farm. The site is expected to connect between 2021 and 2023 depending on the scenario.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*11*				
Two Degrees	11	11	30	54	82
Community Renewables	11	11	31	87	123
Consumer Evolution	11	11	21	33	46
Steady Progression	11	11	20	30	31
Net Zero	11	11	31	87	144

Capacity (MW)	Total increase (2020 - 2035)	Percentage growth
Two Degrees	71	649%
Community Renewables	112	1028%
Consumer Evolution	35	319%
Steady Progression	20	182%
Net Zero	133	1220%

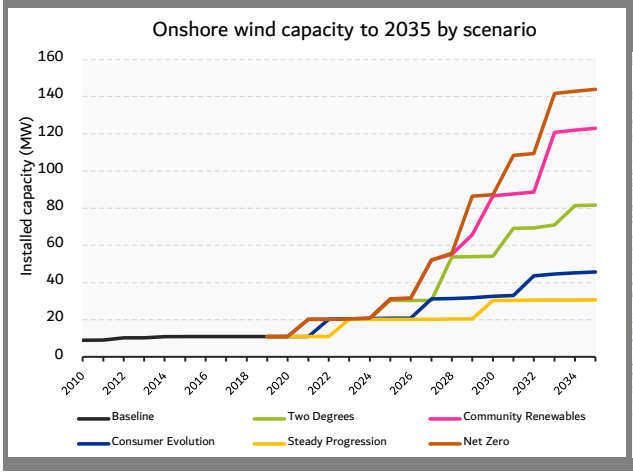
Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
CfD or price support mechanism open to onshore wind	Price support available from early 2020s -weighted towards large-scale projects	Price support available from early 2020s -weighted towards local scale projects	Low price support	No price support	Price support available from early 2020s -weighted towards large scale projects
Planning permission					
Planning environment	Planning environment favours large-scale strategic wind projects	Planning environment and communities supportive of local projects	Planning environment less favourable, although some support for local-led projects	Current prohibitive planning environment continues	Planning environment and communities supportive of local projects
Market and technology factors					
Subsidy free viability and technology improvements	Significant cost reductions in early 2020s. Widespread subsidy free viability in mid-2020s	Significant cost reductions in early 2020s. Widespread subsidy free viability in mid-2020s	Cost reductions impact in mid-2020s. Widespread subsidy free viability in late-2020s	Cost reductions impact in late-2020s. Widespread subsidy free viability in early 2030s	Significant cost reductions in early 2020s. Widespread subsidy free viability in mid-2020s
Repowering	Projects repower after 20 years with 20% increase in capacity	Projects repower after 20 years, with 15% increase in capacity	Projects repower after 25 years with 10% increase in capacity	Projects repower after 30 years with 10% increase in capacity	Projects repower after 20 years with 20% increase in capacity

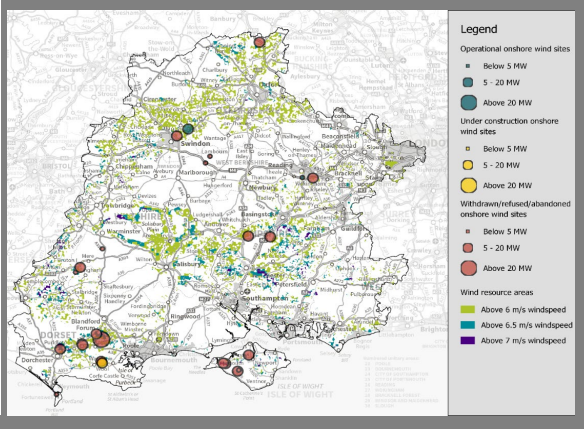
Scenario description
The scenarios all show strong percentage growth as a result of the very low baseline. However with negative planning history in the area, there is not expected to be any large sites built within the time period. In addition to the pipeline, the scenarios project only a few medium-scale sites between 10-20 MW starting to connect from mid-2020s.

In Net Zero the negative planning environment is further outweighed by resource potential in the area and so one additional project is developed ahead of Community Renewables.

