The Drax Power (Generating Stations) Order

Land at, and in the vicinity of, Drax Power Station, near Selby, North Yorkshire

Written Summary of Drax Power Limited's ("the Applicant") Oral Case put at the Environmental Matters Issue Specific Hearing – 5 December 2018
(Submitted for Deadline 4)

The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(q)

Drax Power Limited

Drax Repower Project

Applicant: DRAX POWER LIMITED
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WRITTEN SUMMARY OF DRAX POWER LIMITED'S ("THE APPLICANT") ORAL CASE PUT AT THE ENVIRONMENTAL MATTERS ISSUE SPECIFIC HEARING – 5 DECEMBER 2018

1. INTRODUCTORY REMARKS

1.1 The Issue Specific Hearing ("**ISH**") regarding Environmental Matters was held at 10:00am on 5 December 2018 at the Goole Leisure Centre, North Street, Goole DN14 5QX.

1.2 The ISH took the form of running through items listed in the agenda published by the Examining Authority ("**ExA**") on 27 November 2018 (the "**Agenda**"). The ISH did not deal with the Agenda items in the order they appear on the Agenda, and the format of this note follows the order in which the items were considered at the ISH. The Applicant's substantive oral submissions commenced at item 2 of the Agenda, therefore this note does not cover item 1 which was procedural and administrative in nature.

2. AGENDA ITEM 2 – INTRODUCTION OF THE PARTICIPANTS

2.1 The ExA: Richard Allen as the lead member of the panel and Menaka Sahai as a panel member.

2.2 The Applicant:

2.2.1 Speaking on behalf of the Applicant: Richard Griffiths (Partner at Pinsent Masons LLP).

2.2.2 Present from the Applicant: Oliver Baybut (Environment and Governance Section Head at Drax Power Limited), Jim Doyle (Environmental Consents Officer at Drax Power Limited), Steve Austin (Drax Repower Technical Manager at Drax Power Limited), Gary Preece (Lead Engineer at Drax Power Limited), and Karl Smyth (Group Head of Policy and Government Relations at Drax Power Limited).

2.2.3 The Applicant's consultants and legal advisors: Alexis Coleman (Senior Associate at Pinsent Masons LLP), Abigail Sweeting (Solicitor at Pinsent Masons LLP), Clare Hennessey (Technical Director, Infrastructure Planning Director at WSP and Project Director for Drax Repower), Lara Peter (Principal Consultant at WSP and Project Manager for Drax Repower), and Dr Chris Taylor (Associate Director at WSP and EIA Lead for Drax Repower).

2.2.4 The Applicant's environmental consultants (listed alongside their relevant environmental topic area):

(a) Gas engineering: Dr Andrew Jackson (Associate at WSP);

(b) Air quality: Bethan Tuckett-Jones (Technical Director, Head of Air Quality at WSP);

(c) Ecology: Philip Davidson (Associate Director at WSP);

(d) Landscape and visual impact: Maritta Boden (Associate at WSP); and

(e) Climate and carbon: James Peet (Principal Consultant at WSP).

2.3 The following parties participated in the ISH:

2.3.1 North Yorkshire County Council ("**NYCC**") and Selby District Council ("**SDC**"): Sarah Morton (Senior Solicitor (Business and Environmental Services)), Michael Reynolds (Senior Policy Officer (Infrastructure)), Julia Casterton (Principal Ecologist), John Wainwright (Principal Landscape Architect), Martin Woolley (independent Landscape Consultant commissioned by NYCC and SDC);

2.3.2 Yorkshire Wildlife Trust ("**YWT**"): Sara Robin, Laura Hobbs;

2.3.3 Environmental Agency ("**EA**"): Chris Gaughan (Regulatory Officer and Combustion Lead for Yorkshire), Steven Glenville (Site Inspector for Drax Power Station), Matthew Wilcock (Sustainable Places);

2.3.4 ClientEarth ("**CE**"): Sam Hunter Jones;

2.3.5 Biofuelwatch ("**BFW**"): Duncan Law;

2.3.6 Julian May; and

2.3.7 Cath Kibbler.

3. AGENDA ITEM 3 – MAIN DISCUSSION POINTS

3.1 Environmental Topic B: The Principle of the Proposed Development and the Effects on Climate Change

Part (i): Whether or not the proposed development is compliant with National Policy Statement (NPS) EN-1

Whether 'need' is a matter before the ExA

3.2 **The ExA** stated that the purpose of the ISH was not to examine the merits of the policies contained within the NPS. The ExA, referring to paragraph 3.1.3 of NPS EN-1 and CE's Written Representation (REP2-002), asked Sam Hunter Jones why CE asserts there is no need for the Proposed Scheme. Mr Hunter Jones confirmed that whilst CE does not seek to challenge the content of EN-1, it disagrees with the interpretation of EN-1 including paragraph 3.1.3. Mr Hunter Jones stated that need is an important consideration and EN-1 sets out the relative need for different technologies. Mr Hunter Jones also referred to paragraph 3.2.3 requiring the Secretary of State ("**SoS**") to take into account the Proposed Scheme's actual contribution to satisfying such need. He asserted that paragraph 3.1.4, with respect to substantial weight, should be read in the context of paragraph 3.2.3. Mr Hunter Jones stated that the ExA needed to take into account the projected need the Proposed Scheme would satisfy, and that it was not appropriate to read paragraph 3.1.3 as referring to schemes or projects when it says "types of infrastructure".

3.3 **The ExA** asked Mr Hunter Jones which part of paragraph 3.2.3 of NPS EN-1 demonstrates that greater weight can be given to this paragraph than to paragraph 3.1.3. Mr Hunter Jones referred to the final two sentences of paragraph 3.2.3, which provide that "*The [SoS] should therefore give substantial weight to considerations of need. The weight which is attributed to considerations of need in any given case should be proportionate to the anticipated extent of a project's actual contribution to satisfying the need for a particular type of infrastructure*."

3.4 **Richard Griffiths** on behalf of the Applicant confirmed that, as per the Applicant's Response to Written Representations (REP3-024), paragraph 3.2.3 of EN-1 is an important paragraph but that it should be read together with paragraphs 3.1.3 and 3.1.4 which provide the over-arching decision making principles. It is unsustainable to suggest, as Mr Hunter Jones appeared to do, that greater weight should be attached to paragraph 3.2.3. Mr Griffiths explained that it is clear that the starting point for assessing the Application is on the basis that the NPS has set out that need has been established and that this should be given substantial weight. Mr Hunter Jones' submission that paragraph 3.1.3 should not be read as referring to schemes or projects when it says "types of infrastructure" is plainly wrong. Paragraph 3.1.3 refers to the assessment of applications for development consent. By their very nature applications are schemes or projects. It follows that the advice is quite clear that the decision maker must decide the application on the basis that need has been demonstrated. Moreover, the contribution the scheme makes to the need must be given substantial weight (paragraph 3.1.4). The precise amount or category of weight (within that floor set of "substantial") is determined on the basis set out in paragraph 3.2.3. The Proposed Scheme is providing 3.8GW of energy (a pillar of EN-1); it provides grid stability (a second pillar of EN-1); and it provides energy in a highly efficient way and so is economical (the third pillar of EN-1).

3.5 **The ExA** asked whether paragraph 3.2.3 of EN-1 should be understood in the context of paragraph 3.1.3. Mr Griffiths confirmed this was correct (as well as paragraph 3.1.4), explaining that the ExA does not need to grapple with whether there is a need; the ExA is told to assume there is a need. What the ExA has to grapple with is the precise amount or category of substantial weight to give to this project's contribution to that need.

3.6 **The ExA** asked, with respect to the proportionality of the substantial weight, where the Applicant had set out what category of substantial weight should be given to the Proposed Scheme. Mr Griffiths explained that this went to the overall scheme benefits which are set out throughout the whole Application; whilst these benefits include the amount of generation, efficiency and providing energy economically, the NPS is also clear that the need is not just about providing more electricity, it is also about grid stability, and the Proposed Scheme also offers essential resilience for the grid. Mr Griffiths confirmed that the Applicant would provide a note at a future deadline to address the proportionality that should be given to the substantial weight.

3.7 **Mr Hunter Jones** asserted that this explanation from the Applicant did not give meaningful context to paragraph 3.2.3. Mr Griffiths responded, stating that it is fundamental to all energy decisions under the Planning Act 2008 ("**PA 2008**") and the NPS, and made clear by EN-1, that the ExA and the SoS is taken to assume that the need is established, and that substantial weight is applied to that need. It is for the decision maker to determine the amount or category of substantial weight to give that need.

3.8 **Duncan Law** from BFW stated that there was too much emphasis on the NPS given its age (taking effect in 2011) and that a possible starting point was the updated energy projections. Mr Law asserted this was in accordance with EN-1 paragraph 3.3.18. Mr Law referred to the Applicant's Response to Written Representations (REP3-024) in which it made a distinction between a statement of need in 2011 and estimates of capacity in 2018. Mr Law asserted that the energy landscape has changed since 2011 and the approach to the Proposed Scheme needs to reflect current energy policy.

3.9 **Mr Griffiths** responded, explaining that EN-1, paragraphs 3.6.1 and 3.6.3 and EN-2, paragraph 1.1.1 state that fossil fuels continue to play a vital role in providing a reliable supply, maintaining security of supply, and providing a flexible supply and therefore play an important role in transitioning to a low carbon economy. This is because, as EN-1 paragraph 3.3.4 states, fossil fuel generation has particular benefits: it can be brought on line quickly when there is high demand and shut down when demand is low, thus complementing generation from nuclear and the intermittent generation from renewables. Fossil fuels, therefore, must be seen as not only providing electricity generation, but also in terms of grid resilience. There is nothing in EN-1 that excludes fossil fuels from the analysis of need. Indeed, the contrary is true – the specific benefits of fossil fuels and its continuing role are identified.

3.10 With respect to Mr Law's comments about the age of the NPS, Mr Griffiths stated that these submissions amount to an attack on the merits of the NPS which is impermissible; the submissions confuse need and projections (see below) and, in any event the Government could have amended the NPS at any time including by prohibiting fossil fuel generation. The Government has not done this. Indeed, the role of fossil fuels identified in EN-1 has been endorsed in more recent Written Ministerial Statements:

(a) 18 November 2015: "*New nuclear and gas will be central to our energy secure future...*" and "*One of the greatest and most cost-effective contributions we can make to emission reductions in electricity is by replacing coal fired power stations with gas*."

(b) 17 May 2018: "*The UK must have safe, secure and affordable supplies of energy with carbon emissions levels that are consistent with the carbon budgets defined in our Climate Change Act and our international obligations. We believe that gas has a key part to play in meeting these objectives both currently and in the future." and "...every scenario proposed by the Committee on Climate Change setting out how the UK could meet its legally binding 2050 emissions reduction target includes demand for natural gas*."

3.11 The above cited Written Ministerial Statements are provided with this summary at **Appendix 1** (2015 statement) and **Appendix 2** (2018 statement).

Whether the NPS treats 'need' and 'demand/projection' independently and differently

3.12 **The ExA** explained that need is a policy response from the Government, and stated that there appeared to be confusion between demand and need. The ExA referred to the table on page 11 of CE's Written Representation ("**WR**") (REP2-002), which is the Department for Business, Energy and Industrial Strategy's ("**BEIS**") 2017 Updated Energy & Emissions Projections ("**UEP**"). The ExA asked for confirmation that CE had submitted this as an update to Table 3.1 of the NPS EN-1. The ExA asked Mr Hunter Jones to talk through the table submitted in its WR.

3.13 **Mr Hunter Jones** stated that in terms of need and demand, the NPS EN-1 gives unabated fossil fuels a low priority. In that context, he said, scenarios showing a viable level of gas on the grid can be treated as being the best available proxy for need. Mr Hunter Jones said the BEIS updated projections were a useful indication of likely anticipated need, and stated that CE did not rely solely on those projections but also on others such as from Sandbag and National Grid scenarios. Mr Hunter Jones stated that EN-1 does not prescribe the approach the decision maker should take to assess need, and stated that the projected need is illustrative.

3.14 **The ExA** asked Mr Hunter Jones why he says greater weight should be given to renewables rather than fossil fuels, given paragraph 3.1.3 of EN-1 and the demonstrated need for all types of fuels. Mr Hunter Jones responded that relative need is a core concept of EN-1, and that whilst EN-1 referred to energy types generally, EN-1 uses words such as “some” with respect to fossil fuel generation, whereas words such as "rapid" and "urgent" were used with respect to renewable sources. Mr Hunter Jones continued, stating that EN-1 refers to the risk of carbon lock in from over supply of fossil fuel generation. He asserted that the concept of relative need runs throughout.

3.15 **The ExA** asked Mr Hunter Jones about the deployment of renewable energy generation and whether it had met Government targets. Mr Hunter Jones stated that the BEIS UEP projected 28GW from renewable sources in 2017, and 40GW had been delivered. The ExA queried these figures as being different from the table set out in CE's WR. Mr Hunter Jones stated that the figures are addressing different aspects of the energy situation; the WR refers to projections for new build, and the figures just given relate to capacity live on the grid.

3.16 **The ExA** again asked Mr Hunter Jones to explain the table on page 11 of CE's WR and to explain what CE concludes from this. Mr Hunter Jones stated that the table shows there is a range of new build gas expected up until 2035, and talked through the National Grid projections, and asserted that the projections in those scenarios should be treated by the decision maker as the maximum need for gas.

3.17 **The ExA** sought clarification on Mr Hunter Jones' position, and Mr Hunter Jones stated CE's view that there is a projection of demand for 6GW for gas generation, which has already been met with new projects, based on 15GW of capacity that has been consented or is in the capacity market. He submitted that the idea that there is need for additional capacity in the planning system is out of step with the National Grid projections. Mr Hunter Jones further submitted that the decision maker has to assume that all consented projects will be built. He stated that the Applicant had to demonstrate that the Proposed Scheme is sufficiently different from the other consented projects.

3.18 **Mr Griffiths** stated that the NPS does not give a low priority to thermal plants. Paragraph 3.1.1 of EN-1 states "*The UK needs all the types of energy infrastructure covered by this NPS in order to achieve energy security at the same time as dramatically reducing greenhouse gas emissions*". Government could have easily established a priority hierarchy. It deliberately chose not to. Whilst paragraph 3.3.15 of EN-1 makes reference to a "particular" need for low carbon energy, ("*there is an urgent need for new (and particularly low carbon) energy NSIPs to be brought forward as soon as possible*"), importantly it ascribes the urgent need to all types of energy NSIP including fossil fuels. It is simply wrong to say that the NPS approaches the need for fossil fuel generation as something other than urgent. There is nothing in the NPS which requires decision makers to give a greater priority or weight to low carbon generation than to fossil fuel generation. EN-1, paragraph 3.1.2 states that the Government "*does not consider it appropriate for planning policy to set targets for or limits on different technologies*", whilst paragraph 3.3.24 states that it is not the planning system's role "*to deliver specific amounts of generating capacity for each technology type*".

3.19 **Mr Griffiths** submitted that there is a clear distinction between need and projected capacity / demand. "Need" arises from the requirement to:

(a) provide energy security and meet carbon reduction objectives (EN-1, paragraphs 3.3.2-3.3.6);

(b) to replace closing existing capacity (EN-1, paragraphs 3.3.7-3.3.9);

(c) to support renewable energy generation (and, for this reason, fossil fuel plants may still have a role even when the sector is almost entirely decarbonised (EN-1, paragraph 3.3.11)) (EN-1, paragraphs 3.3.10-3.3.12); and

(d) to meet future increases in demand (in particular, from the electrification of sectors such as industry, heating and transport) (EN-1, paragraphs 3.3.13-3.3.14).

3.20 "Projected capacity" is a forecast. EN-1 makes it quite clear that these forecasts do not translate into targets. Mr Hunter Jones' submission that the projected capacity for gas should somehow be a maximum need for gas is antithetical to the clear approach in EN-1 that the Government (a) assumes need is demonstrated and (b) declines to set targets or limits for particular types of generation.

3.21 EN-1 also makes it quite clear at paragraph 3.3.18 that "*it is not possible to make an accurate prediction of the size and shape of demand for electricity*" in the future and that "*projections do not reflect a desired or preferred outcome for the Government in relation to the need for additional electricity generating capacity or the types of electricity generating capacity required*."

3.22 This is further supported by the Government's Clean Growth Strategy, October 2017 (the Executive Summary of this strategy and the link to the full strategy is provided at **Appendix 3** to this summary), which states at page 54 that "*we cannot predict the exact technological changes that will help us deliver on the fourth and fifth carbon budgets (and beyond)"* and "*To explore this uncertainty, we test different potential versions of the future based on current knowledge. These are not firm predictions of the future and should not be taken as sectoral targets*."

3.23 EN-1 is clear on the need for a major increase (double or triple) in electricity generation capacity by 2050 in order to enable the switching of industry, transport and building heating to electrical energy which will result in less GHG emissions (paragraph 3.3.14). As set out above, it is not the role of the Government to set targets for or limits on different technologies, nor to deliver specific amounts of generating capacity for each technology type.

3.24 **Mr Griffiths** explained that treating consented capacity as the need having been met has no basis in Government policy, makes no allowance for whether or not there is actual generation on the ground (which in the end is what matters), is inconsistent with an overarching approach that assumes need and with the clear policy approach that leaves to the market the delivery of the necessary infrastructure. Moreover, the Government does not surrender control once consent is granted. It has other controls such as taxation, emissions limits, and the capacity market by which it can control the capacity that is actually brought on line. Again, if the Government had wished decision makers to count consented but un-built capacity as satisfying need, it would have said so. Indeed, it would have had to say so explicitly given that such a position would be inconsistent with the market based approach.

3.25 **Gary Preece**, Lead Engineer from the Applicant, explained what is known as "the Stack", or National Grid's merit order, and how that dictates the sources of energy generation.

3.26 The term 'Stack' in the market sense is applied to the list of available generation, at a point in time. The list is ordered based on the cost of generation (i.e. efficiency). The cost in question is the Short Run Marginal Cost ("**SRMC**") (i.e. the cost of producing the next MWhr ignoring fixed costs such as salaries, business rates, capex etc). There is no published Stack, it is an assumption made by market participants from the fundamentals of generating costs, fuel, carbon emissions and low carbon support, start up or shut down costs. These assumptions, along with observation of how a generating unit is dispatched compared to market price, lead to the assumptions of SRMC.

3.27 In a liquid efficient market the cheapest generator will have an advantage over more expensive generators in potential selling price, and will therefore be dispatched first. The market will buy from multiple generators sufficient volume to meet demand. The most expensive unit bought in that stack is normally referred to as the 'Marginal Generator' and its selling price as the 'Marginal Price'. All generators in the Stack will seek to sell at the Marginal Price.

3.28 Once trading is complete the generators will be dispatched to meet their power sales obligation. If this Stack is not capable of providing the security and balance requirements of the System Operator (which it never is) the System Operator will buy or sell power to achieve what it needs, be that generation/demand balance or ancillary services. The System Operator ("**SO**") will look to purchase these balancing and ancillary services from the cheapest provider and will effectively look at a real time cost Stack to achieve lowest cost. However, the services required from the “SO Stack” (that is, the System Operator Stack, utilised for system services, rather than pure generation capacity) is not based purely on the incremental cost of a MWhr, other generator dynamics and capabilities are equally as important, for example, start time, ramp rates, frequency response, reactive capability. The SO Stack is therefore much more mercurial and can change from one half hour to the next.

3.29 It follows from this that less efficient plants (such as coal and older gas plants) are further down the Stack than renewable plants, which cost less to run and are therefore more efficient. For affordable electricity capacity it is therefore likely that the more efficient (and therefore cheaper) energy producers will be dispatched first, and so as long as the sun is shining and wind blowing, that would be the renewable plants. For the SO Stack, if National Grid requires system services (such as grid stability, transfer requirements etc) it will call on thermal plants, as those plants offer the capabilities referred to above, whereas renewable sources cannot fulfil that role.

3.30 As is explained later in this summary, in the boundary area where Drax power station is located, if there is a high penetration of renewable energy from the north and Scotland, this results in a large security requirement which has to be met from fossil fuel plants in the SO Stack (currently coal and other lower efficiency plants). The current projection of the total transfer requirement (i.e. the energy needed to transmit renewable energy around the system to where it is needed) for the boundary area in which Drax operates is 16GW, hence there are still significant levels of gas generation projected for 2030.

3.31 The Proposed Scheme's efficiency, flexibility to offer enhanced services, and its location would mean it sits high on the SO Stack.

3.32 **Mr Hunter Jones** referred to consented projects being able to be constructed many years after permission was granted, and suggested that by consenting projects based on need, this turned the planning system into a "green light" system. He submitted that the planning system had to consider the merits of projects which may include economic factors and projections.

3.33 **Mr Griffiths** reiterated that the focus was on the category of substantial weight to be given to the actual contribution from the Proposed Scheme to the identified need. As noted above, if the Government had intended for there to be a limit on consented capacity it would have made this clear in the NPS. Moreover, Mr Hunter Jones' approach fails to take into account the market based approach that is at the heart of the Government's policy on energy. Mr Griffiths also noted that the consent for the Proposed Scheme would have to be implemented within 5 years of the Order being made.

3.34 **The ExA** stated that the NPS is not directing the decision maker as to how much fossil fuels should be allowed. The ExA asked Mr Griffiths whether, if there are more consented schemes than meet the projected demand, that is sufficient to reduce the weight in accordance with paragraph 3.2.3 of EN-1. Mr Griffiths confirmed that reliance on consented capacity was not sufficient to reduce the weight under paragraph 3.2.3. He stated that there is no certainty with respect to consented schemes, and it would be wrong to assume that consented capacity automatically translates into constructed capacity. No one can conclude with certainty that by the 2020s / 2030s there will be grid security based on current consented capacity.

3.35 The updated forecasts in the BEIS' UEP published in January 2018 says consented capacity does not preclude additional capacity being built, indeed as EN-1 states at paragraph 3.3.3, the larger the difference between available capacity and demand, the more resilient the system will be, which in turn helps society.

3.36 **Mr Griffiths** went on to explain that the Proposed Scheme would not displace renewable energy (for the reasons explained by Mr Preece and the Stack / merit order), rather it would support and co-exist with renewable energy. The need identified in the NPS is not just about electricity generation, it is also about grid stability. The need for thermal plants, such as the Proposed Scheme, providing grid stability increases or remains stable the more renewables there are on the grid (this is explained in more detail later in this summary with respect to Boundary B7a).

3.37 **Mr Griffiths** continued, explaining that because of the way the Stack operates renewable energy sources are cheaper to run and therefore sit higher on the Stack. Given the efficiency of the Proposed Scheme (due to the technology proposed to be employed and the efficiency gains from re-utilising the cooling towers, and having added features such as open cycle gas turbines ("**OCGT**") and battery storage), and the way the Stack operates, it would only displace less efficient energy sources, which will be older, less efficient thermal plants sitting below it on the Stack.

3.38 **Mr Griffiths** explained that if the Proposed Scheme is not consented, existing Units 5 and 6 potentially have to change by 2025 to meet the lower emissions intensity for coal. This would be met by co-firing. Equally if those units were closed the country loses 1,320MW of generation capacity. The SoS does not want to lose electricity generation and that capacity would still need to be provided somewhere; because of the way the Stack works, lower efficiency, higher carbon plant would remain online if not displaced by the Proposed Scheme.