Comparison to National Grid Future Energy Scenarios and previous 2018 study
The scenarios are in line with the earlier 2018 study and ahead of regional FES for the licence area in all scenarios. The regional FES does not consider the pipeline site, or where the existing baseline does not well-represent the resource potential.

Distribution
Projections are distributed according to resource and the locations of failed developments (see below). Around 70 MW of applications have been rejected or not progressed over the last ten years.





Other generation scenarios

SSEN Southern licence area

Baseline

Other generation capacity (MW)

Baseline year	Landfill gas	Sewage gas	Geothermal	Unidentified	Total
2015	128	1	7	37	173
2016	129	2	7	38	176
2017	133	2	7	38	180
2018	133	2	7	38	180
2019	133	2	7	38	180

The baseline of 'Other generation' is 180 MW. The largest proportion of generation in this categorgy is landfill gas with 128 MW. In addition, there is 2 MW of sewage gas from two 1 MW sites.

There is one geothermal project, the 7 MW Southampton District Energy Scheme, which connected in 1998.

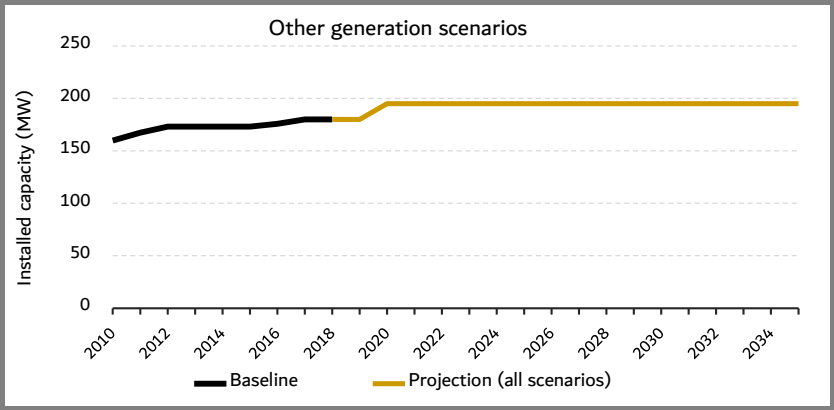
A further 38 MW of projects are unidentified.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)
Landfill gas	2	15

There are two pipeline sites in SSEN's connection data which are both landfill gas connections. The majority of this capacity is from a 14 MW site in BOTLEY WOOD_BSP ESA which is is expected to connect in 2020 in all scenarios.

Scenarios



Scenario description

The 'Other generation' category includes technologies that are not expected to change over the scenario period, or by scenario. It also includes generators where the generation source cannot be identified.

Capacity increases to 195 MW in 2020 as a result of the two pipeline landfill sites in all scenarios.

No further growth in these technologies is projected in any scenario.

Solar PV (<1 MW) scenarios

SSEN Southern licence area

Baseline

Baseline year	Solar PV capacity (MW) <10 kW (domestic)	10 kW - 1 MW (commercial)
2015	224	105
2016	232	116
2017	240	121
2018	248	127
2019	253	131

The baseline of small scale solar in the SSEN Southern licence area is 381 MW.
In the 2018 scenarios, the solar sites were classified by Feed-in-Tariff registration as either commercial or domestic. They are now classified by size in order to be consistent with the Open Networks Building Blocks. This analysis assumes that projects under 10 kW are domestic scale and between 10 kW and 1 MW are commercial and community-scale solar, of which the majority will be rooftop. This difference means the results are not directly comparable to the previous study which had an assumed rooftop baseline of 344 MW.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)
< 10 kW (domestic)	-	-
10 kW - 1 MW (commercial)	17	3.4
Total pipeline	**17**	**3.4**

There are 17 sites totalling 3.4 MW capacity in the pipeline. They had a variety of connection acceptance dates between 2011 and 2019.

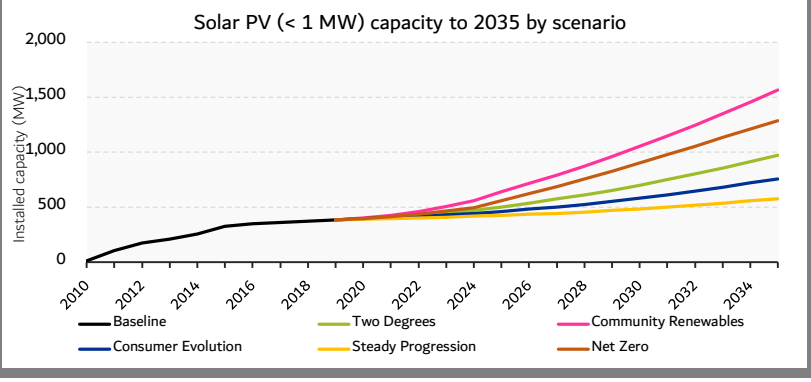
Only five sites with a recent enquiry and acceptance date (totalling 1.3 MW) are assumed to go ahead in all scenarios in 2020.

Scenarios

Solar PV (<1 MW) capacity (MW)	2019	2020	2025	2030	2035
Baseline	*384*				
Two Degrees	384	397	502	698	972
Community Renewables	384	400	638	1,053	1,564
Consumer Evolution	384	395	461	581	759
Steady Progression	384	392	425	484	579
Net Zero	384	398	560	900	1,289

Solar PV (<1 MW) capacity (MW)	Total increase	Percentage growth
	(2020 - 2035)	
Two Degrees	587	153%
Community Renewables	1180	307%
Consumer Evolution	375	98%
Steady Progression	194	51%
Net Zero	905	236%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
Smart Export Guarantee improves investment case	SEG is of marginal benefit for smaller sites and lower electricity users.	SEG provides price support for local scale projects	No price support exposes investors to market risks	No price support exposes investors to market risks	SEG provides sufficient price support for large and medium sites
Social housing support	No support for social housing post 2019	Small support for social housing post 2019	No social housing support post 2019	No social housing support post 2019	No support for social housing post 2019
New housing regulations drive solar PV deployment	Regulations favour larger installations	Carbon targets drives solar PV uptake from early 2020s	Regulations focus on decentralised small-scale installations	No incentives	Carbon targets drives solar PV uptake from early 2020s
Market and technology factors					
Technology cost reductions	Cost reductions slow down	Continued falls through scenario period	Continued falls through scenario period	No further cost reduction	Cost reductions slow down
Rooftop PV and battery flexibility revenue	Domestic benefit from time of use tariff and commercial from flexibility revenue from 2022	Flexibility revenue/savings available from 2022 with electricity storage or EV	Flexibility revenue /savings for commercial and domestic late in period	No flexibility market developed - low battery and EV take up	Flexibility revenue/savings available from 2022 with electricity storage or EV



Scenario description
With current deployment of small scale solar extremely low relative to historic rates, there is high uncertainty about the level of future capacity growth.

Within these scenarios, Community Renewables sees an increase of over 1 GW in the next 15 years, driven by the licence area's relative affluence and irradiance levels compared to the UK more widely. The lowest capacity growth is Steady Progression which only sees a smaller 49% increase over the 15 years.

Comparison to National Grid Future Energy Scenarios and previous 2018 study.
The scenarios are similar to the 2018 study except for Community Renewables, which is below the earlier projections as a result of reduced solar capacity projected in Community Renewables between FES 2018 and FES 2019.

Two Degrees is higher than FES 2019 regional figures. This reflects the licence areas significant potential for medium-scale solar on commercial sites and in new build properties from 2025.

Net Zero is between Community Renewables and Two Degrees, reflecting the need to maximise potential for generation but also the emphasis on centralised power generation in the 2019 Net Zero FES sensitivity.

Distribution
The future capacity of small scale solar PV has been projected separately by retrofit domestic, new domestic and commercial sites. These separate projections for capacity were distributed according to levels of: social housing, new housing, existing housing, affluence and commercial and industrial units respectively.

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Solar PV (>=1 MW) scenarios

SSEN Southern licence area

regen transforming energy

Baseline

Baseline year	Capacity (MW)	Number of new projects
2015	1259	55
2016	1716	39
2017	1750	11
2018	1774	5
2019	1783	2

The baseline of ground mounted solar PV capacity in the licence area accounts for 20% of the total capacity in GB. There are 200 sites currently connected totalling 1,784 MW. The average size is 9 MW.