3.39 **Sara Robin** from YWT asked why 3,800MW was required to replace existing capacity of 1,320MW. Mr Preece from Drax Power Limited explained that a projected increase in renewable energy does not result in decreased demand in thermal generation, because of the security requirements for thermal generation to back up the large penetration of renewables. There would still therefore be a projected demand for fossil fuel generation without the Proposed Scheme, and without the Proposed Scheme that demand would be met by the less efficient, higher carbon intensity plants that the scheme would take over from (as demonstrated above in the explanation of the "Stack" and the "SO Stack").

3.40 **The ExA** asked for clarification, that if there is a high penetration of renewables, demand for plants such as the Proposed Scheme would also increase. Mr Preece confirmed that this was correct and referred to National Grid Future Energy Scenarios 2018[1], which show the predicted energy mix for 2030 (page 96), and for each of the 2030 scenarios show generation from gas as being comparable to or more than currently generated. (The response to the ExA's question is expanded upon further below, in relation to Boundary B7a).

3.41 **Oliver Baybut** from Drax Power Limited, added, with respect to system support services, that whilst all types of energy generation provide capacity, not all types provide system services which is one of the main requirements of the National Grid. In addition to balancing supply and demand in real time, National Grid is responsible for ensuring that the national transmission system is operated within a number of defined technical limits to ensure its safety and stability, and it does this by procuring a number of system services, including:

(a) Frequency response: The national transmission system must maintain a stable system frequency of 50 Hz. Frequency response is an automatic change in generation or demand to counteract changes in system frequency.

(b) Inertia: Inertia determines how quickly frequency will change when there is an imbalance between generation and demand; the greater the inertia on the system, the slower the change in

[1] http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf

frequency. Thermal generators can contribute to inertia and hence support the stability of the grid.

(c) Voltage control: Reactive power (measured in Mvar) is used to control voltage. Generation, demand and network equipment (such as transformers, overhead lines and cables) can either generate or absorb reactive power. These contributions need to be kept in balance to keep the voltage at the right level. Voltage is a local property of the system so requirements vary from one region to another.

(d) Black start: Black start is the service used to restore the system in the unlikely event of a partial or total shut down. To restore power, National Grid needs generation capable of starting up without external power supplies, energising the transmission system and supporting the reconnection of demand – only thermal generation can do this.

3.42 These services are needed to support the higher penetration of renewables, and are being lost as coal comes off line.

3.43 **Julian May** submitted that he did not agree thermal plants are needed for inertia and rapid response, and referred to other technologies which he considered could provide those system services, such as wind turbines. Mr Hunter Jones supported Mr May's submission and referred to a report from Vivid Economics and Imperial College London that explains this. Mr Hunter Jones submitted that the Applicant needed to say what it thinks the reasonable / minimum capacity needed on the grid will be by 2030 to provide those system services.

3.44 **Mr Preece** explained that inertia was just one of the system requirements for the grid to run safely and efficiently. Mr Preece further explained that the current rate of change of frequency is set at 0.25Hz/sec, the requirement to maintain this value is 135GWs of which 70% comes from large generation (which means it must be synchronous generation such as from gas, coal or nuclear, above 100MW), this can be somewhere in the region of 24 generating units, even in summer when demand is low.

3.45 **Mr Preece** explained that in order to assess and understand existing and future constraints and requirements across the national electricity transmission, National Grid as the Electricity System Operator has divided the UK into a number of regional 'boundaries'. Across the North of England there are three transmission regions including Boundary B7a (in which Drax Power Station is located). At times of high wind generation the power flow will mostly be from north to south, with power coming from both internal boundary generation and generation further north in Scotland. When most of this area and Scotland is generating power from renewables, transmission capability (i.e. the capability to transfer electricity safely, efficiently and therefore economically from the renewable plant where it is generated to where it is needed) can be very limited, as those transfer requirements are required to be met by fossil fuel generation (such as the Proposed Scheme) rather than renewables, in order to provide large values of reactive power, inertia and short circuit infeed for system stability. Furthermore, in the future a large amount of onshore and offshore wind connecting north of Boundary B7a will mean a continued requirement for reactive power, short circuit infeed and inertia in order to provide safe and efficient transfer of power. Given the large degree of wind capacity feeding in to Boundary B7a, it also has an important security requirement to ensure demand can still be met when the intermittent generation is not operational.

3.46 Boundary B7a also manages and contributes to power flows from south to north, when output from wind and solar generation in the north drops and electricity needs to be transferred northwards to address the shortfall. In the future, this transfer requirement will continue to grow as aging nuclear power stations and gas-fired power stations in the north are decommissioned.

3.47 As identified in National Grid's Ten Year Statement (a link to which is provided in **Appendix 4**, alongside a copy of Chapter 3 of the Ten Year Statement which is most relevant in relation to the Boundary B7a requirements), there is a security requirement for Boundary B7a to maintain short circuit levels and inertia. Larger and more efficient flexible plant can maintain higher levels of inertia and short circuit infeed to assist in system security. Wind and solar generation do not contribute to inertia as they are decoupled from the transmission system. Chapter 3 of the Ten Year Statement in particular sets out the requirements for each boundary area including Boundary B7a. For Boundary B7a the Ten Year Statement shows an increase in the security requirements and transfer capability for a high renewable penetration in a two degrees scenario (that is, the scenario to meet UK carbon budgets). The security requirements are to offset South to North power flows that would be normally covered by intermittent wind generation in the North, whilst maintaining the regional demand requirements. As set out above, those security requirements and ensuring stability on the net, are services that cannot be provided by renewables, and the demand for such requirements will give rise to the need for more efficient flexible thermal plants to cover the intermittency of renewables ("security required for transfer"). This will also result in additional requirements for reactive power (i.e. from thermal plants) promoting efficient power flows during volatile periods as they differ from summer to winter, and those plants will also add to inertia to arrest frequency deviations (System Concern) and short circuit infeed for system security (Local).

Part (ii): The tests of s104 of the Planning Act 2008

Whether the proposed development contravenes international obligations and any other enactment in respect to the Climate Change Act 2008 and the Paris Climate Agreement 2015 (S104(4) and (5))

3.48 **The ExA** asked Mr Hunter Jones which international obligations he considered the Proposed Scheme is in breach of.

3.49 **Mr Hunter Jones** referred to Article 2(1)(a) of the Paris Agreement and made submissions in relation to the temperature limits committed to under the Paris Agreement, and stated that EN-1 was designated under the previous United Nations climate change regime which referred to limiting warming to two degrees, whereas the Paris Agreement is more ambitious and limits warming to "well below two degrees".

3.50 **Mr Griffiths** queried whether CE's position is that the NPS is in breach of the Paris Agreement. The ExA asked Mr Hunter Jones whether CE's position is that the Proposed Scheme breaches international obligations.

3.51 **Mr Hunter Jones'** response was that CE is not seeking to challenge EN-1, but section 104 provides a route to not apply EN-1. Mr Hunter Jones made further submissions in response to the ExA's questioning about whether the Proposed Scheme would be in breach of the Paris Agreement or other international obligations.

3.52 **Mr Griffiths** requested that Mr Hunter Jones put these legal submissions in writing so that they can be considered further by the ExA and the Applicant, as it was not clear what Mr Hunter Jones was inviting the ExA to do in this respect. Mr Griffiths submitted that it is not possible to conclude that the Proposed Scheme would bring the UK in breach of obligations relating to global and UK-wide emissions. The Proposed Scheme will increase greenhouse gas ("**GHG**") emissions directly, but it will also result in reductions in GHG emissions indirectly both due to displacing less efficient, higher carbon intensity plants, and by facilitating improvements in other sectors. By supplying new electricity generation from gas rather than coal, by providing security of supply, by offering fast and flexible generation through battery and OCGT technology, the Proposed Scheme will help other sectors to switch to electrification. That benefit has to be taken into account. It is not as simple as saying this one project will produce x amount of GHG emissions, when it will enable other areas to reduce GHG emissions that would otherwise not be able to achieve reductions due to a lack of installed capacity, lack of flexibility or lack of security of supply.

3.53 EN-1 is clear on the need for an increase in electricity generation to enable other sectors to switch to electrification, which will result in fewer GHG emissions. That switch will help enable the UK to meet its legally binding climate change targets, and fossil fuel generation is therefore part of the Government's approach to meeting such obligations. There is no basis for saying the Proposed Scheme would bring the UK in breach of those obligations.

3.54 **Mr Griffiths** submitted that this was an issue that cannot be approached on a sectoral basis, as it relates more broadly on a global basis. The NPS was devised to help the UK meet the climate change act and to meet the carbon budget; EN-1 expressly deals with climate change and the road to 2050. The Proposed Scheme meets those policy requirements, and will therefore not contravene the UK's international obligations and other enactments.

3.55 **James Peet,** Principal Consultant at WSP on behalf of the Applicant, confirmed that it was difficult to conclude than an individual project would result in an international breach. This is because international commitments, similar to the carbon budgets, are set at an economy wide level. The emissions from any individual project are very small compared to the entire economy, and therefore breaches by the entire economy cannot be blamed on an individual project. As such, the method for decarbonising the entire economy (which is what is required) is by the application of Government policy designed to bring about compliance. This issue is why NPS EN-1 does not require individual projects to be compared to the carbon budgets but at the same time sets out energy policy in the context of climate change obligations. In addition, this issue is recognised amongst EIA / GHG practitioners, as there are no agreed significance thresholds for GHG emissions. This is because it is not possible to conclude that an individual project will result in an international breach. If the Government felt any need to amend NPS EN-1 in light of the Paris Agreement it could have.

3.56 **Mr Griffiths** submitted that paragraph 5.2.2 of the NPS EN-1 makes clear the role of the decision maker and the planning system, given the range of non-planning policies aimed at decarbonising electricity generation, such as the EU Emissions Trading System (EU ETS). Paragraph 5.2.2 provides:

"*CO2 emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). However, given the characteristics of these and other technologies, as noted in Part 3 of this NPS, and the range of non-planning policies aimed at decarbonising electricity generation such as EU ETS (see Section 2.2 above), Government has determined that CO2 emissions are not reasons to prohibit the consenting of projects which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy NPSs (e.g. the CCR and, for coal, CCS requirements). Any ES on air emissions will include an assessment of CO2 emissions, but the policies set out in Section 2, including the EU ETS, apply to these emissions. The [SoS] does not, therefore need to assess individual applications in terms of carbon emissions against carbon budgets and this section does not address CO2 emissions or any Emissions Performance Standard that may apply to plant.*"

3.57 **Mr Griffiths** stated that it was important to recognise that paragraph 5.2.2 and the NPS more generally was crafted on the basis of increasing electricity generation to decarbonise other sectors to meet the carbon budget. The NPS, or a subsequent Written Ministerial Statement, could have prohibited new thermal plants, however thermal plants are needed for the various reasons already given in relation to providing more efficient and affordable thermal generation capacity, and also for the system services provided. Thermal plants are part of the mix to help meet the climate change targets. Mr Griffiths confirmed that the meaning of paragraph 5.2.2 was that the SoS does not need to assess an individual plant against the carbon budget.

3.58 **Mr Law** of BFW referred to a report from the Intergovernmental Panel on Climate Change (IPCC), prepared in the context of the 1.5 degree increase the Paris Agreement strives for. Mr Law's submission was that it would be difficult to say that a plant that will add carbon to the atmosphere will help get to zero carbon by 2050.

3.59 **Mr Preece** explained (as set out earlier in this summary) that there is a National Grid security requirement needed to rapidly deploy renewable energy. As increased renewable generation needs reliance on the system. Mr Preece explained that to reach the National Grid two degrees targets, thermal power plants would be needed to enable more renewables to run in the area, and they would need to be more efficient than the plants currently operating. In response to a question from the ExA, Mr Preece explained that wind and solar are intermittent and are therefore not considered secure. Security of supply happens where there is a consistent supply of energy. This is based on National Grid's statement of security (National Grid's Ten Year Statement, page 61 (see **Appendix 4**)). Mr Hunter Jones' approach is to focus on the proposed plant alone and to give no consideration as to the indirect impacts of that plant. That is not, as already explained, the approach taken to climate change targets.

3.60 **Mr Hunter Jones** stated that in National Grid's two degrees scenarios (projections as to how the UK’s 2050 decarbonisation target could be achieved), there is a reduction in gas capacity. Mr Hunter Jones also commented that the Applicant needs to indicate what it considers the future minimum thermal capacity requirement for system services would be.

3.61 **Mr Preece** responded, explaining that there are forecasts for the transfer requirements in Drax's area (Boundary B7a, as explained above) only. For 2030 the forecasted transfer requirement is for 13GW up to 17GW in Boundary B7a (National Grid's Ten Year Statement, page 61 (see **Appendix 4**)). There would then be a security requirement to meet, and that is dependent upon how many renewables actually come on stream. Mr Preece noted that these figures are just forecasted projections.

3.62 **Cath Kibbler** asked for an explanation of technical terminology used such as the Stack, boundary and transfer requirements.

3.63 **Mr Preece** explained that the "Stack" is essentially a list of power plants in merit order based on their efficiency, and the Proposed Scheme would sit in that Stack. Its position in the stack would be based on its efficiency and how much it costs to dispatch energy, so it follows that less efficient plants (such as coal and older gas plants) would sit below it (and therefore be displaced or pushed further down the stack by the Proposed Scheme), and renewable plants, which cost less to run and are therefore more efficient, would sit above it (which is why the Proposed Scheme would not displace or block renewable plants coming forward). The stack is run by the System Operator (National Grid) to dispatch power plants on the list as it requires them. For affordable electricity capacity it is therefore likely that the more efficient (and therefore cheaper) energy producers will be dispatched first, and so as long as the sun is shining and wind blowing, that would be the renewable plants. For the SO Stack, if National Grid requires system services (such as grid stability, transfer requirements etc) it will call on thermal plants, as those plants offer the capabilities referred to above, whereas renewable sources cannot fulfil that role. (A more detailed explanation is provided earlier in this summary)

3.64 **Mr Preece** explained that National Grid has split the UK into boundary areas (as explained earlier in this note in relation to Boundary B7a, where Drax is located). National Grid's Ten Year Statement (a link to which is provided in **Appendix 4**, alongside a copy of Chapter 3 of the Ten Year Statement which is most relevant in relation to the Boundary B7a requirements) forecasts the requirements for each boundary area, and also determines the security requirements for each boundary area for when the renewables within or feeding into each boundary are intermittent.

3.65 The Applicant intends to explain these concepts in more detail in the paper referred to earlier in this summary, which it will submit at a future deadline.

3.66 **The ExA** asked Ms Robin on behalf of YWT about YWT's Response to the ExA's Written Questions (REP2-046), and how YWT considers the Proposed Scheme does not comply with the Climate Change Act. Ms Robin submitted that if there is a new and large plant it could be in contravention of the Climate Change Act. The ExA clarified whether Ms Robin meant it would be in contravention of the overall aims of the Act, and asked whether it was possible for the SoS to come to a view that the Proposed Scheme would put the UK in breach of its international obligations and any other enactments given the compliance date is 2050. Ms Robin responded that a slow and steady decrease in emissions was needed, and if the Proposed Scheme is part of the energy mix until 2050 it could make it harder for capital to be deployed into much lower carbon technologies.

3.67 **Mr Griffiths** submitted that there was no evidence that this plant would displace capital going into renewables. Thermal plant complements renewables, and the operational cost of renewables will be cheaper and therefore more efficient (meaning they would be higher on the "Stack", and not displaced by thermal plants lower down the Stack). Mr Griffiths referred to his earlier response on the point about being in contravention of any climate change obligations.

3.68 **Mr Law** referred to the Committee on Climate Change and that increasing generation capacity makes hitting carbon budgets harder. Mr Hunter Jones made a reference to needing clean low carbon power by 2050 in the Clean Growth Strategy. Mr Griffiths referred to recent policy documents including the Government's Clean Growth Strategy and the 2015 and 2018 Written Ministerial Statements already cited, which support the policies in the NPS.

An assessment against s104(7) of the PA208

Assessment of adverse impacts, and in particular a focus on whether or not the baseline scenarios as used in the ES in respect of provision elsewhere, and an emissions intensity of 450g/CO2/kWh are misleading; and concerns regarding the cumulative and transboundary effects

3.69 **The ExA** noted that other parties had raised points about the Applicant's baseline data for its climate assessment being inaccurate.

3.70 **Mr Hunter Jones** submitted that the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ("**EIA Regulations**") required an assessment against a future baseline based on the likely evolution of circumstances, and made various assertions about the assumptions relied upon by the Applicant's future baseline scenarios. Mr Hunter Jones submitted that the Applicant had created the false impression that the output from the Proposed Scheme was not capable of being provided by other (renewable) generation. He asserted that average emissions intensity was the more appropriate figure to use for the future baseline.

3.71 **The ExA** sought clarification as to whether Mr Hunter Jones was seeking to question the figures set out for the baseline in Table 15-15 of Chapter 15 of the Applicant's ES (APP-083) or just the emissions intensity. Mr Hunter Jones responded that the emissions intensity also affects the figures in Table 15-15. He asserted that if the emissions intensity used was at a credible level, the absolute emissions impact should be significantly worse.

3.72 **The ExA** asked if it was Mr Hunter Jones' intention to produce his own figures for Table 15-15. Mr Hunter Jones said he would look at procuring such figures. Mr Griffiths asked if this further evidence could be submitted for Deadline 5 to give the Applicant an opportunity to respond. Mr Hunter Jones could not commit to this but undertook (in response to a request from the ExA) to provide an update at Deadline 4 as to when such figures would be available.

3.73 **Mr Peet,** on behalf of the Applicant, stated that the difference in opinion comes down to what will be displaced by the Proposed Scheme, which relates to the need for fossil fuel generation already discussed, and the way in which the 'Stack' operates (as also explained earlier in this summary). Mr Peet explained that the most appropriate baseline is the emissions intensity that would be used without the Proposed Scheme. The Proposed Scheme will provide generation capacity, but also system services, in particular security of supply. The position of the Proposed Scheme in the Stack and the way the SO Stack operates means that it would run, not instead of renewables on the system, but in place of other fossil fuel plants on the system which are less efficient at providing generation capacity or system services. The services provided by the Proposed Scheme could only be provided, in the absence of the scheme, by other plant on the Stack (i.e. fossil fuel plant).

3.74 The average emissions intensity for one year is an average of both renewables and fossil fuel plants on the system; this does not represent a realistic alternate scenario of plant that would operate in the absence of the Proposed Scheme. The capacity otherwise produced by the Proposed Scheme would be produced by less efficient sources (i.e. plant that are below where the Proposed Scheme would sit on the Stack).

3.75 **Mr Peet** explained that the 450gCO2/kWh comes from three different counterfactual scenarios, or three different baselines, to get the same emissions intensity, regardless of the scenario / baseline:

(a) Co-firing with biomass – Co-firing is a proven method that Drax has utilised previously, and a 4:3 ratio would achieve 450gCO2/kWh. The Applicant would require no further consents in order to co-fire, as it could achieve this utilising its existing permitted development rights and under its existing Environmental Permit. Further it is reasonable to assume that co-firing will remain economically viable;

(b) Carbon capture storage (CCS) – Whilst not currently feasible, given the policy drive from Government and the Applicant's proactive role in driving innovation with respect to CCS, it is not an unreasonable position to assume that CCS could play a role in the future. There is the potential for co-firing to evolve so that the power station is more dependent on CCS as that technology becomes viable. CCS could help achieve the same emission intensity of 450gCO2/kWh; and

(c) Displaces other plant of the same or higher emissions intensity – if Units 5 & 6 were to be decommissioned instead of continuing in operation, the 450gCO2/kWh figure is still a reasonable assumption, as there would continue to be a need for system services, which cannot be provided by renewables, particularly in the area in which Drax operates. If the Proposed Scheme did not go ahead, those system services would have to be provided by other fossil fuel plant on the grid (as they are the only types of plant that can provide the required system services). As explained previously, because the Proposed Scheme would be more efficient than existing fossil fuel plants, it would sit at the top of the Stack (in terms of fossil fuel plant), and displace lower efficiency plant lower down the Stack. The reason for this is that the schemes with lower fuel costs (efficient plant) out compete the projects with higher fuel cost (inefficient plant). This means that as the wholesale cost of electricity rises in line with demand, projects become economical to run starting with renewables, followed by efficient fossil fuel plant finishing with inefficient fossil fuel plant. This means that the Scheme does not displace renewables, and without the Scheme, more inefficient fossil fuel plant would run. The 450gCO2/kWh figure has been used for two reasons in this context. First, in the BEIS document that outlines the 450gCO2/kWh thresholds for coal plant (*implementing the end of unabated coal by 2025*), it is stated that the 450gCO2/kWh is broadly the emissions intensity of an unabated gas generator. Secondly, the most efficient fossil fuel plant on the grid is Combined Cycle Gas Turbine Plant (CCGT). In 2017 the average efficiency of this plant as presented in spreadsheet 5.10 of the UK government's energy statistics (DUKES), as 48.7%. This number excludes the most inefficient types of fossil fuel generation such as reciprocating engines, and is an average of all CCGTs, and as such is likely to be a higher efficiency than the plant that the Proposed Scheme would displace. None the less, if this efficiency is used to calculate the carbon intensity of this plant, using the same method as presented in the ES, this results in an emissions intensity of 480gCO2/kWh, as such 450gCO2/kWh should be considered conservative.

3.76 **The ExA** referred to a scenario (as suggested by CE) where Units 5 and 6 close and that capacity is not met elsewhere by less efficient plant, and asked that by not assessing that scenario it could be said that the Applicant has not assessed the worst case. The ExA suggested that the approach taken has assessed the best case scenario, and asked the Applicant whether that alternate baseline should have been assessed in the ES. Mr Peet responded that he did not agree that it was reasonable or realistic to assume that the capacity and system services otherwise provided by the scheme would (1) be provided by renewables, (2) be provided by plant as efficient as the Proposed Scheme, or (3) be provided by plant more efficient than the Proposed Scheme. The requirement is for the baseline to be reasonable or realistic. It is not reasonable or realistic to assume no capacity would be required in place of the Proposed Scheme, as the UK requires additional capacity as outlined in NPS EN-1. It is not reasonable or realistic to assume renewables would operate in place of the Proposed Scheme because as previously described, renewables cannot provide the same system services as the scheme. The plant currently providing grid stability and security are not renewables, and are coal and old gas plant with a higher emissions intensity (at present above 450gCO2/kWh in many cases); taking this and future changes to emissions limits into account, as well as the high efficiency of the Proposed Scheme due in part to the reuse of existing assets (in particular the cooling towers), it is not realistic to assume that plant as efficient as, or more efficient than, the Proposed Scheme, would operate in place of the Proposed Scheme. Therefore, given the way that the plant has been designed to maximise efficiency, its specific role in addressing grid stability and the way National Grid operates via the SO Stack (explained above), a baseline where the electricity and services required without the Proposed Scheme, come from renewables, or plant as efficient, or more efficient than the scheme, is not a reasonable or realistic worse case baseline. As required, the approach in the ES assessment was to take a realistic worse case baseline. As outlined previously, the plant that the Proposed Scheme is expected to displace has an intensity that is likely to be above 480gCO2/kWh. As such 450gCO2/kWh is considered to be a realistic worst case baseline.

3.77 **Mr Hunter Jones** stated that the ES assumes a load factor of 100%. Mr Hunter Jones states that the Applicant was correct in stating that there may be higher, less efficient generation to replace the Proposed Scheme, however, he asserted that such plant was highly unlikely to displace all of the capacity generated by the Proposed Scheme (making reference to the closure of various coal power stations), and that some of those system services could be undertaken by batteries, interconnectors, diesel generators etc. Mr Preece responded, confirming that Aberthaw, Ratcliffe and West Burton coal plants are still operational, contrary to statements made by Mr Hunter Jones. Mr Preece further explained that to meet National Grid's requirement for system services with batteries would be very difficult due to the amount of generation required and the sheer size of battery required as a result.

3.78 **Mr Preece** also addressed an earlier comment from Mr Hunter Jones that the UK could have 85% renewables by 2032, stating that to do so 81GW of wind generation would be required, and currently there is 13GW built, 13GW consented and 13GW seeking approval. Mr Preece stated that coal power stations, including Cottam and West Burton, are currently operating, including throughout the summer to meet the current generation need.

3.79 In order to demonstrate the current reliance on coal plants (and that the coal plants referred to by Mr Hunter Jones are in fact still operational), the Applicant has produced below the output from the inertia model, taken from the BMRU (Trading) database for 5 December 2018[2], showing the coal plants dispatched ("PN'd") on that day (see column "J", third from the right), including West Burton and Cottam.

Total System Inertia Model (Revision 7)

	Station Name	BMU Code	Distribution Zone	System Zone	Station Type	Number of Generators	Inertia Per Generating Unit (MWs/MVA)	Inertia (GWs)	Maximum Generation (MW)	PN'd Inertia	BOA'd Inertia
192	Drax	T_DRAXX-4	3	8	Coal	1	3.79	2.88	645.00	600.00	
193	Drax	T_DRAXX-5	3	8	Coal	1	3.79	2.88	645.00	645.00	
194	Drax	T_DRAXX-6	3	8	Coal	1	3.79	2.88	645.00	0.00	
195	Keadby	T_KEAD-1	3	8	CCGT/CHP	1	5.71	5.11	760.00	731.00	
196	Brigg	E_BRGG-1	3	8	CCGT/CHP	1	6.49	0.00	0.00	0.00	
197	West Burton A	T_WBUPS-1	9	10	Coal	1	3.50	1.99	483.00	480.00	
198	West Burton A	T_WBUPS-2	9	10	Coal	1	3.50	2.07	503.00	0.00	130.00
199	West Burton A	T_WBUPS-3	9	10	Coal	1	3.50	2.07	503.00	0.00	
200	West Burton A	T_WBUPS-4	9	10	Coal	1	3.50	1.99	483.00	0.00	
201	West Burton B	T_WBURB-1	9	10	CCGT	1	7.81	3.95	430.00	423.00	
202	West Burton B	T_WBURB-2	9	10	CCGT	1	7.81	3.95	430.00	428.00	
203	West Burton B	T_WBURB-3	9	10	CCGT	1	7.81	3.95	430.00	85.00	
204	Cottam	T_COTPS-1	9	10	Coal	1	3.50	2.05	497.00	0.00	
205	Cottam	T_COTPS-2	9	10	Coal	1	3.50	2.09	507.00	500.00	
206	Cottam	T_COTPS-3	9	10	Coal	1	3.50	2.09	507.00	0.00	
207	Cottam	T_COTPS-4	9	10	Coal	1	3.50	2.05	497.00	0.00	
208	Cottam Development	T_CDCL-1	9	10	CCGT/CHP	1	5.55	2.61	400.00	417.00	
209	Staythorpe	T_STAY-1	9	10		1	7.81	3.99	433.75	424.00	
210	Staythorpe	T_STAY-2	9	10		1	7.81	3.99	433.75	419.00	
211	Staythorpe	T_STAY-3	9	10		1	7.81	3.99	433.75	425.00	
212	Staythorpe	T_STAY-4	9	10		1	7.81	3.99	433.75	428.00	
213	CDCL	?	?		CCGT/CHP			0.00			
214	Saltend	T_SCCL-1	3	8	CCGT/CHP	1	5.71	2.69	400.00	391.00	
215	Saltend	T_SCCL-2	3	8	CCGT/CHP	1	5.71	2.69	400.00	379.00	
216	Saltend	T_SCCL-3	3	8	CCGT/CHP	1	5.71	2.69	400.00	395.00	
217	Killingholme	T_KILNS	3	8	CCGT/CHP	1	5.71	4.57	680.00		
218	Killingholme(EON)	T_KILNS-1	3	8	CCGT/CHP	1	5.46	2.18	340.00	0.00	
219	Killingholme(EON)	T_KILNS-2	3	8	CCGT/CHP	1	5.46	2.18	340.00		
220	Immingham	T_HUMR-1	3	8	CCGT/CHP	1	7.79	10.81	1180.00	1085.00	
221	South Humber Bnk(1)	T_SHBA-1	3	8	CCGT/CHP	1	7.70	7.17	792.00	796.00	
222	South Humber Bnk(2)	T_SHBA-2	3	8	CCGT/CHP	1	5.71	3.55	528.00	533.00	
223	Westermost Rough	T_WTMSD-1			Wind			0.00	210.00		
224	Humber Gateway				Wind			0.00	219.00		
225											
226	Rugeley	T_RUGPS-1	9	11	Coal	1	3.50	2.05	498.00		
227	Rugeley	T_RUGPS-2	9	11	Coal	1	3.50	2.05	498.00		
228	Ironbridge	T_IRNPS-1	9	11	Coal	1	3.50	2.00	485.00		
229	Ironbridge	T_IRNPS-2	9	11	Coal	1	3.50	2.00	485.00		
230	Derwent	E_DERW-1			CCGT/CHP			0.00	214.00		
231	Ratcliffe-on-Soar	T_RATS-1	9	11	Coal	1	3.50	2.06	500.00	500.00	
232	Ratcliffe-on-Soar	T_RATS-2	9	11	Coal	1	3.50	2.06	500.00	500.00	
233	Ratcliffe-on-Soar	T_RATS-3	9	11	Coal	1	3.50	2.06	500.00	490.00	
234	Ratcliffe-on-Soar	T_RATS-4	9	11	Coal	1	3.50	2.06	500.00	500.00	

3.80 With respect to the 100% load factor point made by Mr Hunter Jones, the Applicant notes that, as outlined above, the 450gCO2/kWh figure is a credible conservative baseline. This is because the design of the Proposed Scheme and the way National Grid operates means we know the type of plant the scheme will displace. However, we do not know the amount of time the Scheme will run. This will depend on how often the scheme's services are required by the National Grid. This, amongst other factors, will depend on the weather. As such we do not know how often the plant will run, so

[2] Note, the highlighting in the database has no meaning – it is just the way the spreadsheet is produced.

we have assumed that it will run at a load factor of 100% as a worst-case scenario, which overestimates the absolute emissions from the Scheme.

3.81 **The ExA** referred to Mr Hunter Jones' assertion that the average emissions intensity figure should be utilised for the scenario where the provision of capacity is provided elsewhere (i.e. other than by Drax power station). Mr Peet responded, explaining that because of the economics of how the Stack works, we know that the capacity would be taken up by older / less efficient gas plants (i.e. because National Grid would only come to the Proposed Scheme when other plants higher up the Stack were unavailable). Mr Peet submitted that it is not a credible baseline to assume the Proposed Scheme would be displacing the renewables at the top of the Stack (and that those renewables would therefore take up the capacity if not for the Proposed Scheme).

3.82 **Mr Hunter Jones** suggested that thermal generation can be displaced by a range of generation, including renewables. Mr Preece stated that large thermal plant cannot be replaced by other technologies, such as battery. National Grid's Future Energy Scenarios show increasing levels of battery storage. However those scenarios still include gas generation. If battery storage were to be relied upon to provide back up generation for high proportions of wind and solar generation, the scale of batteries would be significant. For example, 17-30GW of battery would need to have storage capacity in the TerraWatt hours (because the longer the battery stores electricity, the higher the MWh/TWh) to provide energy for periods when intermittent renewables are not generating. By way of example, in 2018 there was three weeks of low wind during which renewables only contributed to 10% of generation, in that scenario, if back up generation during that period was reliant on battery storage battery capacity would be needed at a TerraWatt hours level which requires vast amount of physical storage and is neither financially viable nor efficient.

An assessment of the benefits of the proposed development

3.83 **Mr Griffiths**, in response to a question from the ExA, briefly outlined the benefits of the Proposed Scheme as follows:

(a) Generation benefits (as already set out above), being generation capacity, affordability, efficiency and displacing less efficient and higher carbon intensity generation, system services including grid stability and security of supply, supporting decarbonisation of other sectors; and

(b) Non-generation benefits, being:

(i) Societal and wider economic benefits due to grid stability (see NPS EN-1 paragraph 2.2.27);

(ii) The use of existing operational land - this minimises the use of greenfield land and compulsory acquisition of existing farm land. This also means there are fewer environmental impacts during construction and operation than a new power station might have on previously undeveloped land, or on land that does not have an existing electricity generating use;

(iii) The use of existing infrastructure - the re-utilisation of as much existing infrastructure as possible (such as the existing cooling systems, cooling towers (which are more efficient than any alternatives that could be newly constructed elsewhere) and steam turbines at Drax Power Station) avoids such infrastructure potentially becoming redundant despite remaining within its operating life and being capable of contributing to more efficient energy production and a lower carbon footprint (given it is already constructed);

(iv) Support to the local economy by providing significant employment opportunities during the construction works, which would generate approximately direct 1,200 full-time equivalent (FTE) / jobs per year as well as approximately 600 FTE indirect and induced jobs; and

(v) Net gain for biodiversity for area based habitats (5%) and linear habitats (6%) following implementation of a Landscape and Biodiversity Strategy (see Outline Landscape and Biodiversity Strategy REP2-026, and Biodiversity Net Gain Assessment REP2-023). Following construction, measures in the Landscape and Biodiversity Strategy would aim to deliver a further gain for biodiversity of habitats by restoring these within the footprint of the Proposed Scheme where possible.

Part (iii): Whether Carbon Capture Storage should be considered as a mitigation measure

3.84 **The ExA** asked the Applicant to set out its position on CCS and respond to the suggestion made by CE that it should be installed at the outset of the Proposed Scheme's operation, as mitigation.

3.85 **Mr Griffiths** submitted that CCS is not being proposed as part of the Proposed Scheme. It is not for CE to seek to amend the application. As CCS forms no part of the development, it cannot be mitigation. However, the Proposed Scheme is CCR – Carbon Capture Ready. CCR is a policy requirement set out in EN-1 paragraph 3.6.6, and EN-2, paragraph 2.3.4 and 2.3.5 - a new fossil fuel generating station above 300MW can only be consented if it is CCR. Mr Griffiths stated that the Government is therefore planning for the future through this policy requirement. The energy NPSs set out the urgent need for gas fired generating stations, but ensured that such plants will be CCR. This means that the Proposed Scheme will be able to deploy CCS when it becomes feasible to do so and subject to obtaining any necessary consents required at the time, and at that point CCS would be mitigating Units X and Y. No weight can therefore be applied to this "future mitigation" as you have no absolute certainty in the consent that it will come forward, which is what is required for "mitigation." However, the Government, having ensured that this proposal and other plants like it will be CCR, can, when the technology is commercially available, require its use by, for example, lowering emissions levels for certain types of plant.

3.86 **The ExA** asked what the uncertainty was with CCS. Mr Griffiths stated that the Government is committed to developing and funding CCS, and made reference to the first-ever summit of 50 international leaders to accelerate global rollout of innovative technology to reduce emissions and tackle climate change, hosted by the UK in Edinburgh in November 2018. Mr Griffiths also referred to the pilot schemes Drax has pioneered (piloting the first bioenergy carbon capture storage project of its kind in Europe, and promoting the White Rose CCS scheme). However, the CCS technology is new and has to go through testing and financial modelling, which is being undertaken at the moment. The Government's intention is to roll out CCS at scale in the 2030s. What there is certainty on, in terms of the Proposed Scheme, is that there is sufficient land for CCS when the time comes.

3.87 **Mr Griffiths** submitted that a requirement for CCS could not be placed on the DCO, given the current early stages of CCS technology, as the consent would not be bankable as no-one can confirm today how much such technology would cost as the financial modelling is still being undertaken. Instead, the Government would use its other mechanisms to impose the requirement of CCS on CCR plants in the future.

3.88 **The ExA** asked whether the Applicant's position was that whilst the Proposed Scheme was policy compliant, CCS was not mitigation for the Proposed Scheme. Mr Griffiths confirmed that CCS will be mitigation in the future, when feasibility and financial modelling make it so, however, whilst it is a material consideration given the Government's position, there is no certainty as to when or if that mitigation can be provided. The position is similar to the arguments put forward by CE and others in terms of relying on battery storage to provide system services to the grid, which similarly cannot be relied upon at this stage given the lack of certainty and feasibility surrounding that technology at the scale needed for grid stability and security.

3.89 **Mr Hunter Jones** asked how the Applicant's position on CCS sat with its baseline being reliant on CCS. Mr Griffiths explained that that is not the Applicant's position, and that it has explained how it would meet the 450gCO2/kWh emissions intensity level by co-firing, which could evolve into CCS by the 2030s. Mr Griffiths noted that it was irrelevant in any event because the Proposed Scheme would only displace less efficient plant and so the alternate baseline also justified the 450gCO2/kWh.

3.90 **The ExA** asked whether, given the significant adverse effect on GHG, the Applicant should be more ambitious and commit to CCS. Mr Griffiths responded, highlighting the Proposed Scheme's reduction in GHG emissions per MW of generation capacity – the scheme will be materially more efficient by:

(a) Increasing the generation capacity of Units 5 and 6 by 173%;

(b) Yet producing only 90% more GHG emissions (ES, Chpt.15, Table 15-3).

3.91 This is a benefit of the Proposed Scheme, particularly having regard to its role in displacing existing older, less efficient coal and gas plant.

3.92 **Mr Griffiths** submitted that it was wholly unreasonable to expect an Applicant to commit to a technology that is not yet feasible. Government policy recognises this and has identified the way forward for decision makers: to ensure that plants are CCR. It would be to re-write national policy to go beyond the requirements of EN-1. Mr Griffiths reiterated that Drax is a company that embraces innovation, ambition and new technology (citing the two CCS projects referred to earlier).

3.93 **Mr Griffiths** continued, explaining that the Government has the means (such as by Written Ministerial Statements, or new legislation such as with respect to abated coal after 2025) to require CCS in the future. The Government can introduce legislation requiring that land safeguarded for CCR, is used to provide CCS by a certain date. The Government has the power for plants not complying with such legislation to be closed. The planning system is not the only tool available.

3.94 **Mr Hunter Jones** made a comment in relation to the adverse economic effect of retrofitting CCS being taken into account. Mr Griffiths stated that (a) it is not retrofitting in its proper sense where the plant has been designed from the start to fit CCS, (b) there is some irony in raising that point given that the imposition of CCS now would render the scheme financially unviable/ un-financeable and (c), in any event, if the intention of the Government and the NPS has been to require CCS, it would have done so.

3.95 **Environmental Topic A: The Changes to the Proposed Development**

3.96 **The ExA** referred to its procedural decision of 3 November 2018 to accept the non-material amendment application to remove Stage 0 from the Application (submitted at

Deadline 2). Mr Griffiths confirmed the Applicant will provide the further information required by the procedural decision at Deadline 4.

3.97 **Mr Griffiths** explained the changes the subject of the Applicant's non-material amendment application submitted at Deadline 3. Mr Griffiths outlined the changes as follows:

(a) The following non-material changes have been made to the **battery facility**:

Firstly, in terms of the design:

(i) There would not be a formal building, so reference to “building” in the draft DCO was wider than it needed to be. Rather the battery cells, will be protected/shielded most likely by cladding. It should be noted that the term "building" in the draft DCO includes "structure" so there is technically no change here, but given a building with a roof is not going to be erected (for reasons associated with the cooling of the batteries), the Applicant considered it more appropriate to change the language.

(ii) The battery cells will be like shipping containers with some form of structure/cladding around them to protect them.

(iii) The draft DCO, at Requirement 6, requires details of the "cladding or shield to enclose or protect the battery energy storage cells" to be submitted to the relevant planning authority before commencement of Work Number 3.

(iv) The parameters of the battery facility have not changed.

Secondly, the construction phasing of the battery storage facility has changed slightly:

(i) The cells were always phased over Stages 1 and 2, however, before, the "building" was going to be erected in Stage 1, so it was oversized for Stage 1 to allow the cells for Stage 2 to be installed within it. However, as there will be no building but rather a protection added to the battery cells, this protection would be added as the cells are installed, so in Stage 1 and then in Stage 2. This is the only difference, which is minimal - in effect, construction traffic would decrease slightly in Stage 1, and increase slightly in Stage 2, but this does not change the overall assessment in the Environmental Statement as explained in the Applicant's assessment of the Deadline 3 changes at Examination Library Reference (REP3-022).

Thirdly, reference to 100MW in Work Number 3A and 3B has been removed. This is because there is no point to this restriction.

(ii) The area assumed for Work Number 3 and the parameters for the facility are the key restrictions, and they have not changed.

(iii) The Units X and Y both have their restrictions, which total 3.6GW, which leaves 200MW for the overall restriction at the top of Schedule 1.

(iv) It would be confusing to refer to MWs in Work Number 3, given the battery storage facility operates on a MWh basis – the longer the battery stores electricity, the higher the MWh, so 4 hours of storage, would be 400MWh.

(b) Illustrative **layout of the AGI**

(i) The changes to this layout do not change the parameters or the Environmental Impact Assessment, as the changes are simply to the illustrative layout drawing and not to the Work Numbers. The changes do, however, change the rights over some parcels of land, which is the subject of the Additional Land Application.

(ii) The AGI is still within the Work Number 6 area. The revisions reflect the latest discussions with National Grid, and this is the latest iteration of how the AGI might look. An AGI is usually located towards the edge of fields but from an engineering perspective because of the depth of the existing pipe that the new pipe is connecting into, National Grid has recommended that the AGI be moved to enable a better and easier connection. This also assists on the landscaping front, as more landscaping can be added which is a net benefit.

(iii) The layout drawing now also shows the oil separator / filtration tank to attenuate the run off before it goes in to the Dickon Field drain, this was envisaged originally in the drainage proposals. Following discussions with the Internal Drainage Board, the access road was widened to allow for access to the tank to avoid obstruction of the road. Therefore, the Applicant has extended the freehold acquisition of plot 62. Hence the extension of the south-eastern corner of 62. This is a normal part of site drainage mitigation.

(iv) An access has now also been created as well for the landowner - this has been requested by the landowner. This access means a culvert over the ditch is required.

(c) **Parameter Changes**

For the majority of the design changes, the reason for the change is that the Applicant's preferred supplier has refined its solution for the new technology that is to be fitted. The Applicant sought to ensure the parameters were wide enough at submission, but inevitably with new technology, the design develops. Drax is far more advanced than many applicants by having its preferred supplier providing design information to feed into the assessment. This will limit any changes post grant, should the DCO be made. Hence the non-material change application.

The three main changes relate to the Heat Recovery Steam Generator ("**HRSG**"), the stack and the Gas Turbine Air Inlet. The changes were discussed by reference to Table 2 of the Applicant's

Assessment of Non-Material Amendments to Proposed Scheme (REP3-022).

Heat Recovery Steam Generator

(i) Length has increased by 7m; width increased by 6m and the height has increased by 11m.

(ii) These new parameters include the ability for cladding as additional mitigation.

Stack

(iii) The Stack height feasibility study required a 6m clearance between the top of existing cooling towers and the new stacks. This is due to building downwash.

(iv) This originally gave a stack height of 120m or 126m AOD. However, an error has emerged with the existing cooling tower height; the cooling towers are just over 2 metres higher. Accordingly, to maintain the 6m clearance, the new stacks need to be a minimum of 122.5 metres high. To provide a maximum height, the Applicant is proposing 123m (or 128.5m to 129m AOD).

(v) The Environmental Impact Assessment and Habitats Regulations Assessment have been based on the parameters of 120m/126m AOD, so this increase is outside those parameters by 3m. However, the key parameter is the 6m clearance from the existing cooling towers, which remains constant.

(vi) The slight increase in air quality terms actually means a marginal beneficial effect. Long term concentrations including deposition are lower overall, but order of magnitude of the change is 0.01%, so a very small improvement.

(vii) Regarding LVIA, the change does not affect the conclusions, as the height of the stacks was always measured by reference to the 6m clearance. As that has not changed, you cannot see an increase in height, which means no change to the assessment.

Gas Turbine Air Inlet

(viii) Length has increased by 10m; width has increased by 8m and height has decreased by 1m.

(ix) In terms of landscape and visual impact, there is no change in materiality as the Gas Turbine Air Inlets are seen in the context of industrial landscape and changes do not tip the balance.

3.98 In response to a question from the ExA, Mr Griffiths confirmed that the changes had not been formally discussed with the planning authority as the changes were so minor. The ExA asked how the increase to the pipe rack was a minor change. Mr Griffiths confirmed that the original parameters had been an error, and that the length of the pipe rack was required as it was a pipe that went around and attached to various buildings within the existing power station site. Mr Griffiths confirmed that the correct measurements had been assessed in the ES, but that in any event, it made no difference as the pipe rack was not visible.

3.99 **The ExA** asked whether, as the stacks go beyond what was assessed in the ES, the new stack height and the assessment needed to be a certified document in Schedule 15 of the DCO. Mr Griffiths explained that in terms of air quality the figures for the increased stack heights have been run but they either do not result in any changes or result in very marginal changes to the figures in the ES. Mr Griffiths further explained that Chapter 3 of the ES (Site and Project Description) would need to be read in the context of the Applicant's Assessment of Non-Material Amendments to Proposed Scheme (REP3-022). Mr Griffiths submitted that the DCO would be clear and not create confusion with the parameters in Schedule 13 giving the maximum and minimum heights for the stacks, and the statement that Chapter 3 of the ES is ready in light of the changes.

3.100 **The ExA** asked whether the Applicant envisaged there would be any further changes to the Application. Mr Griffiths confirmed that there would be no more changes to the Application.

3.101 **Ms Morton** on behalf of NYCC and SDC confirmed the Councils had no comments on the changes.

3.102 **Chris Gaughan** from the EA stated that the Applicant has already submitted a variation to the Environmental Permit to accommodate these changes. Mr Gaughan noted that a revised air dispersion model will need to be submitted with respect to the increased stack height.

3.103 **The ExA** noted that it would make a decision on the non-material application shortly, hopefully in the week commencing 10 December 2018.

3.104 **Environmental Topic C: Landscape and Visual, and Design**

3.105 **The ExA** asked NYCC / SDC what its position was on the local and regional historical significance of the existing structures at Drax power station. John Wainwright stated that he had a good understanding of the historical and design context of the power station, and referred to statements from the 1960s which explain the architectural and landscape significance and the setting of the power station at the time. Mr Wainwright stated that a lot of effort had gone into considering the design, and that is reflected in the existing power station. Mr Wainwright considered that what is on the ground now does reflect the spirit of the principles established in the original design. Mr Wainwright continued, referring to where the Proposed Scheme conflicts with the original power station design.