New solar categories based on size were created for this study and so the numbers are not directly comparable to the 2018 baseline.

Pipeline

Pipeline summary	Total number of projects	Total capacity (MW)	Average capacity (MW)
Small sites (1 - 15 MW)	17	116	7
Large sites (15 MW and over)	23	743	32
Total pipeline	**40**	**859**	**21**

The licence area has a very significant pipeline of large solar projects with 41 projects totalling 856 MW. This has increased by 770 MW since the previous study done in 2018.
The vast majority of sites accepted a connection agreement in 2019. The connection date logic, based on planning status, is detailed below:

Connection date logic
For TD: All sites connect. Those with planning permission connect in the next 2 years.
For CR: All sites connect. Those with planning permission connect in the next 2 years.
For CE: All sites connect. Those with planning permission connect in the next 4 years.
For SP: Only sites with evidence of planning, or a recent connection agreement connect (total = 660 MW).
For NZ: All sites connect. Those with planning permission connect in the next 2 years.

Scenarios

Capacity (MW)	2019	2020	2025	2030	2035
Baseline	*1,783*				
Two Degrees	1,783	1,828	2,604	3,463	**4,118**
Community Renewables	1,783	1,803	2,525	3,238	**3,543**
Consumer Evolution	1,783	1,803	2,100	2,771	**2,881**
Steady Progression	1,783	1,803	1,910	2,382	**2,456**
Net Zero	1,783	1,828	2,534	3,568	**4,583**

Capacity (MW)	Total increase	Percentage growth
	(2020 - 2035)	
Two Degrees	2334	131%
Community Renewables	1759	99%
Consumer Evolution	1097	62%
Steady Progression	673	38%
Net Zero	2799	157%

Growth factors	Two Degrees	Community Renewables	Consumer Evolution	Steady Progression	Net Zero
Government policy and support					
Support mechanism that reduces risk for investors	Support available from early 2020s - weighted towards large-scale projects	Support available from early 2020s -weighted towards local-scale projects	No price support exposes investors to market risks	No price support exposes investors to market risks	Price support available from early 2020s for all scale projects
Planning permission					
Planning environment	Supportive planning environment for large-scale strategic projects only	Supportive planning environment for local projects, as well as high levels of support from the public	Planning environment less favourable, although there is some support for local-led projects	Planning environment does not prioritise decarbonisation and favours large-scale projects	Supportive planning environment for local projects, as well as high levels of support from the public
Market and technology factors					
Cost reductions in technology and installations	Cost reductions support new projects in early 2020s	Cost reductions support new projects in early 2020s	Cost reductions support new projects in mid 2020s	Cost reductions support new projects in late 2020s	Cost reductions support new projects in early 2020s
Electricity price cannibalisation	Price cannibalisation impacts viability towards end of period	Price cannibalisation impacts viability towards end of period	Price cannibalisation impacts viability in late 2020s	Price cannibalisation impacts viability in middle 2020s	Price cannibalisation does not impact capacity increase
Co-location with storage potential due to cost or charging changes	Widely viable co-location model from early 2030s	Widely viable co-location model from mid-2020s	Widely viable co-location model from late 2020s	Widely viable co-location model from late 2020s	Widely viable co-location model from early 2030s

Scenario description
With a very large pipeline, the licence area's large-scale solar capacity is expected to more than double in Two Degrees, Community Renewables and Net Zero. In these scenarios the capacity reaches a total of between 3.5 to 4.5 GW by 2035.

Rate of growth peaks in the mid-2020s before decreasing due to prices of power during high solar periods being eroded. Under Net Zero, however, the growth rate remains high, reflecting the potential for business models which use excess generation during high solar periods, supporting electricity price.

Comparison to National Grid Future Energy Scenarios and the previous 2018 study
The scenarios are consistent with the 2018 study and the highest growth expected in the regional FES projections. However the growth in Steady Progression and Consumer Evolution is higher than regional FES because they reflect the large pipeline.

Distribution
Growth of projects not in the pipeline are distributed by resource availability, planning environment and agricultural land grades.