3.106 **Mr Griffiths** highlighted that Mr Wainwright had not answered the question in relation to historical significance. Mr Griffiths confirmed that Drax power station is not listed, and nor does it have any other national, regional or local heritage designation. Mr Griffiths also referred to the draft Statement of Common Ground with NYCC and SDC (REP1-006) which does not refer to any harm to any historical significance of the power station.

3.107 **The ExA** noted that the power station has not been designated, and locally there is no significance attached to it, and asked NYCC/SDC why this was. Mr Wainwright clarified that his response had related to historic architectural landscape not heritage value. Michael Reynolds said he had spoken to the NYCC archaeologist who said that because the power station is remaining with the Proposed Scheme that there is no effect on heritage. Mr Reynolds said he would need to check whether there was ever a suggestion the power station should be locally listed.

3.108 **The ExA** asked the Applicant how design had been taken into account in the design of the Proposed Scheme, in the context of the engineering requirements.

3.109 **Mr Griffiths** explained that the starting point for the design of the Proposed Scheme was Drax's objectives and of relevance in those objectives was:

(a) re-utilisation of as much existing infrastructure as possible (such as cooling systems, cooling towers and steam turbines); and

(b) utilise as much existing operational land within the Existing Drax Power Station Complex as possible so as to maximise the use and efficiency of existing infrastructure

3.110 These objectives lent themselves to Drax looking at site locations within the Existing Drax Power Station Complex. Drax has previously considered developments adjacent to the Existing Drax Power Station Complex, but for the Proposed Scheme these sites were discounted because:

(a) additional compulsory acquisition of land would likely be required, whereas Drax owns the freehold of the Existing Drax Power Station Complex;

(b) a greenfield site would have to change its use, where as the Existing Drax Power Station Complex has a long history of power generation;

(c) a greenfield site would result in a loss of agricultural land and impacts on biodiversity, whereas the Existing Drax Power Station Complex is already a brownfield site;

(d) new electrical infrastructure would be required, whereas the Existing Drax Power Station Complex has a substation located within its boundary; and

(e) a greenfield site would not enable Drax to meet its objectives of re-using existing infrastructure.

3.111 The Councils have agreed that the existing site is an appropriate location for energy generation.

3.112 Having chosen the Existing Drax Power Station Complex for Units X and Y, the next task was to find the precise location within the Complex.

3.113 **Steve Austin**, Drax Repower Technical Manager at Drax Power Limited, explained the assessment of sites within the Complex for the power islands. Mr Austin referred to options for locations on the western and eastern side of the Complex. The chosen position is on the east side, which is the closest side to the gas national transmission network and the 400K substation. Locating the Units on the west side, would give rise to more compulsory acquisition of land, especially for the gas connection pipeline. In addition:

(a) the east side is more efficient for the 400KV substation;

(b) the west side is the location of the old coal stack, which would affect efficiency of the gas fired generating station due to the potential for "dirty air"; and

(c) the western side was dismissed fairly easily due to access for Abnormal Indivisible Loads ("**AILs**") and the requirement for additional trunking roads to transport the AILs.

3.114 **Mr Austin** explained that one of the main objectives of the Proposed Scheme is to be the most efficient CCGT power plant using existing infrastructure. The gas turbine

Units X and Y have therefore been placed as close as possible to the existing steam turbines, in order to achieve the shortest possible length of steam pipework, as this adds to the efficiency. The eastern side of the Complex was best in this respect.

3.115 In addition, with respect to the design of the larger elements of Units X and Y it is noted that:

(a) There was no physical space for a horizontal HRSG. Having a vertical HRSG, means the HRSG wraps around the stack, making them more bulbous at the base which ties into the cooling towers.

(b) Regarding the stacks, Drax looked at routing the flues through the existing chimney. However, that would require 1.5km of flue, which is not sustainable - indeed the gases would likely not be hot enough when at base of the chimney to rise, so bolster fans would be required which would affect efficiency.

3.116 The site layout has been a result of collaboration between the preferred equipment supplier and Drax engineers to optimise the existing site.

3.117 **The ExA** asked the Councils what kind of off site mitigation they are seeking. Mr Wainwright referred to the adverse landscape effects as recorded in the Applicant's ES. Mr Wainwright said the Councils' view is that the harm is substantial and warrants mitigation. He considered there was no mitigation proposed that would make meaningful difference. Mr Wainwright stated that he was not satisfied with version 2 of the Outline Landscape and Biodiversity Strategy submitted at Deadline 2, and referred to a meeting where he had made various suggestions in relation to the strategy. Mr Wainwright referred to having suggested the Applicant review its land holding and the Leeds City Strategy. He said he had suggested the Applicant explore what offsetting would be available.

3.118 **The ExA** asked about green infrastructure and asked what Mr Wainwright would expect to see in relation to the Proposed Scheme. Mr Wainwright stated that the regional and local strategies look for landscape connectivity, benefits to community, access to open space, direct landscape improvements, and reduction of flood risk. Mr Wainwright referred to taking a holistic view to landscape improvement.

3.119 **The ExA** asked Mr Wainwright whether the holistic view was within the Site Boundary or also beyond. Mr Wainwright said this view should be taken within the boundary but also to mitigating the adverse effect up to 10km from the power station.

3.120 **The ExA**, noting that the Proposed Scheme is a sizeable structure, asked what reasonably could be done to mitigate or reduce the severity of the impact. Mr Wainwright acknowledged that the scale of the Proposed Scheme it is not easy to directly screen, and made a reference to opportunities to screen for residential community fringes. He referred to the hierarchy by which one should start with direct mitigation, reduction, and then move on to compensation and offsetting.

3.121 **Mr Wainwright** explained that suggestions of partners had been made to the Applicant and there had been some contact. He stated that Martin Woolley had been instructed to do an independent review in the last two weeks to see what projects there could be. This review has been undertaken.

3.122 **Mr Griffiths** responded, stating that Mr Wainwright's response was disappointing, as there had been good discussion between the Applicant and NYCC and SDC. Mr Griffiths explained that the Applicant had done what it could in terms of mitigation as far as reasonably practical in line with the NPS tests. Mr Griffiths referred to the Applicant's Landscape and Visual Amenity Effects – Appropriateness of Proposed (REP2-033), which explains the Applicant's approach in this respect. Mr Griffiths also noted that the consultation undertaken with the authorities is set out in Section 4 of that document.

3.123 **Maritta Boden** of WSP, on behalf of the Applicant, explained that prior to the submission of Revision 2 of the Outline Landscape and Biodiversity Strategy ("**OLBS**") at Deadline 2, the document had been discussed in numerous meetings with the Councils, working with the Applicant's and Councils' ecologists and landscape architects. The structure of the revised OLBS was agreed with the Councils and reflected the request from the Councils to set out a clear understanding of the Drax ownership and the extent of the mitigation that had been considered and discounted, and what was then carried forward within the red line boundary and as additional land within Drax's ownership but outside the red line boundary. The version of the OLBS submitted for Deadline 2 reflected the structure agreed with the Councils.

3.124 **Ms Boden** talked through some of the plans attached to the OLBS, explaining where areas were dismissed as being best and most versatile land (Grade 1), because they already contain mature planting and covered under previous mitigation measures associated with the original power station, because of fundamental constraints such as a tributary into the River Ouse, because the areas would not have served a purpose in terms of reducing effects on visual receptors, or because land was required for future uses.

3.125 **Ms Boden** explained that she has had detailed discussions with Drax Power Limited to consider its existing land holdings. The areas for mitigation planting are identified in red on the plan shown in the OLBS, Figure 6.7.2 Optioneering Plan. Ms Boden explained that for the areas shown in green, internal design objectives had been prepared. The design of those areas is still to be determined, however, the Applicant has made considerable effort to go through Weddle’s landscape management report to make sure that internal design objectives were prepared which reflect some of Weddle’s landscape design objectives, and such objectives are included in the OLBS. The landscape design for these areas (following detailed design of the structures / plant to be located in these areas) will seek to meet these objectives. It was noted that this would be secured by Requirement 7 of the DCO, which secures compliance with the detailed Landscape and Biodiversity Strategy(s) to be approved by the relevant planning authority.

3.126 **The ExA** noted to NYCC / SDC that it appeared the Applicant has been working to meet the requirements set out by NYCC / SDC. The ExA asked NYCC / SDC where the divergence was with the Applicant. Mr Reynolds stated that there have been a lot of discussions with the Applicant, that the discussions had been extensive and that the Applicant has been very good in responding to the Councils' requests. Mr Wainwright made various comments in relation to the plan showing land within the Applicant's control. With respect to the previously identified "green area" (where the internal design objectives will apply), Mr Wainwright stated that there was no assurance that landscaping within those areas would be delivered.

3.127 **The ExA** asked Mr Wainwright why the requirement in the DCO, requiring the relevant planning authority to sign off on the Biodiversity and Landscape Strategy was not sufficient comfort and control, given that it gives the Councils the ability to comment on and approve the strategy. Ms Morton said that NYCC / SDC would consider the specific wording on this point, and confirmed (in response to a further question from the ExA), that it would be the wording of the strategy that would be reviewed rather than the DCO requirement.

3.128 **The ExA** noted the NYCC / SDC concerns and asked the Applicant whether it was prepared to continue dialogue with the Councils. Mr Griffiths confirmed that the Applicant wants to resolve this issue with the Councils, and noted that the Applicant has a good working relationship with the Councils. Mr Griffiths noted, however, that it was not clear what the Councils wanted, and that there was further confusion in this respect following the paper submitted by Martin Woolley on Tuesday 4 December

2018. The paper prepared by Mr Woolley appears to confuse the concept of offsetting, and the landholding it identifies to mitigate impacts is in the wrong direction to where those impacts are experienced. Mr Griffiths submitted that the document is about enhancement, which is outside the scope of mitigation as per the EIA Regulations. The paper makes references to contributions of £9.5 – £14 million, which is 11 times more than the contribution required for the new nuclear power station at Hinkley, which is situated near an Area of Outstanding Natural Beauty. Mr Griffiths submitted that the document was outside the sphere of what could be considered as it amounts to a request for a community benefit, however, he noted that the Applicant would discuss the document with the Councils once it had had a further chance to consider its contents.

3.129 **The ExA** stated it would welcome dialogue continuing, and noted that the amount of money proposed did appear to be significantly more than was usual for off site landscaping.

3.130 **Mr Wainwright** made comments about further opportunities being explored in relation to existing projects, noting that he considered real community benefits could be achieved. Mr Woolley explained that he considered enhancement can be mitigation. He explained his approach to preparing the paper, in relation to identifying weaknesses in landscape areas, identifying existing organisations within the area, precedents referred to, and how in theory landscape character could be restored. Mr Woolley referred to the prices cited as being based on landscape rates from recent references. The document then sets out Mr Woolley's recommendations to deal with the likely significant effects.

3.131 **Mr Griffiths** asked for clarification as to whether the Councils endorse those recommendations (including asking for circa £10.6m). Mr Reynolds confirmed that the Councils (although it is noted it is not clear whether Mr Reynolds was answering on behalf of both SDC and NYCC, or only NYCC) endorse the recommendations and see them as a starting point to continue discussions.

3.132 **The ExA** noted that it will take a decision whether to accept the document in to the Examination and will then be able to raise further questions on this for the next deadline.

3.133 **Environmental Topic D: Biodiversity**

Biodiversity Net Gain

3.134 **Philip Davidson** of WSP, on behalf of the Applicant, summarised the main principles of the Biodiversity Net Gain Report submitted at Deadline 2 (REP2-023). Mr Davidson explained that the revised report had been updated to reflect minor changes to the calculations as a result of emerging scheme information. Mr Davidson confirmed that the principles of the assessment had remained the same, and that the assessment follows the DEFRA metric which is the accepted standard method. The assessment remains similar to that assessed in the ES.

3.135 **Mr Davidson** explained that the assessment looks at two aspects; area and linear based habitats, noting that there was an area based gain of 5% BNG (a slight reduction since the ES assessment) and a linear based gain of 6% (an improvement since the assessment submitted with the ES).

3.136 **The ExA** asked Mr Davidson to highlight the areas of improvement. Mr Davidson explained that in relation to the slight decrease in area based net gain (it was previously identified as 11%), this was a result of more information being available with respect to baseline conditions at some areas for compensation. It was also noted that additional hedgerows would be provided, which had affected the calculation for linear based habitats.

3.137 It was noted by the Applicant that removal of Stage 0 from the Application had also been a contributing factor in the reduction from 11% to 5% of area based habitats. This was due to proposed landscaping in Area H (which was removed from the Proposed Scheme as being part of Stage 0) no longer being counted in the biodiversity net gain calculations.

3.138 **The ExA** asked YWT about the concerns it had raised in its Written Representation about the amount of biodiversity net gain ("**BNG**"), and its view of the revised BNG Assessment. Ms Robin noted that although she had not dissected the report completely, she was happy with the calculations. She noted that it was good to see the increase in linear units. Ms Robin submitted that some authorities are now looking at a 20% BNG. Ms Robin clarified that not a lot of authorities have adopted this approach and referred to Lichfield Council, and noted that Buckinghamshire was considering this approach. She also noted that Warwickshire expect a BNG on all projects, although there was no specific target.

3.139 **The ExA** asked NYCC / SDC what the policy requirement was, and Julia Casterton, Principal Ecologist for NYCC / SDC confirmed that there were county and district level policy hooks for securing net gain, reflecting national planning policy, but no specific targets.

3.140 **The ExA** asked YWT what would be required to achieve 20%. Ms Robin stated that there were opportunities around land that is within the blue area (i.e. the blue area on Figure 6.7.1 of the OLBS) for linear units by planting or enhancing hedgerows or trees, as well as within SUDS systems and linear swales. Ms Robin stated that 20% BNG is an aspiration, and it would be great if that was met.

3.141 **Mr Griffiths** responded, submitting that the Proposed Scheme is policy compliant, and delivers BNG in line with the development plan. Mr Griffiths noted that the target supported by YWT is aspirational and has no basis in policy. Mr Davidson explained that an important point is the internal design objectives in the OLBS; these are the areas (referred to earlier in the context of landscape as the "green area") that landscaping cannot be designed for until the detailed design and layout of the plant in those areas is finalised, however, Mr Davidson noted that it would be highly unusual for the entire footprint to be built on, and as a result the current BNG figures are conservative and could be expected to increase. Mr Davidson also noted that the 6% increase for linear habitats equates to an additional 1km of hedgerow to be provided as part of the Proposed Scheme.

3.142 **Mr Davidson** referred to the BREEAM guidance (Guidance Note 36 (2018) provided at **Appendix 5**) which sets out a target of 5% as being "net gain". Transport for London's target is a 5% increase for net gain, the Berkeley Group's (a large housing developer) target is 0.1%, and Warwickshire council aims for replacement of any area lost (i.e. 'no net loss'). Mr Davidson's view was that the approaches taken were quite varied currently. He also noted the current consultation in relation to the existing DEFRA metric.

3.143 **Ms Robin** stated that up to 4% of the BNG figure can be a result of inaccuracies in the metric and said she would like to see confidence that there would be a net gain.

3.144 **The ExA** queried whether 5% really did reflect net gain. Mr Davidson explained that the DEFRA metric tries to take into account various factors and respond to risk factors, and as a result the area of new habitat / planting to be provided is larger than the area the Proposed Scheme impacts upon. A lot of areas affected are existing hard standing or low quality habitats. What sounds like a relatively small net gain does reflect those factors and the proposals for the Proposed Scheme mean that we are putting back quite a bit more than is being taken away.

3.145 **Ms Casterton** stated that she considered 5% BNG was a minimal contribution, and wanted to understand the split between the factors contributing to the reduction from

11%. Ms Casterton noted that she was pleased with the BNG Assessment and calculations, but considered there could be areas which had been discounted on landscape grounds which could be enhanced as part of ecology.

3.146 Mr Griffiths confirmed that the Applicant would provide a short note to confirm the position in this respect. Mr Griffiths also confirmed the Applicant would consider whether an existing Drax landholding could be utilised for further habitat.

3.147 The Applicant has considered this point further following the hearing. In terms of the split between the factors altering the BNG for area based habitats between the two versions of the BNG Assessment, approximately 5% of the reduction in gain was due to existing habitats, primarily in Additional Area 2, being found to be in a better condition than was assumed for the production of Rev 001 of the OLBS and BNG Assessment. The remaining ~1% reduction in BNG between Rev 001 and 002 of the reports, is due to the removal of Area H from the Proposed Scheme (Area H relates to the area in which the Site Reconfiguration Works / Stage 0 is being carried out). This is due to the landscaping provided as part of the works to Area H no longer being counted as part of the Proposed Scheme by virtue of the non-material amendment to remove Stage 0 from the Application.

Trenchless crossing techniques

3.148 **Mr Griffiths** explained that there is a commitment to utilise, where possible, trenchless techniques at certain crossings - this is set out in response to BHR 1.1, page 58 of the Applicant's Response to the Examining Authority's Written Questions (REP2-042). There is a need for some flexibility until various surveys are undertaken. The Outline CEMP (REP2-025), at paragraph 3.8.2 secures this commitment, with the CEMP secured by Requirement 16 in the draft DCO. Mitigation has been proposed which is secured in the Outline CEMP, and which Natural England has agreed to.

3.149 **Mr Davidson** explained the approach to the ES assessment on trenchless techniques. The ES considered the potential for both trenchless and open cut crossings (although the crossings are expected to be trenchless), however, there could be additional information that comes to light meaning it is required or necessary to undertake open cut crossings. For example, with respect to water voles, options are provided for mitigation that might be needed should it not be possible to use a trenchless technique. Mr Griffiths confirmed that Natural England has agreed that the proposed mitigation measures are appropriate, as set out in its Response to the Examining Authority's Written Questions (REP2-045).

3.150 **Ms Casterton** referred to Appendix 3 of the OLBS in relation to trenchless techniques. **Mr Davidson** confirmed that based on the current engineering assessment it is highly likely trenchless techniques will be used, however, because of further surveys from an engineering perspective, there is the possibility that an open cut crossing would be used – that would result in a water course diversion for one day to one week. Mr Griffiths offered that the Applicant could strengthen the CEMP so that before any techniques are carried out there would be the assessment of the whole pipeline route and then a final decision would be made as to the techniques, and that information would be provided to the relevant planning authority, to assist them with their monitoring and enforcement of the CEMP.

3.151 **Ms Casterton** noted that the mitigation in relation to the crossings had been agreed by Natural England and she noted that NYCC had agreed it on a high level. She noted she was unclear on the parameters of the displacement licence with respect to the impact on water voles. Ms Casterton noted that a more detailed method statement would be required in relation to the area where water voles have been found. Mr Davidson confirmed that this was a class licence granted by Natural England to undertake low impact activities for protected species (instead of an individual licence being required). He noted that one of the requirements of the licence is to deliver some conservation, and Mr Davidson stated that some of the measures proposed at the time of detailed design could be used to demonstrate gain for water voles and other measures may also include looking at the design and reinstatement of the watercourse, as well as minimising the working width.

3.152 **Environmental Topic E: Air Quality**

3.153 **The ExA** asked for clarification as to whether Selective Catalytic Reduction ("**SCR**") is deemed to be Best Available Techniques ("**BAT**"). Mr Gaughan of the EA outlined the background in relation to the BAT Reference document for Large Combustion Plants ("**LCP BREF**") and emissions standards for new build CCGT, in particular whether the high efficiency of new CCGT (in excess of the 60.5% efficiency envelope) meant that such plants were outside the scope of LCP BREF. If outside the scope of LCP BREF, the associated limit values for NOx emissions of 30mg/Nm3 annually and 40mg/Nm3 daily would not apply. Mr Gaughan reported that the EA had consulted with Energy UK and DEFRA and a conclusion had been reached in the past few weeks that the high efficiency plant is deemed to be within the scope of LCP BREF, and as a result the associated emissions levels ("**AELs**") for NOx would apply. Mr Gaughan noted that it is the Applicant's responsibility to demonstrate to the EA how BAT is satisfied and the AELs reached.

3.154 **Mr Griffiths** confirmed that the issue of SCR as BAT is a question for the EA as part of the Environmental Permit, and is actually irrelevant for the DCO Application process. This is because the DCO Application has assessed the Proposed Scheme both with SCR and without SCR. The issue now is one for discussion between the EA and the Applicant for the Permit.

4. **AGENDA ITEM 4 – MATTERS FOR CLARIFICATION**

4.1 In terms of groundwater level monitoring, **Matthew Wilcock** of the EA confirmed that the Applicant's consultants, WSP, have provided further information in relation to groundwater monitoring. This information has been discussed and Mr Wilcock confirmed that the EA is satisfied with the approach proposed.

4.2 In terms of the working width, **Mr Griffiths** explained that the Applicant cannot be precise and say a maximum 30m for the Working Width, as it may need to be wider depending on ground conditions. However, the Outline CEMP (REP2-025) at paragraph 3.4.3 states "*the working width will be minimised as far as possible to reduce impacts and losses*", so there is a commitment to minimise the working width, which could also mean that it will be narrower than 30m if that was feasible. The Outline CEMP is secured in Requirement 16 to the draft DCO.

4.3 **Mr Reynolds** confirmed the Councils had no view on this.

4.4 **Mr Griffiths** confirmed the revised Works Plans would be submitted for Deadline 4, removing the reference to Work Number 15A.

4.5 Mr Griffiths provided an update on Statements of Common Ground ("**SoCG**") as follows:

(a) **NYCC / SDC** – an agreed draft was submitted at Deadline 1. The Applicant is aiming to update the draft for Deadline 4, and that draft will identify the outstanding items for agreement, which are as discussed in today's hearing.

(b) **YWT** – discussions are on-going, although it is noted that the Applicant won't agree to the 20% aspirational target for BNG.

(c) **Highways England** – discussions are on-going and some points are being finalised between the parties.

(d) **EA** – discussions on-going. The Applicant has submitted further information on CCR and CHP which is being reviewed by the EA.

4.6 **The ExA** noted that it would be useful to submit draft versions of the SoCGs to the Examination at any time.

4.7 **The ExA** clarified that for the signed SoCGs, there were no matters of disagreement outstanding. Mr Griffiths confirmed that all matters were agreed in the signed SoCGs, and any SoCG signed at the end of the Examination will confirm the matters that are unresolved.

APPENDIX 1 - MINISTERIAL STATEMENT - ENERGY AND CLIMATE CHANGE POLICY

18 Nov 2015 : Column 17WS

Written Statement

Wednesday 18 November 2015

ENERGY AND CLIMATE CHANGE

Energy and Climate Change Policy

The Secretary of State for Energy and Climate Change (Amber Rudd): Today I am setting out my priorities for the UK's energy and climate change policy for the coming Parliament and publishing the DECC autumn update which sets out our key priorities and the recent progress the Department has made against them.

Affordable, reliable clean energy is critical to our economy, our national security, and to family budgets. We need secure energy so people can get on with their lives and businesses can plan for the future. Affordable energy so the people that foot the bill get a good deal, and clean energy to safeguard our future economic security and ensure we can meet our climate change commitments.

I am confident the steps we have taken alongside National Grid and Ofgem will ensure the security of our electricity supply in the next few years. In the long-term, our vision is of markets characterised by rigorous competition to keep costs down. We want to see a competitive electricity market, with government out of the way as much as possible, by 2025.

New nuclear and gas will be central to our energy secure future and we are encouraging investment in our shale gas exploration so we can add new sources of home-grown supply to our real diversity of imports. Today I am launching a consultation on a strategy to maximise the economic recovery of the North Sea.

We are world leaders in offshore wind and globally we can make a lasting technological contribution. Today I will announce that we will make funding available for three auctions in this Parliament with the first taking place by the end of 2016. This support will be strictly conditional on the delivery of the cost reductions we have seen already accelerating. If that happens we could support up to 10GW of additional offshore wind in the 2020s. We have already seen the cost of solar come down by 35% in the last three years.

One of the greatest and most cost-effective contributions we can make to emission reductions in electricity is by replacing coal-fired power stations with gas. We will be launching a consultation in the spring on when to close all unabated coal-fired power stations. Our consultation will set out proposals to close coal by 2025—and restrict its use from 2023.

If we take this step, we will be one of the first developed countries to deliver on a commitment to take coal off the system.

We have to demonstrate that the low carbon transition can be cost-effective and will deliver growth for the economy and affordable energy prices for consumers. We are on track for our current and next carbon budgets but the fourth carbon budget is going to be tough to achieve. We will need action right across the economy:

18 Nov 2015 : Column 18WS

in transport; waste and buildings. We will be setting out our plans next year for meeting the fourth and fifth carbon budgets.

To reduce bills and carbon we will also work to cut energy use itself. Over the last five years, more than 1.2 million households are seeing lower bills due to energy efficiency improvements. We are committed to ensuring a million more get the same benefits by the end of this Parliament, and that support is concentrated on those in greatest need.

A fully smart energy system could help us to reduce costs further by tens of billions of pounds over the decades ahead. Smart meters are a key building block and every home and small business in Britain will get them by the end of 2020. Alongside the National Infrastructure Commission, we will work with National Grid, Ofgem and others to consider how to reform the current system operator model to make it more flexible, responsive and independent.

As well as taking action at home, we must work with others internationally. Climate change is a global problem, not a local one. This is why I am determined that we help restore the EU emissions trading system to full health and build stronger ties on energy within Europe, and why a global deal in Paris next month is so important. Paris must deliver that and help unleash the levels of private investment and local action needed.

DECC Autumn Update

Also today I am publishing the DECC autumn update which provides an overview of the Department's priorities and includes a number of progress reports, updates and recent publications of interest. This will be available on the gov.uk website.

In particular these include the Green Deal and Energy Company Obligation (ECO) annual report for 2015 and the fourth DECC annual report on the roll-out of smart meters.

Green Deal and Energy Company Obligation (ECO) Annual Report

The Green Deal and Energy Company Obligation (ECO) annual report for 2015 covers the extent to which Green Deal plans and ECO have contributed to the carbon budgets. These schemes have helped install 1.6 million energy efficiency measures in 1.3 million homes since 2010.

Copies of the report will be made available in the House Library. The report will be available on the gov.uk website.

Fourth DECC Annual Report on the Roll-Out of Smart Meters

The report sets out progress made in 2015, and covers the work that Government and industry are undertaking to ensure that the smart metering roll-out delivers the expected benefits to households and small businesses by the end of 2020.

The programme is making good progress and consumers are already enjoying the control and convenience that smart metering brings, with over 1.7 million smart and advanced meters already operating in homes and businesses.

The annual report can be found at:

https://www.gov.uk/government/policies/helping-households-to-cut-their-energy-bills/supporting-pages/smart-meters.

[HCWS312]

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APPENDIX 2 - ENERGY POLICY: WRITTEN STATEMENT - HCWS690

Energy Policy:Written statement - HCWS690

WS **Department for Business, Energy and Industrial Strategy**

Made on: 17 May 2018

Made by: **Greg Clark** (Secretary of State for Business, Energy and Industrial Strategy)

Commons **HCWS690**

Energy Policy

My Rt. Hon. Friend James Brokenshire, the Secretary of State for Housing, Communities and Local Government, and I wish to reiterate the Government's view that there are potentially substantial benefits from the safe and sustainable exploration and development of our onshore shale gas resources and to set out in this statement to Parliament the actions we are taking to support our position. This joint statement should be considered in planning decisions and plan-making in England.

The UK must have safe, secure and affordable supplies of energy with carbon emissions levels that are consistent with the carbon budgets defined in our Climate Change Act and our international obligations. We believe that gas has a key part to play in meeting these objectives both currently and in the future. In part as a result of the UK's diverse range of energy sources, which include natural gas, we have had competitively-priced energy since 1990 whilst reducing carbon emissions across the economy by 49% – a leading performance among developed nations. Gas still makes up around a third of our current energy usage and every scenario proposed by the Committee on Climate Change setting out how the UK could meet its legally-binding 2050 emissions reduction target includes demand for natural gas. As set out in the Clean Growth Strategy, innovations in technologies such as Carbon Capture Usage and Storage (CCUS) have the potential to decarbonise this energy supply still further and prolong its role in our energy mix.

However, despite the welcome improvements in efficiency and innovation from companies operating in the North Sea, the ongoing decline in our offshore gas production has meant that the UK has gone from being a net exporter of gas in 2003 to importing over half (53%) of gas supplies in 2017 and estimates suggest we could be importing 72% of our gas by 2030. Our current import mix, via pipelines from Norway and Continental Europe and LNG terminals that can source gas from around the world, provides us with stable and secure supplies. However, we believe that it is right to utilise our domestic gas resources to the maximum extent and exploring further the potential for onshore gas production from shale rock formations in the UK, where it is economically efficient, and where environment impacts are robustly regulated.

We also believe that further development of onshore gas resources has the potential to deliver substantial economic benefits to the UK economy and for local communities where supplies are located by creating thousands of new jobs directly in extraction, local support services, and the rest of the supply chain. A potential new shale gas exploration and production sector in the shale basins of England could provide a new economic driver. We also see an opportunity to work with industry on innovation to create a "UK Model" - the world's most environmentally robust onshore shale gas sector - and to explore export opportunities from this model, a core theme of our modern industrial strategy.

But to achieve these benefits, we need to work with responsible companies prepared to invest in this industry as they proceed with the exploration process, to test the size and value of the potential reserves and to ensure that our planning and regulatory systems work appropriately whilst assisting local councils in making informed and appropriate planning decisions. So we are setting out a series of actions, including those committed to in the Government's 2017 manifesto to support the development of shale gas extraction.

Planning

The UK has world class regulation to ensure that shale exploration can happen safely, respecting local communities and safeguarding the environment. The development of the shale gas industry so far has already led to millions of pounds being invested in the UK, supporting businesses and the supply chain, and creating British jobs. We have recently seen four planning approvals for exploratory shale development. The Government remains fully committed to making planning decisions faster and fairer for all those affected by new development, and to ensure that local communities are fully involved in planning decisions that affect them. These are long standing principles. No one benefits from the uncertainty caused by delay which is why, in September 2015, Government set out a range of measures to help ensure every planning application or appeal was dealt with as quickly as possible.

However, recent decisions on shale exploration planning applications remain disappointingly slow against a statutory time frame of 16 weeks where an Environmental Impact Assessment is required. So, we are announcing a range of measures to facilitate timely decisions. These measures only apply in England.

Planning policy and guidance

This Statement is a material consideration in plan-making and decision-taking, alongside relevant policies of the existing National Planning Policy Framework (2012), in particular those on mineral planning (including conventional and unconventional hydrocarbons).

Shale gas development is of national importance. The Government expects Mineral Planning Authorities to give great weight to the benefits of mineral extraction, including to the economy. This includes shale gas exploration and extraction. Mineral Plans should reflect that minerals resources can only be worked where they are found, and applications must be assessed on a site by site basis and having regard to their context. Plans should not set restrictions or thresholds across their plan area that limit shale development without proper justification. We expect Mineral Planning Authorities to recognise the fact that Parliament has set out in statute the relevant definitions of hydrocarbon, natural gas and associated hydraulic fracturing. In addition, these matters are described in Planning Practice Guidance, which Plans must have due regard to. Consistent with this Planning Practice Guidance, policies should avoid undue sterilisation of mineral resources (including shale gas).

The Government has consulted on a draft revised National Planning Policy Framework (NPPF). The consultation closed on 10 May 2018. In due course the revised National Planning Policy Framework will sit alongside the Written Ministerial Statement.

We intend to publish revised planning practice guidance on shale development once the revised National Planning Policy Framework has been launched ensuring clarity on issues such as cumulative impact, local plan making and confirmation that planners can rely on the advice of regulatory experts.

Planning decision making

To support a decision-making regime that meets the future needs of the sector we will progress our manifesto commitments by:

- holding an early stage consultation, in summer 2018, on the principle of whether non-hydraulic fracturing shale exploration development should be treated as permitted development, and in particular on the circumstances in which this might be appropriate.

- consulting, in summer 2018, on the criteria required to trigger the inclusion of shale production projects into the Nationally Significant Infrastructure Projects regime.

Further, we will strengthen community engagement by consulting in due course on the potential to make pre-application consultation a statutory requirement.

Support for those involved in decision making

We are aware that the shale applications and the planning process can be complex for local authorities. Building capacity and capability within local authorities to deal with shale development is a vital step towards speeding up decision making. We will help achieve this by announcing, today:

- the launch of a new £1.6 million shale support fund over the next two years to build capacity and capability in local authorities dealing with shale applications.
- the creation of a new planning brokerage service for shale applications to provide guidance to developers and local authorities on the planning process to help facilitate timely decision making. The service would focus exclusively on the planning process and will have no role in the consideration or determination of planning applications. The service will not comment on the merits of a case and will also have no role in the appeals process.

In addition, the Government recognises that early engagement with local authorities, including capitalising on formal pre-application discussions, is critical in building confidence in decision making and securing support for development proposals and set realistic timeframes for decisions. We expect this to be formalised by a Planning Performance Agreement providing certainty for all parties. And we then expect all parties – including decision-makers in local authorities – to stick to the timetable.

Opportunities for Redress

While we are confident that the measures announced in this Written Ministerial Statement will speed up decision making on shale applications, we cannot be complacent. Therefore:

- we will continue to treat appeals against any refusal of planning permission for exploring and developing shale gas, or against any non-determination as a priority for urgent determination by the Planning Inspectorate, making additional resources available where necessary.
- under the Written Ministerial Statement in 2015 the criteria for recovering planning appeals were amended to include proposals for exploring and developing shale gas. This was applied for a two-year period subject to further review. The Secretary of State for Housing, Communities and Local Government has conducted a review and remains committed to scrutinising appeals for these proposals. We are therefore announcing that the criteria for considering the recovery of planning appeals are continued for a further two years. The new criterion is added to the recovery policy of 30 June 2008, Official Report, column 43WS.
- the Secretary of State for Housing, Communities and Local Government will actively consider calling in shale applications particularly where statutory deadlines have been exceeded. Each case will be considered on its facts in line with his policy. Priority timeframes for urgent determination will be given to any called-in applications.
- the Government continues to commit to identifying underperforming local planning authorities that repeatedly fail to determine oil and gas applications within statutory timeframes. When any future applications are made to underperforming authorities, the Secretary of State will consider whether he should determine the application instead.

Shale Regulator

The UK regulatory regime for shale gas is considered among the most robust and stringent in the world. However, we acknowledge that it is also complex, with three regulators, the Environment Agency, the Health and Safety Executive and the Oil and Gas Authority, all with responsibilities for regulation. It is not always transparent to both the public and industry who is responsible for what. Therefore, the Government is setting up a Shale Environmental Regulator which will bring the regulators together to act as one coherent single face for the public, mineral planning authorities and industry. We intend to establish the regulator from the summer.

We anticipate that the plans for the Shale Environmental Regulator and future consultations will only apply in England.

Community Benefits

We strongly believe that communities hosting shale gas developments should share in the financial returns they generate. The Government welcomes the shale gas companies' commitment to make set payments to these communities, which could be worth up to £10m for a typical site. Actions to support local communities are an important complement to the planning actions set out above. With that in mind, we want to go further, and we will work with industry to see how we can improve this offer.

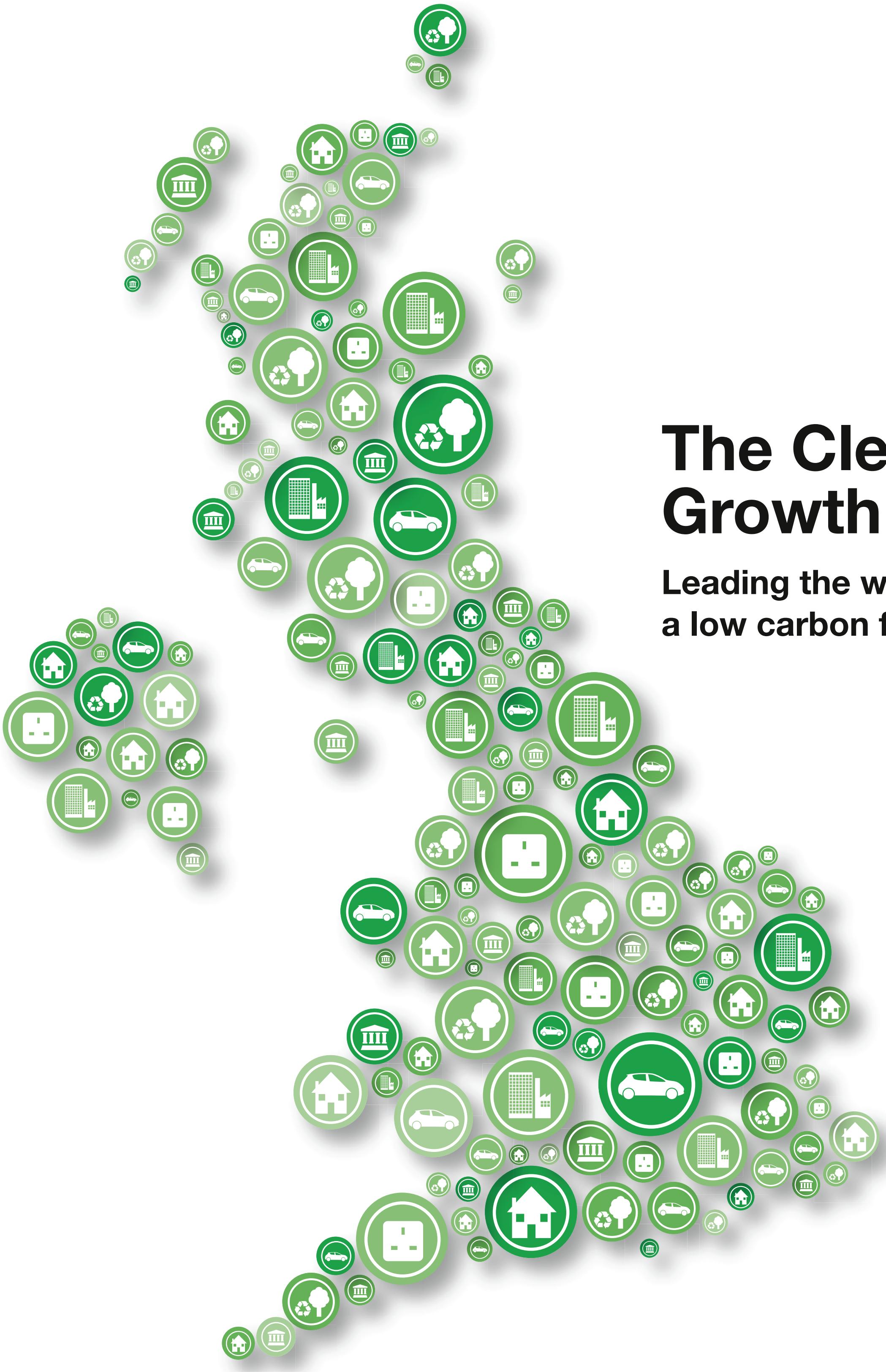
In addition to this offer we also announced in the Autumn Statement 2016 that the Shale Wealth Fund will provide additional resources to local communities, over and above industry schemes and other sources of government funding. Local communities will benefit first and determine how the money is spent in their area.

This statement has also been made in the House of Lords: **HLWS671**

APPENDIX 3 - THE CLEAN GROWTH STRATEGY (EXECUTIVE SUMMARY) - Link to full Strategy below

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

HM Government



The Clean Growth Strategy

Leading the way to a low carbon future

Building our Industrial Strategy

The Clean Growth Strategy
Leading the way to a low carbon future

Presented to Parliament pursuant to Sections 12 and 14 of the Climate Change Act 2008

Amended April 2018 from the version laid before Parliament in October 2017

October 2017

The Clean Growth Strategy can be found on the BEIS section of GOV.UK:

https://www.gov.uk/government/publications/clean-growth-strategy

Any enquiries regarding this publication should be sent to us at CleanGrowthStrategy@beis.gov.uk.

Amendments to the version laid before Parliament in October 2017

The following corrections have been made:

p122, p142: The unit label for the metric "Biodegradable waste sent to landfill" has been corrected to read "Million Tonnes".

p156: The text "(in real 2016 prices)" has been removed.

p156: Three values in table 11 have been corrected.

A few other minor typographic errors have also been corrected.

Contents

Foreword from the Prime Minister

10 DOWNING STREET
LONDON SW1A 2AA

This Government is determined to leave our natural environment in a better condition than we found it. Clean growth is not an option, but a duty we owe to the next generation, and economic growth has to go hand-in-hand with greater protection for our forests and beaches, clean air and places of outstanding natural beauty.

There is no conflict between this aspiration and our plan to create an economy that works for everyone. But to do this we need a clear strategy that brings Government, business and society together. This Strategy sets out the action we will take to cut emissions, increase efficiency, and help lower the amount consumers and businesses spend on energy across the country.

The United Kingdom has a proud record in this field. Britain was one of the first countries to recognise the challenge posed by climate change and we have led the world in taking action to reduce carbon emissions. Our investment in green energy has seen Britain produce record amounts of renewably-generated electricity. On the world stage, we were instrumental in driving through the landmark Paris Agreement.

Protecting our environment for the next generation also benefits our wider economic prosperity. The UK has helped new green industries to develop which have brought jobs and growth, even as we have taken decisive action to protect the world around us.

In this document, we set out the actions we are taking to put clean growth at the centre of our modern Industrial Strategy: changing the way we heat our homes, power our cars, and run our electricity grid. But we cannot achieve this through Government action alone. We must harness the ingenuity and determination of all our people and businesses across the country if we are to build a better, greener Britain. The Government will help British businesses and entrepreneurs to seize the opportunities which the global low carbon economy presents, from electric vehicles to offshore wind.

Success in this mission will improve our quality of life and increase our economic prosperity. It will mean cleaner air, lower energy bills, greater economic security and a natural environment protected and enhanced for the future.

[redacted]

Seizing the clean growth opportunity

Greg Clark
Secretary of State
for Business, Energy
and Industrial Strategy

The move to cleaner economic growth is one of the greatest industrial opportunities of our time. This Strategy will ensure Britain is ready to seize that opportunity.

Our modern Industrial Strategy is about increasing the earning power of people in every part of the country. We need to do that while not just protecting, but improving the environment on which our economic success depends. In short, we need higher growth with lower carbon emissions. This approach is at the heart of our Strategy for clean growth.

The opportunity for people and business across the country is huge. The low carbon economy could grow 11 per cent per year between 2015 and 2030, four times faster than the projected growth of the economy as a whole.

This is spread across a large number of sectors: from low cost, low carbon power generators to more efficient farms; from innovators creating better batteries to the factories putting them in less polluting cars; from builders improving our homes so they are cheaper to run to helping businesses become more productive.

This growth will not just be seen in the UK. Following the success of the Paris Agreement, where Britain played such an important role in securing the landmark deal, the transition to a global low carbon economy is gathering momentum. We want the UK to capture every economic opportunity it can from this global shift in technologies and services.

Our approach to clean growth is an important element of our modern Industrial Strategy: building on the UK's strengths; improving productivity across the country; and ensuring we are the best place for innovators and new businesses to start up and grow.

A good example of this is offshore wind, where costs have halved in just a few years. A combination of sustained commitment – across different Governments – and targeted public sector innovation support, harnessing the expertise of UK engineers working in offshore conditions and private sector ingenuity, has created the conditions for a new industry to flourish, while cutting emissions. We need to replicate this success in sectors across our economy.

This Strategy delivers on the challenge that Britain embraced when Parliament passed the Climate Change Act. If we get it right, we will not just deliver reduced emissions, but also cleaner air, lower energy bills for households and businesses, an enhanced natural environment, good jobs and industrial opportunity. It is an opportunity we will seize.

[redacted]

Executive Summary

Clean growth means growing our national income while cutting greenhouse gas emissions[1]. Achieving clean growth, while ensuring an affordable energy supply for businesses and consumers, is at the heart of the UK's Industrial Strategy. It will increase our productivity, create good jobs, boost earning power for people right across the country, and help protect the climate and environment upon which we and future generations depend.

UK Leadership and Progress

Our Strategy for clean growth starts from a position of strength.

The UK was one of the first countries to recognise and act on the economic and security threats of climate change. The Climate Change Act, passed in 2008, committed the UK to reducing greenhouse gas emissions by at least 80 per cent by 2050 when compared to 1990 levels, through a process of setting five year caps on greenhouse gas emissions termed 'Carbon Budgets'. This approach has now been used as a model for action across the world, and is mirrored by the United Nations' Paris Agreement.

We have been among the most successful countries in the developed world in growing our economy while reducing emissions. Since 1990, we have cut emissions by 42 per cent[2] while our economy has grown by two thirds[3]. This means that we have reduced emissions faster than any other G7 nation, while leading the G7 group of countries in growth in national income over this period[4].

This progress has meant that we have outperformed the target emissions reductions of our first carbon budget (2008 to 2012) by one per cent[5] and we project that we will outperform against our second and third budgets, covering the years 2013 to 2022, by almost five per cent and four per cent respectively[6]. Our economy is expected to grow by 12 per cent over that time[7]. This will be a significant achievement.

We have made progress across every sector of our economy.

[1] There are several greenhouse gases (GHGs) that contribute to climate change, the most abundant of which is carbon dioxide. Because of this, we measure emissions of GHGs in terms of millions of tonnes of carbon dioxide equivalent (Mt). One tonne of carbon dioxide fills roughly the same space as a small house.

[2] BEIS (2017) BEIS provisional UK emissions statistics 1990-2016 https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016

[3] ONS (2016) Quarterly National Accounts Statistical bulletins (Series ABMI. Seasonally adjusted chained volume measures) https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi

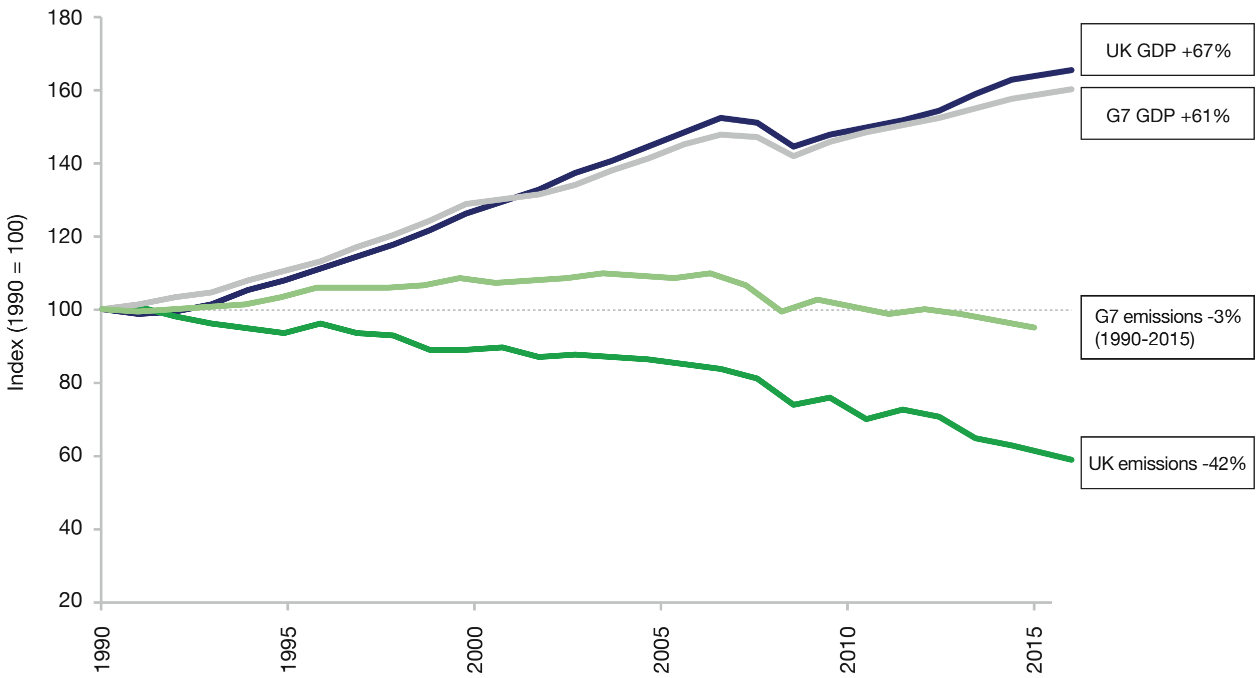
[4] Figures on per capita basis. OECD (retrieved September 2017) http://stats.oecd.org/index.aspx?DataSetCode=PDB_LV; World Resources Institute (2017) CAIT Climate Data Explorer http://cait.wri.org

[5] DECC (2014) https://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period

[6] BEIS (2017) Energy and Emissions Projections 2016 https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016

[7] OBR (March 2017) Economic and Fiscal Outlook http://budgetresponsibility.org.uk/efo/economic-fiscal-outlook-march-2017/; OBR (January 2017) Fiscal Sustainability Report http://budgetresponsibility.org.uk/fsr/fiscal-sustainability-report-january-2017/

Figure 1: UK and G7 economic growth and emissions reductions[8]



Source: UNFCCC; World Bank; BEIS

- In 2016, 47 per cent of our electricity came from low carbon sources, around double the level in 2010[9], and we now have the largest installed offshore wind capacity in the world. Our homes and commercial buildings have become more efficient in the way they use energy which helps to reduce emissions and also cut energy bills, for example average household energy consumption has fallen by 17 per cent since 1990[10]. Automotive engine technology has helped drive down emissions per kilometre driven by up to 16 per cent and driving a new car bought in 2015 will save car owners up to £200 on their annual fuel bill, compared to a car bought new in 2000[11]. England also recycles nearly four times more than it did in 2000[12].

[8] UNFCCC Data Interface (retrieved September 2017) http://di.unfccc.int/time_series; World Bank, World Development Indicators (retrieved September 2017) http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD; BEIS (2017) Final GHG Emissions Inventory Statistics https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015

[9] BEIS (2017): Digest of UK Energy Statistics 2017 https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes

[10] BEIS (2017) Energy Consumption in the UK https://www.gov.uk/government/statistics/energy-consumption-in-the-uk Change in average consumption per household 1990-2016

[11] Annual average household saving from driving a car purchased new in 2015 (the latest year for which data is available) compared to driving a car purchased new in 2000. Fuel savings valued using 2015 prices. DfT (2017) National Travel Survey; DfT (2017) Vehicles Statistics; ICCT (2015) From Laboratory to Road; BEIS (2016) Green Book supplementary appraisal guidance

[12] Defra (2016) ENV18 - Local authority collected waste: annual results tables: https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables

- This progress has been aided by the falling costs of many low carbon technologies: renewable power sources like solar and wind are comparable in cost to coal and gas in many countries[13]; energy efficient light bulbs are over 80 per cent cheaper today than in 2010[14]; and the cost of electric vehicle battery packs has tumbled by over 70 per cent in this time[15].
- As a result of this technological innovation, new high value jobs, industries and companies have been created. And this is driving a new, technologically innovative, high growth and high value "low carbon" sector of the UK economy. Not only are we rapidly decarbonising parts of the domestic economy, but thanks to our world leading expertise in technologies such as offshore wind, power electronics for low carbon vehicles and electric motors, and global leadership in green finance, we are successfully exporting goods and services around the world – for example, one in every five electric vehicles driven in Europe is made in the UK[16]. This progress now means there are more than 430,000 jobs in low carbon businesses and their supply chains, employing people in locations right across the country[17].

This progress has altered the way that we see many of the trade-offs between investing in low carbon technologies that help secure our future but that might incur costs today. It is clear that actions to cut our emissions can be a win-win: cutting consumer bills, driving economic growth, creating high value jobs and helping to improve our quality of life.

Of course, greenhouse gas emissions are a global problem and action is needed from all countries. The UK has played a key role in demonstrating international leadership on tackling climate change through its domestic action, climate diplomacy and financial support. The UK was among the first to recognise climate change as an economic and political issue as opposed to solely an environmental one and has used its world leading economic, science and technical skills to shape the global debate around climate change, for instance making the economic case for climate action in the landmark Stern Report in 2006[18]. The UK has also used its influence and resources to help developing countries with their own clean growth – and our actions to date are expected to save almost 500 million tonnes of carbon dioxide over the lifetime of the projects[19], more than the entire annual emissions of France[20]. While we do not count these results against our domestic targets, we can be proud of the impact of the UK's commitment to global climate action.

[13] New Climate Economy (2014) Better Growth, Better Climate http://newclimateeconomy.report/

[14] International Energy Agency (2016) Energy Efficiency Market Report https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016_WEB.PDF

[15] Bloomberg New Energy Finance (2016) 2016 lithium-ion battery price survey https://www.bnef.com/core/insights/15597

[16] European Alternative Fuels Observatory (2017) Top 5 selling BEV analysis: http://www.eafo.eu/vehicle-statistics/m1

[17] ONS (2016) UK Environmental Accounts: Low Carbon and Renewable Energy Economy Survey, Final estimates: 2015 https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2015results

[18] HM Treasury (2006) Stern Review on the Economics of Climate Change

[19] DfID (2017) 2017 UK Climate Finance Results https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/625457/2017-UK-Climate-Finance-Results.pdf

[20] UNFCCC 2015 data (retrieved September 2017) http://di.unfccc.int/time_series

The Opportunities and Challenges

The UK played a central role in securing the 2015 Paris Agreement in which, for the first time, 195 countries (representing over 90 per cent of global economic activity[21]) agreed stretching national targets to keep the global temperature rise below two degrees. The actions and investments that will be needed to meet the Paris commitments will ensure the shift to clean growth will be at the forefront of policy and economic decisions made by governments and businesses in the coming decades. This creates enormous potential economic opportunity — an estimated $13.5 trillion of public and private investment in the global energy sector alone will be required between 2015 and 2030 if the signatories to the Paris Agreement are to meet their national targets[22]. The decision by the US to withdraw from the Paris Agreement served to bring together and bolster action internationally on climate change with many countries underlining their commitment to the Paris Agreement in the days and weeks that followed.

The UK is well placed to take advantage of this economic opportunity. Our early action on clean growth means that we have nurtured a broad range of low carbon industries, including some sectors in which we have world leading positions. This success is built upon wider strengths – our scientific research base[23], expertise in high-value service and financial industries[24], and a regulatory framework that provides long-term direction and support for innovation and excellence in the design and manufacturing of leading edge technology. Capturing part of the global opportunity while continuing to drive down carbon emissions from our own activities could provide a real national economic boost. The UK low carbon economy could grow by an estimated 11 per cent per year between 2015 and 2030 – four times faster than the rest of the economy[25] – and could deliver between £60 billion and £170 billion of export sales of goods and services by 2030[26]. This means that clean growth can play a central part in our Industrial Strategy – building on our strengths to drive economic growth and boost earning power across the country.

Action to deliver clean growth can also have wider benefits. For example, the co-benefit of cutting transport emissions is cleaner air, which has an important effect on public health, the economy, and the environment.

But hitting our carbon budgets and expanding the low carbon economy will not be easy. We have achieved significant results in the power and waste sectors and now need to replicate this success across the economy, particularly in the transport, business and industrial sectors. We also need to reduce the emissions created by heating our homes and businesses, which account for almost a third of UK emissions. If done in the right way, cutting emissions in these areas can benefit us all through reduced energy bills, which will help improve the UK's productivity, and improved air quality, while the innovation and investment required to drive these emissions down can create more jobs and more export opportunities.

[21] World Bank (retrieved September 2017) https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

[22] International Energy Agency (2015) Climate pledges for COP21 slow energy sector emissions growth dramatically https://www.iea.org/newsroom/news/2015/october/climate-pledges-for-cop21-slow-energy-sector-emissions-growth-dramatically.html

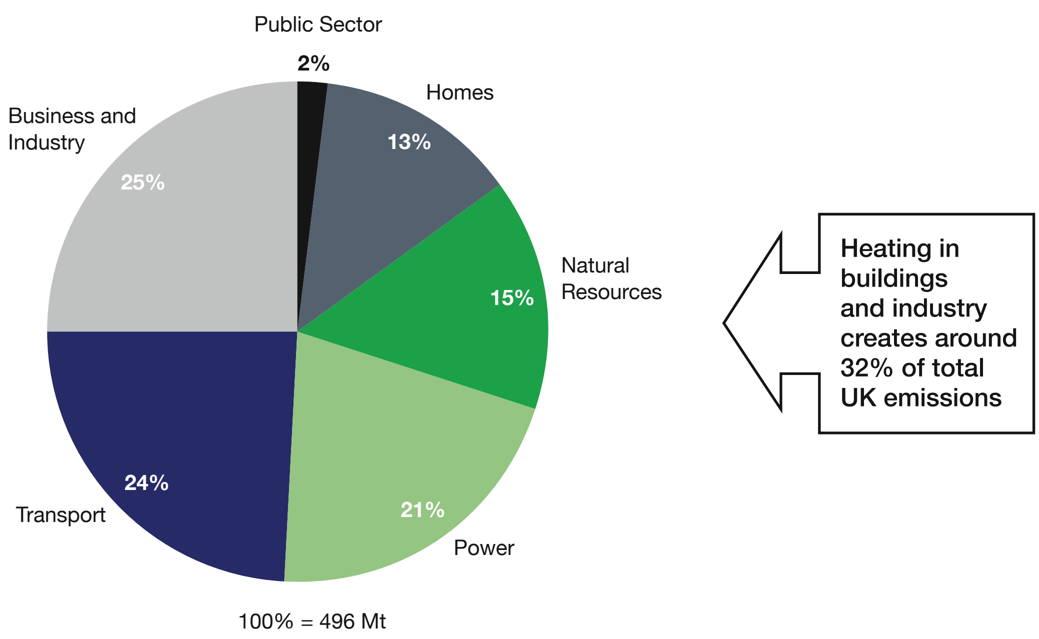
[23] BIS (2013) International Comparative Performance of the UK Research Base – 2013 https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2013

[24] GreenAlliance (2016) Will the UK economy succeed in a low carbon world? http://www.green-alliance.org.uk/UK_low_carbon.php

[25] Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low carbon economy https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/

[26] Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low-carbon economy (supporting data tables) https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/

Figure 2: UK emissions by sector, 2015[27]



Source: BEIS

In order to meet the fourth and fifth carbon budgets (covering the periods 2023-2027 and 2028-2032) we will need to drive a significant acceleration in the pace of decarbonisation and in this Strategy we have set out stretching domestic policies that keep us on track to meet our carbon budgets. However, we are prepared to use the flexibilities available to us to meet carbon budgets, subject to the requirements set out in the Climate Change Act, if this presents better value for UK taxpayers, businesses and domestic consumers.

[27] BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015) https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics; BEIS analysis

Every action that we take to cut emissions must be done while ensuring our economy remains competitive. As we set out in our Industrial Strategy Green Paper, we attach great importance to making sure our energy is affordable[28]. This is why the Government has commissioned an independent review into the cost of energy led by Professor Dieter Helm CBE. This review will recommend ways to deliver the Government's carbon targets and ensure security of supply at minimum cost to both industry and domestic consumers. Once Ministers have had the opportunity to consider the review's proposals, the Government will incorporate its recommendations into the further development of the Clean Growth Strategy as appropriate.

Another imminent challenge is to manage any impact of leaving the European Union as the Government fulfils its commitment to the British people. Leaving the EU will not affect our statutory commitments under our own domestic Climate Change Act and indeed our domestic binding emissions reduction targets are more ambitious than those set by EU legislation. The exact nature of the UK's future relationship with the EU and the long-term shape of our involvement in areas like the EU Emissions Trading System are still to be determined. There are also emerging opportunities to drive more action – for example by putting emission reductions and land stewardship at the heart of a post EU agricultural support policy. We will therefore carefully examine each area of common interest with our EU partners and work to deliver policies and programmes that are at least as beneficial as the current arrangements.

Our Clean Growth Strategy

This Strategy sets out a comprehensive set of policies and proposals that aim to accelerate the pace of "clean growth", i.e. deliver **increased** economic growth and **decreased** emissions.

Our Approach

In the context of the UK's legal requirements under the Climate Change Act, the UK's approach to reducing emissions has two guiding objectives:

1. To meet our domestic commitments at the lowest possible net cost to UK taxpayers, consumers and businesses; and,

2. To maximise the social and economic benefits for the UK from this transition.

In order to meet these objectives, the UK will need to nurture low carbon technologies, processes and systems that are as cheap as possible.

We need to do this for several reasons. First, we need to protect our businesses and households from high energy costs. Second, if we can develop low cost, low carbon technologies in the UK, we can secure the most industrial and economic advantage from the global transition to a low carbon economy. Third, if we want to see other countries, particularly developing countries, follow our example, we need low carbon technologies to be cheaper and to offer more value than high carbon ones.

We cannot predict every technological breakthrough that will help us meet our targets. Instead, we must create the best possible

[28] BEIS (2017) Building our Industrial Strategy https://www.gov.uk/government/consultations/building-our-industrial-strategy

environment for the private sector to innovate and invest. Our approach will maintain that of our Industrial Strategy: building on the UK's strengths, improving productivity across the UK and ensuring we are the best place for innovators and new business to start-up and grow. We are clear about the need to design competitive markets and smart regulation to support entrepreneurs and investors who will develop the new technologies at the scale we need. This will help our wider aim of improving the UK's earning power.

It is only through innovation – nurturing better products, processes and systems – that we will see the cost of clean technologies come down. That is why this Strategy sets out for the first time how over £2.5 billion will be invested by the Government to support low carbon innovation from 2015 to 2021. More broadly, the National Productivity Investment Fund will provide an additional £4.7 billion, with an extra £2 billion a year by 2020-21, representing the largest increase in public spending on UK science, research and innovation since 1979[29]. The UK is also working collaboratively as a core member of "Mission Innovation"[30], a group of leading countries which aims to drive forward clean energy innovation on a global scale.

In addition to supporting innovation, we are focused on policies that deliver social and economic benefits beyond the imperative to reduce emissions. Higher quality, more energy efficient buildings are healthier places to live and work. Reducing the amount of heat we waste will reduce bills. Accelerating the rollout of low emission vehicles contains a triple win for the UK in terms of industrial opportunity, cleaner air and lower greenhouse gas emissions. And crucially, many of the actions in the Clean Growth Strategy will enhance the UK's energy security by delivering a more diverse and reliable energy mix.

Actions taken by the Government on clean growth will be consistent with broader Government priorities, such as delivering clean air. All parts of the UK have a major role to play in delivering our ambitions on clean growth, and the Devolved Administrations have a range of plans and policies in place to deliver emission reductions. We will work closely with them, and with local leaders across the UK, as we develop the policies and proposals set out in this Strategy.

The changes to our infrastructure and the pace of innovation will require significant investment from the private sector. The first steps to support the growth of the green finance sector in the UK are set out in this Strategy. We are building on a position of global leadership in finance and investment. These steps will be followed by ambitious policy proposals to further accelerate investments to deliver our Clean Growth Strategy. To help develop this longer-term work, the Government has set up a new Green Finance Taskforce, comprising senior representatives from the finance industry and Government.

Key Policies and Proposals

The key actions that this Government will take as part of our Strategy are set out below. While these policies and proposals will drive emissions down throughout the next decade, our focus is on the areas where we need to do more to achieve the fifth carbon budget through domestic action in the UK.

Through preparing this Strategy, we have identified areas where we will need to see the greatest progress, both through technological breakthroughs and large-scale deployment, if we are to meet the fifth carbon budget through domestic action.

29 HM Treasury (2016) Autumn Statement 2016 https://www.gov.uk/government/topical-events/autumn-statement-2016

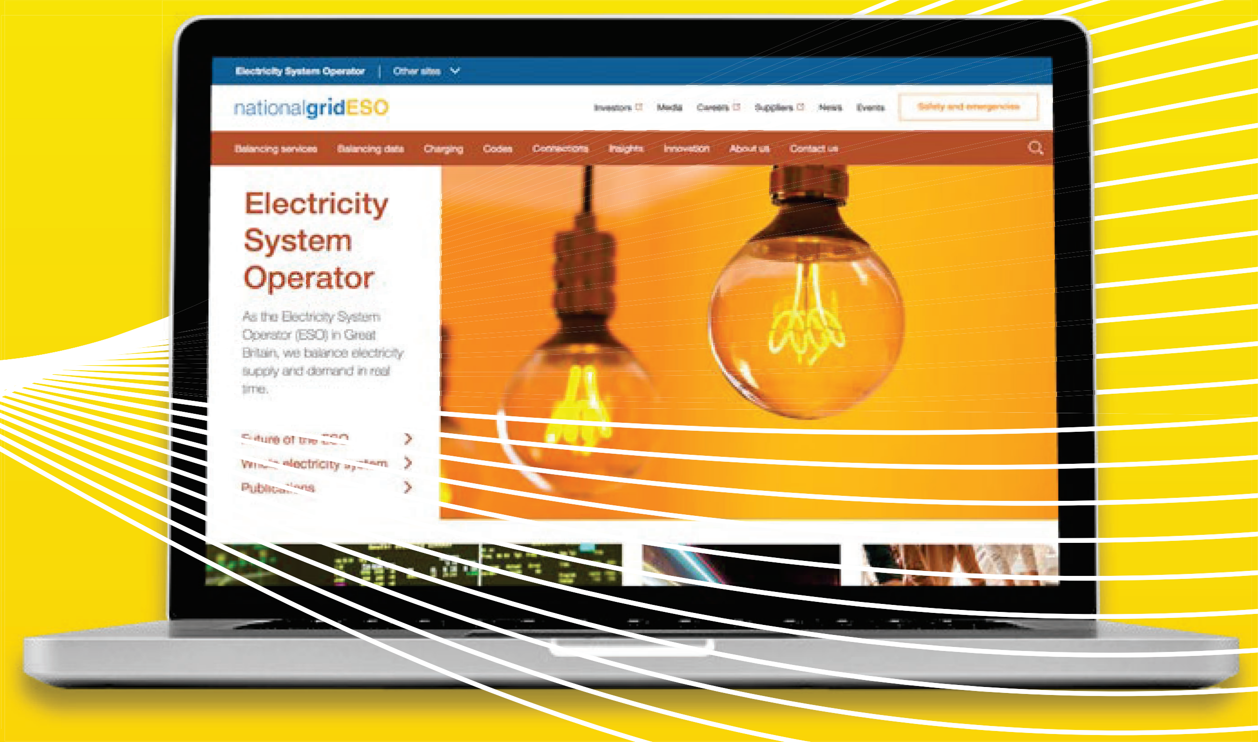
30 Mission Innovation http://mission-innovation.net/

APPENDIX 4 - ELECTRICITY TEN YEAR STATEMENT - CHAPTER 3 (Link to full document below)

https://www.nationalgrideso.com/sites/eso/files/documents/ETYS_2018_Document_v1.pdf

Electricity Ten Year Statement

November 2018



nationalgridESO

How to use this interactive document

To help you find the information you need quickly and easily we have published the *Electricity Ten Year Statement* as an interactive document.

Home button
This will take you to the contents page. You can click on the titles to navigate to a section.

A to Z
You will find a link to the glossary on each page.

Arrows
Click on the arrows to move backwards or forwards a page.

Hyperlinks
Hyperlinks are highlighted in **bold text and underlined** throughout the report. You can click on them to access further information.

Contents

Foreword

Welcome to our *Electricity Ten Year Statement*. This statement puts forward our latest view of the future requirements of GB's electricity transmission system. It also highlights the areas that show future uncertain flows and requirements. Such areas provide opportunities for system development and innovative management solutions.

Our *Electricity Ten Year Statement (ETYS)*, along with our other System Operator (SO) publications, aims to encourage and inform debate, leading to changes that ensure a secure, sustainable and affordable energy future. It is also a key input into the *Network Options Assessment (NOA)* process that makes recommendations as to which investments and solutions should be taken forward. It is important to note that the *ETYS* and the *NOA* only focus on the key major transmission boundaries across GB and that there will be many other system requirements and transmission investments required that are not currently considered in these documents.

Thank you for your continued feedback as to what and how you would like to see the *ETYS* process develop, it is really important that we are sharing the right data in the right way that makes this a useful document for your needs. You will see some changes in this document which are as a result of the direct feedback from you.

As we all know, the electricity industry is changing at an unprecedented pace and scale as we move to a more decarbonised and decentralised nation. This is demonstrated through our 2018 *Future Energy Scenarios (FES)*, which we've developed with stakeholder and industry input, and it is these scenarios that are at the heart of the *ETYS* process in determining the future transmission network needs.

The themes in this year's *FES* are continued closure of fossil-fuelled generation, an influx of wind generation, rising electric vehicle and heat pump demand, and increasing import and export via interconnectors. These changes are leading to high north-to-south transmission flows across Scotland and much of the north of England to meet demand in the Midlands and the South. The number of interconnectors that are predicted to connect towards the south east of England also create stresses on the existing network and is a key focus area to ensure that we can meet the needs of the interconnector connections.

One of the most important transmission developments this year has been the commissioning of the Western HVDC project to link south-west Scotland to north Wales. This adds a significant increase to the capability (circa 2 GW) across the northern part of the network to help manage the high flows of mainly wind generation.

From the results of the work in this document the Transmission Owners (TO) have provided asset solutions to meet the required capability needs. These asset options, alongside reduced or no-build options will be assessed through our *Network Options Assessment (NOA)*. The *NOA* aims to make sure that the transmission system is continuously developed in a timely, economic and efficient way, providing value for our customers. The *NOA 2017/18*, using the assessment results from *ETYS 2017*, recommended £21.6 million of development spend on future network reinforcements in 2018 to provide the required transmission capabilities.

As the Electricity System Operator (ESO), we are always looking to find ways to reduce the costs to the consumer whilst meeting the needs of the transmission network. This year, following the commitments made in the ESO Forward Plan and the Network Development Roadmap consultation, we are looking to encourage and assess a broader range of solutions to meet transmission needs. This range of solutions ranges from smart grid management systems to Distribution Network Operator (DNO) assets that provide transmission support and market solutions. This will help improve our investment recommendations for the benefit of customers and consumers. In this document, we present case studies that demonstrate how we are taking steps towards enhanced tools and analysis to improve our network planning. You can find further details about our enhanced role in network planning in the ESO Forward Plan. You can also find further details about the changes we are making to our methods in the Network Development Roadmap.

I hope that you find this document, along with our other SO publications, useful as a catalyst for wider debate.

Please share your views with us; you can find details of how to contact us on our website https://www.nationalgrideso.com/insights/electricity-ten-year-statement-etys/.

Julian Leslie
Head of Networks, ESO

Key messages

We have assessed the capability of the National Electricity Transmission System (NETS) against the requirements derived from the *Future Energy Scenarios (FES)*, using boundary analysis techniques.

Below is a summary of the main findings, together with how these findings will be used in the *NOA* and the future development of the *ETYS*.

1. The NETS will face future growing needs in a number of regions due to the following factors:
   - Increasing quantities of wind generation connected across the Scottish networks is likely to double north-to-south transfer requirements within ten years. For example, the flow through the Scotland–England boundary is expected to reach 15.7 GW in *FES* **Two Degrees** scenario by 2028, almost three times the current 5.7 GW boundary capability with the Western HVDC reinforcement operational.
   - A potential growth of more than 6 GW in low carbon generation and interconnectors in the north of England, combined with increased Scottish generation, will increase transfer requirements into the English Midlands.
   - Potentially high growth in the next decade of up to 9 GW in generation coming from offshore wind on the east coast connecting to East Anglia risks stressing this region of the network.
   - New interconnectors with Europe will place increased stress on the transmission network, especially southern and eastern regions of the network.

2. The *NOA* process will evaluate options for NETS development and condense them to a set of ESO preferred options and investment recommendations. These results will be shown in the *NOA 2018/19* report to be published in January 2019.
   - For *NOA 2018/19*, we expect to assess around a hundred NETS reinforcement options and, at the time of writing, eight have been initiated by the ESO. Following our cost-benefit analysis (CBA), we will recommend the options requiring expenditure in 2019, as well as those worth delaying.

3. The NETS will see growing impact from new technologies such as electric vehicles, battery storage and heat pumps. As a result, the requirements of NETS are becoming increasingly complex. System requirements are more frequently being driven by conditions other than winter peak demand. We are taking this evolution in requirements into account and are developing analysis tools and processes to assess this future transition. We publish in this year's document the description and the preliminary results of two case studies addressing voltage and thermal year round requirements. We will publish full separate reports about the voltage and thermal year round case studies by March 2019.

4. In April 2019, the ESO will become legally separate from the rest of National Grid. This will shape the future development of the *ETYS* and *NOA* publications, as we work to facilitate competition and improve our reinforcement recommendations for the benefit of our customers and consumers. Furthermore, the ESO is promoting more whole system thinking to facilitate network and market access.

Chapter 3
The Electricity Transmission Network

3.1 Introduction

The GB National Electricity Transmission System must continue to adapt and be developed so power can be transported from source to demand, reliably and efficiently.

To make sure this happens, we must understand its capabilities and the future requirements that may be placed upon it. When we assess future requirements, we need to bear in mind that we have a large number of signed contracts for new generation to connect to the NETS. In addition, the development of interconnectors connecting Great Britain to the rest of the Europe will have a big impact on future transmission requirements.

In our experience, it is unlikely that all customers will connect exactly as contracted today. We cannot know exactly how much and when generation will close and new generation will connect, so we use our future energy scenarios to help us decide on credible ranges of future NETS requirements and its present capability.

This is done using the system boundary concept. It helps us to calculate the NETS's boundary capabilities and the future transmission requirements of bulk power transfer capability. The transmission system is split by boundaries[1] that cross important power flow paths where there are limitations to capability or where we expect additional bulk power transfer capability will be needed. We apply the SQSS[2] to work out the NETS boundary requirements.

In this chapter, we describe the NETS characteristics. We also discuss each of the NETS boundaries, grouped together as regions, to help you gain an overview of the total requirements, both regionally and by boundary.

This chapter also provides analysis to show you how, and when in the years to come, the NETS will potentially face growing future network needs on a number of its boundary regions.

We also provide more in depth discussion for some regions in terms of high voltage management and year round thermal analysis. You can find the preliminary results in this chapter. The full reports will be published separately.

The results presented in this chapter will be used in the *NOA 2018/19* to present an assessment of the ESO's preferred reinforcement options, and recommendations to address the potential future NETS boundary needs.

[1] Please note that these boundaries will be reviewed annually and updated as appropriate.

[2] https://www.nationalgrideso.com/codes/security-and-quality-supply-standards

3.2 NETS background

The NETS is mainly made up of 400kV, 275kV and 132kV assets connecting separately owned generators, interconnectors, large demands and distribution systems.

As the ESO, we are responsible for managing the system operation of the transmission networks in England, Wales, Scotland and offshore. The 'transmission' classification applies to assets at 132kV or above in Scotland or offshore. In England and Wales, it relates to assets at 275kV and above.

National Grid Electricity Transmission owns the transmission network in England and Wales. The transmission network in Scotland is owned by two separate transmission companies: Scottish Hydro Electric Transmission in the north of Scotland and SP Transmission in the south of Scotland. The offshore transmission systems are also separately owned. Sixteen licensed offshore transmission owners (OFTOs)[3] have been appointed through the transitional tendering process. They connect operational offshore wind farms that were given Crown Estate seabed leases in allocation rounds.

[3] https://www.ofgem.gov.uk/system/files/docs/2018/08/electricity_registered_or_service_addresses_new.pdf

3.3 NETS boundaries

To provide an overview of existing and future transmission requirements, and report the restrictions we will see on the NETS, we use the concept of boundaries. A boundary splits the system into two parts, crossing critical circuit paths that carry power between the areas where power flow limitations may be encountered.

The transmission network is designed to make sure there is enough transmission capacity to send power from areas of generation to areas of demand.

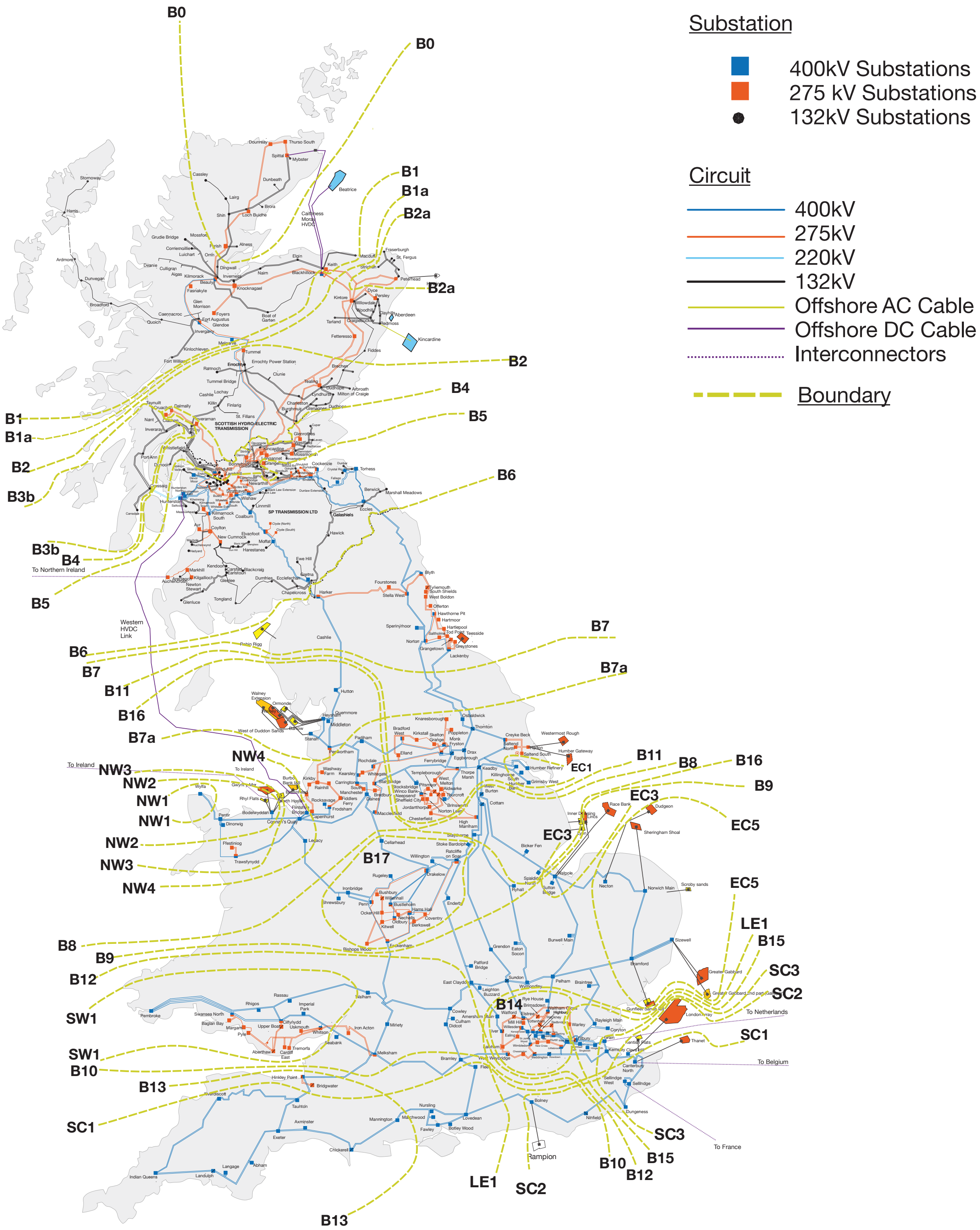
Limiting factors on transmission capacity include thermal circuit rating, voltage constraints and/or dynamic stability. From the network assessment, the lowest known limitation is used to determine the network boundary capability. The base capability of each boundary in this document refers to the capability expected for winter 2018/19.

Defining the NETS boundaries has taken many years of operation and planning experience of the transmission system. The NETS's boundaries have developed around major sources of generation, significant route corridors and major demand centres. A number of recognised boundaries are regularly reported for consistency and comparison purposes. When significant transmission system changes occur, new boundaries may be defined and some existing boundaries either removed or amended (an explanation will be given for any changes). Some boundaries are also reviewed but not studied because of no significant changes in the *FES* generation and demand data of the area from the previous years. For such boundaries, the same capability as the previous year is assumed.

GB NETS boundary map

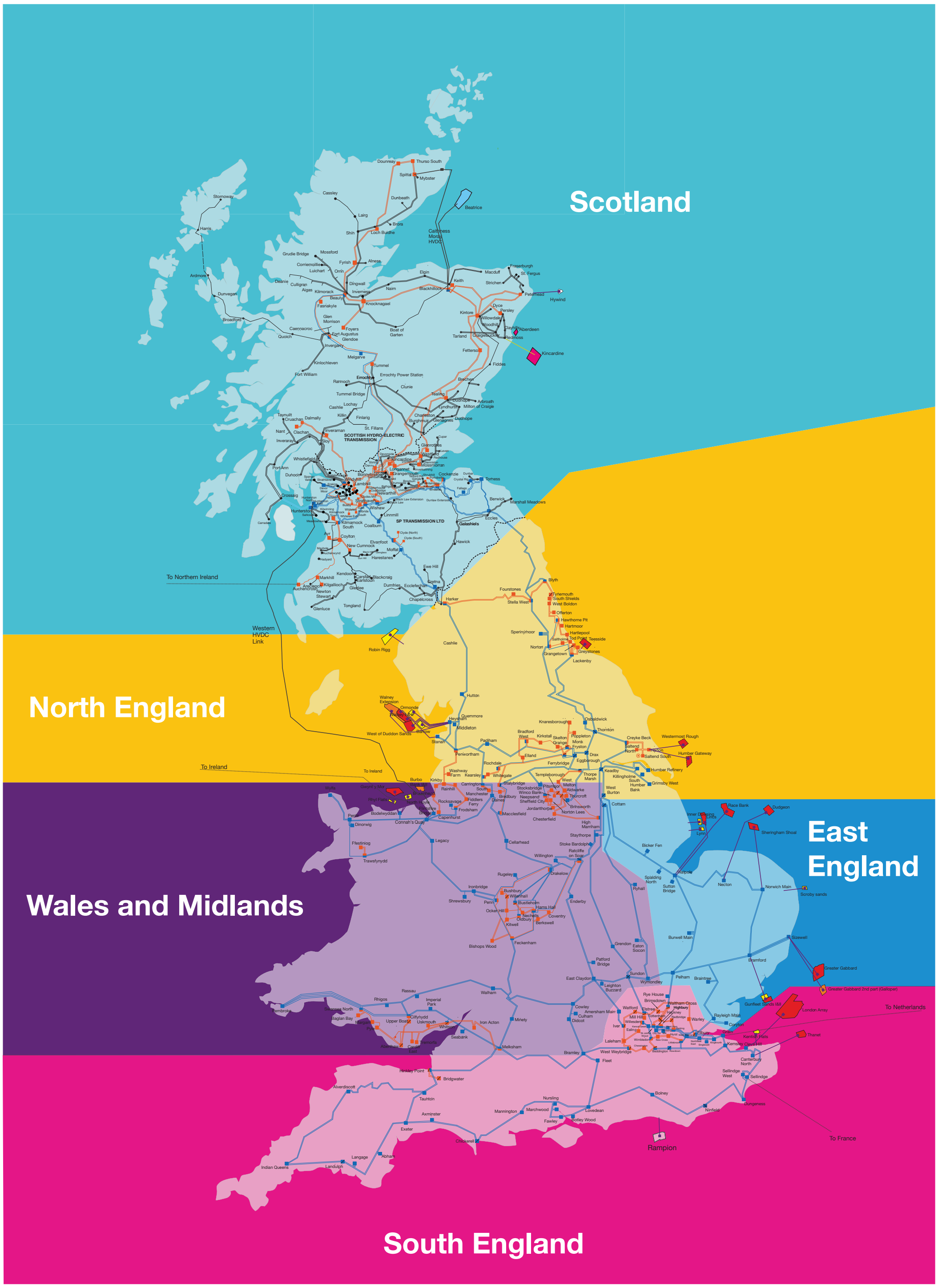
Figure 3.1 shows all the boundaries we have considered for our *ETYS* analysis. Over the years, we have continuously developed the transmission network to ensure there is sufficient transmission capacity to effectively transport power across the country.

Figure 3.1
GB NETS boundaries



To help describe related issues, we have grouped the boundaries into five regions, as shown in Figure 3.2.

Figure 3.2
Regional map



Determining the present capability and future requirements of the NETS boundaries

The boundaries used by *ETYS* and *NOA* can be split into two different types:

Local boundaries – are those which encompass small areas of the NETS with high concentration of generation. These small power export areas can give high probability of stressing the local transmission network due to coincidental generation operation.

Wider boundaries – are those that split the NETS into large areas containing significant amounts of both generation and demand. The SQSS boundary scaling methodologies are used to assess the network capability of the wider boundaries. These methodologies take into account both the geographical and technological effects of generation. This allows for a fair and consistent capability and requirements assessment of the NETS.

- **The security criterion –** evaluates the NETS's boundary transfer requirements to satisfy demand without reliance on intermittent generators or imports from interconnectors. The relevant methodology for determining the security needs and capability are from the SQSS Appendices C and D.
- **The economy criterion –** defines the NETS's boundary transfer requirements when demand is met with high output from intermittent and low carbon generators and imports from interconnectors. This is to ensure that transmission capacity is adequate to transmit power from the highly variable generation types without undue constraint. The relevant methodology for determining the economy needs and capability are from the SQSS Appendices E and F.

Interpreting the boundary graphs

The format of the *ETYS* boundary transfer graphs has changed from last year. The graphs now show a distribution of power flow for each scenario, in addition to the boundary power transfer capability and NETS SQSS requirements for the next twenty years. Using the B6 boundary charts as an example (Figure 3.3), it can be seen that a separate chart is provided for each of the four *Future Energy Scenarios*. Each scenario has different generation and demand so produces different boundary power flow expectations.

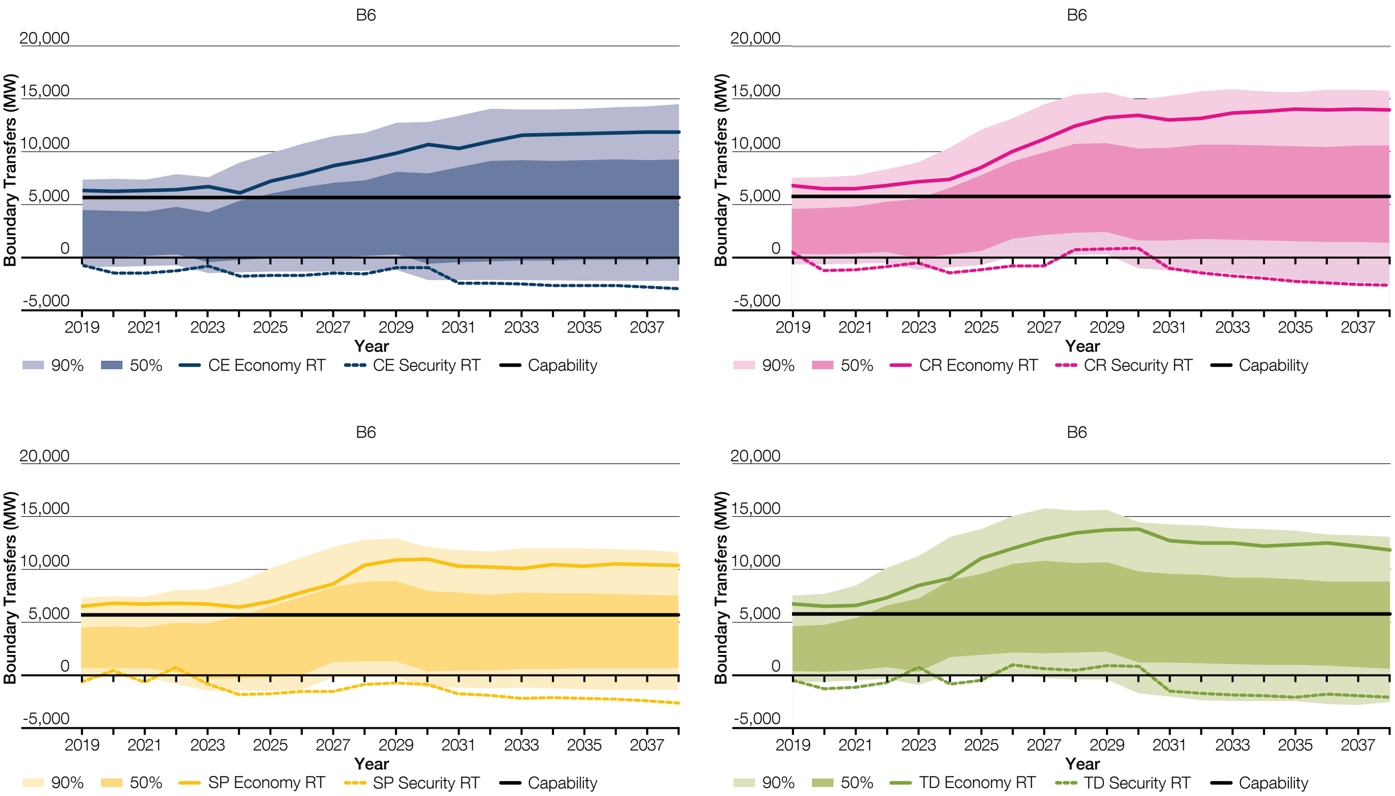
The NETS SQSS sets the methodology to set the wider boundary planning requirements, i.e., the Economy and Security criteria discussed above. These are shown in the graphs as a solid coloured line for Economy required transfer and a dashed coloured line for Security required transfer.

Boundary capability, in accordance with NETS SQSS requirements, is represented as a solid flat line on the graphs. The line position is calculated to represent the expected boundary capability for the coming 2018/19 winter peak. The boundary capability will change over time as the network, generation and demand change, all of which are uncertain. Therefore, to show system future needs and opportunities for each boundary a single straight capability line based on the present conditions is shown.

Two shaded areas are now shown on each boundary graph which represents the distribution of annual power flow. The darker shaded area shows an area in which 50% of the annual power flows lie. In percentile terms, 75% of annual power flows are lower than the upper edge of the darker shaded area and 75% are higher than the lower edge. The lighter and darker shaded areas together show an area in which 90% of the annual power flows lie. In percentile terms, 95% of annual power flows are lower than the upper edge of the lighter shaded area and 95% are higher than the lower edge.

The calculations of the annual boundary flow are based on unconstrained market operation, meaning network restrictions are not applied. This way, the minimum cost generation output profile can be found. By looking at the free market power flows in comparison with boundary capability, it can be seen where future growing needs can be expected.

Figure 3.3
Example of boundary transfer graphs and base capability for a boundary



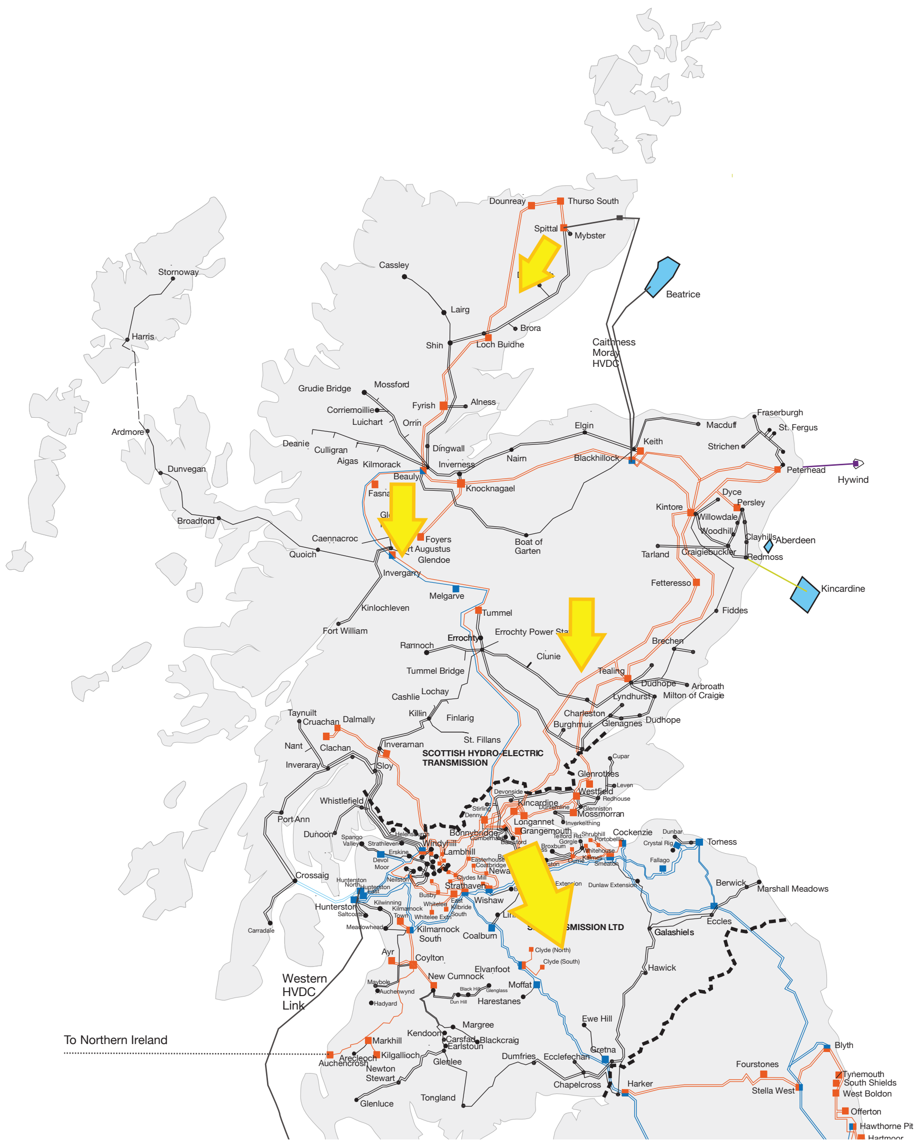
Stakeholder engagement
If you have feedback on any of the content of this document please send it to **transmission.etys@nationalgrid.com**, catch up with us at one of our consultation events or visit us at National Grid ESO, Faraday House, Warwick.

3.4 Network capability and requirements by region – Scottish boundaries

Introduction

The following section describes the Scottish transmission networks up to the transmission ownership boundary with the England and Wales transmission network. The onshore transmission network in Scotland is owned by SHE Transmission and SP Transmission but is operated by National Grid as the ESO. The Scottish NETS is divided by boundaries B0, B1, B1a, B2, B3b, B4, B5 and B6. The B4 boundary is shared by SHE Transmission and SP Transmission. The B6 boundary is shared by SP Transmission and National Grid Electricity Transmission. The figure below shows the general pattern of power flow directions expected to occur most of the time in the years to come up to 2028, i.e power will generally flow from north to south. The arrows in the diagram illustrate power flow directions and are approximately scaled relative to the winter peak flows. The flow of power is largely dependent on the output from wind and other generation sources in Scotland. There will be times, most likely when wind is low and demand is high, when power will flow from south to north.

Figure SR.1
Scottish transmission network and the typical direction of power flows



Primary challenge statement:

Scotland is experiencing large growth in renewable generation capacity, often in areas where the electricity network is limited.

Regional drivers

The rapidly increasing generation capacity, mostly from renewable sources and mainly wind, connecting within Scotland is leading to future growing needs in some areas. Across all the *FES,* the fossil fuel generating capacity in Scotland reaches nearly zero, while interconnector and storage capacity increases. By 2035, the scenarios (shown in Figure SR.2) suggest a total Scottish generating capacity of between 20 and 25 GW.

This potentially leads to increasingly dynamic Scottish network behaviour depending on factors such as weather condition and price of electricity. With gross demand in Scotland not expected to exceed 6 GW (shown in Figure SR.3) by 2040, which is much less than the Scottish generation capacity, Scotland will be expected to export power into England most of the time. At times of low renewable output, Scotland may need to import power from England. In a highly decentralised scenario like **Community Renewables**, local generation capacity connected at the distribution level in Scotland region could reach up to more than 13 GW by 2040. Of that capacity, a typical total embedded generation output on average might be around 4.7 GW. This will vary depending on factors like wind speeds, and how other local generators decide to participate in the market.

Figure SR.2
Generation capacity mix scenarios for Scotland

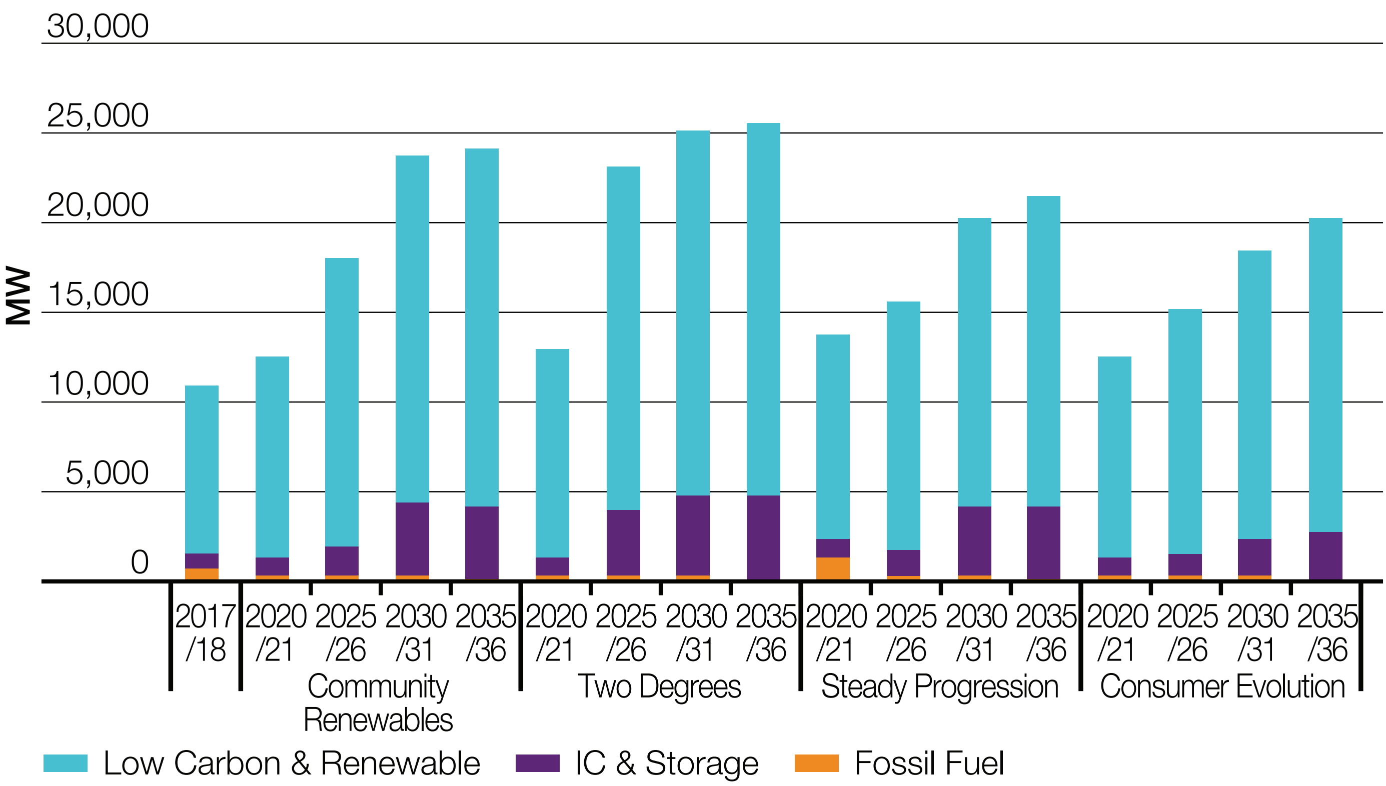
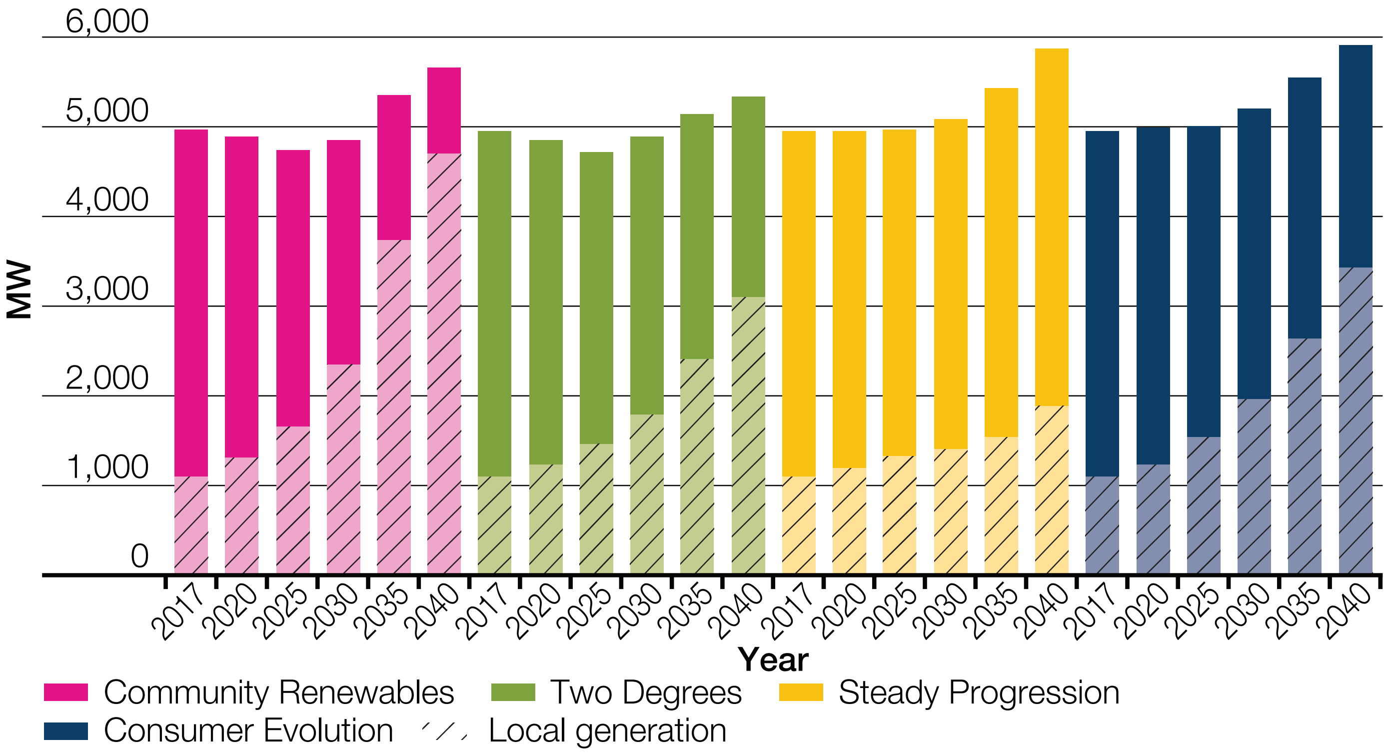


Figure SR.3
Gross demand scenarios for Scotland



The anticipated increase in renewable generation in Scotland is increasing power transfer across the Scottish boundaries. On a local basis, with the anticipated generation development in the north of Scotland, including generation developments on the Western Isles, Orkney and the Shetland Islands, there may be limitations on power transfer from generation in the remote Scottish NETS locations to the main transmission routes (B0, B1).

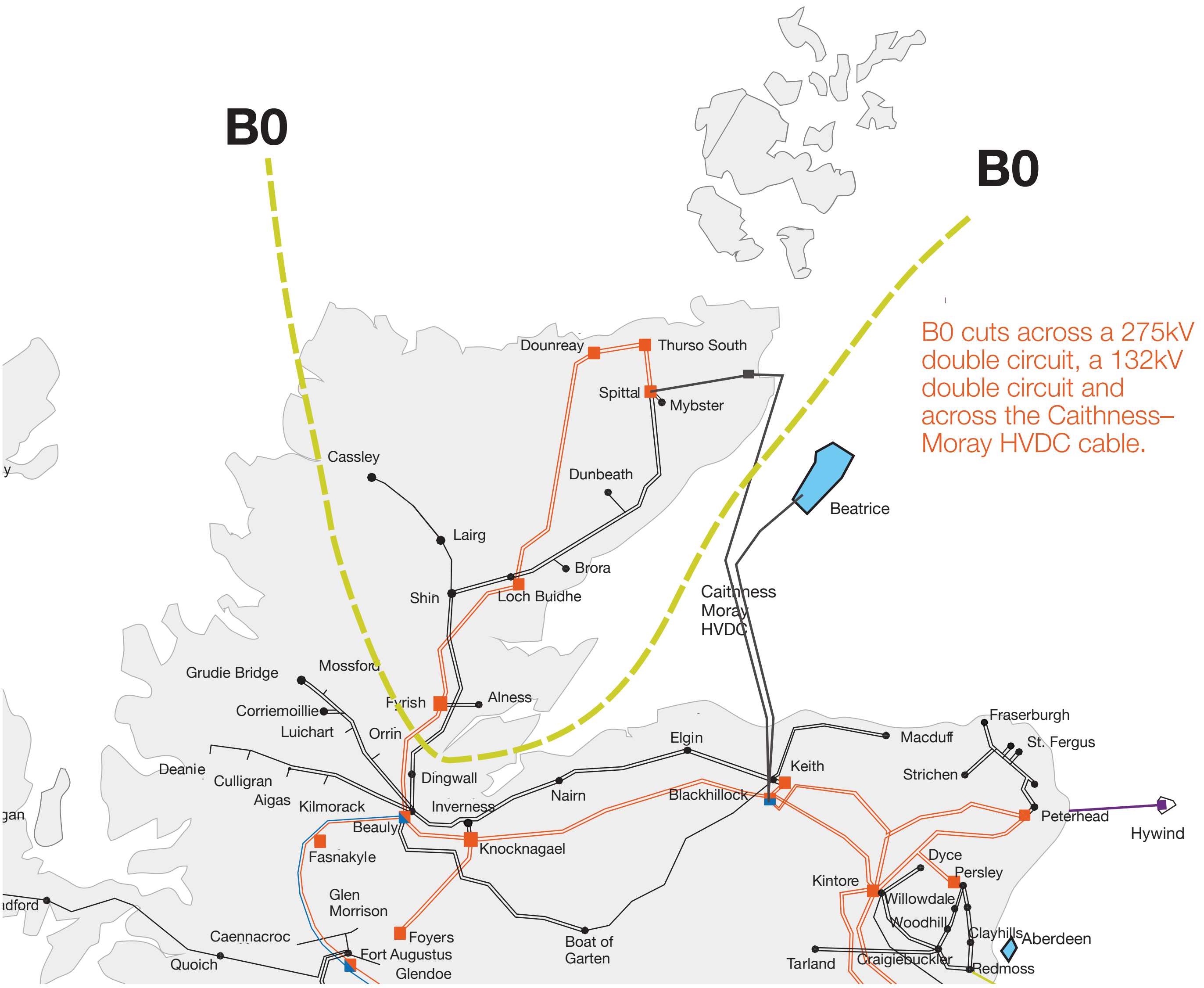
The Argyll and the Kintyre peninsula is an area with significant renewable generation activity and low demand. A boundary assessment is needed to show potential for high generation output and network limitations to power flows on this part of the NETS (B3b).

As generation within these areas increases over time because of the high volume of new renewable generation seeking connection, boundary transfers across the Scottish NETS boundaries (B0, B1, B1a, B2, B3b, B4 and B5 and B6) increase.

The need for network reinforcement to address the above mentioned potential capability issues will be evaluated in the *NOA 2018/19* CBA. Following the evaluation, the preferred reinforcements for the Scotland region will be recommended.

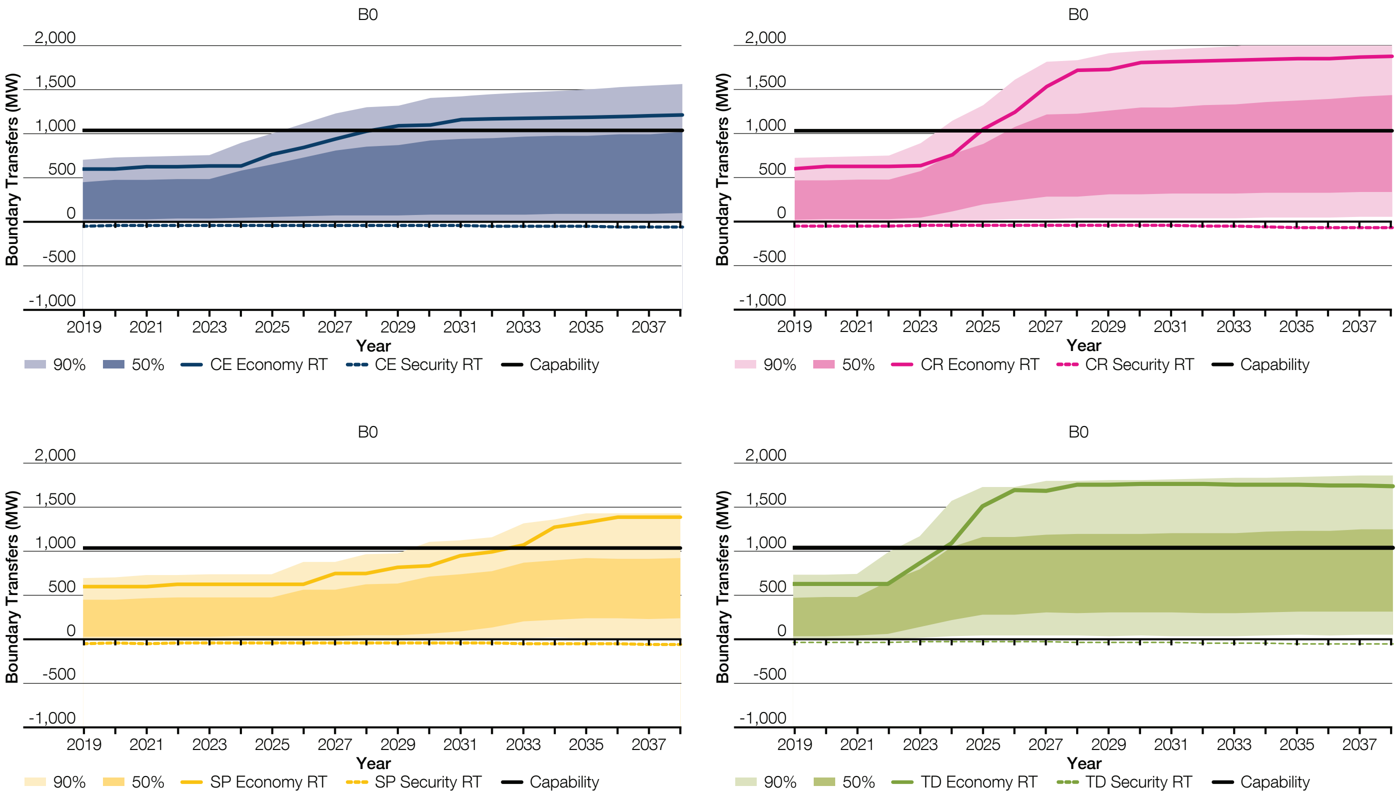
Boundary B0 – Upper North SHE Transmission

Figure B0.1
Geographic representation of boundary B0



Boundary B0 separates the area north of Beauly, comprising the north of the Highlands, Caithness, Sutherland and Orkney. The Caithness–Moray HVDC subsea cable, and associated onshore works, are scheduled to be completed in December 2018, and this will significantly strengthen the transmission network north of Beauly.

Figure B0.2
Boundary flows and base capability for boundary B0



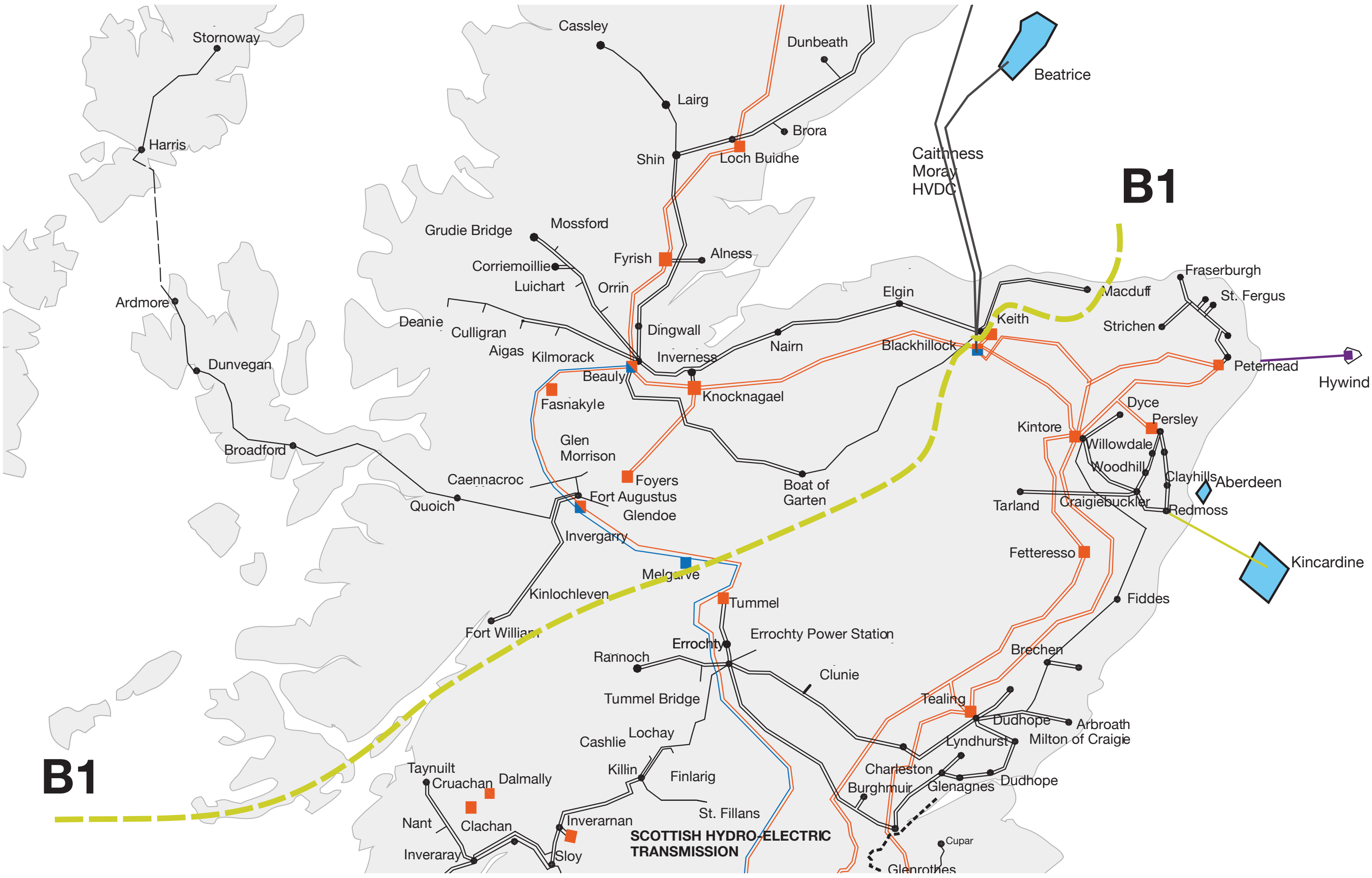
Boundary requirements and capability

Figure B0.2 above shows the projected boundary flows for B0 for the next 20 years. The boundary capability is limited to around 1.0 GW, following the completion of the Caithness–Moray reinforcement project in December 2018, due to a thermal constraint.

The power transfer through B0 is increasing due to the substantial growth of renewable generation north of the boundary. This generation is primarily onshore wind, with the prospect of significant marine generation resource in the Pentland Firth and Orkney waters in the longer term.

Boundary B1 – North West SHE Transmission

Figure B1.1
Geographic representation of boundary B1

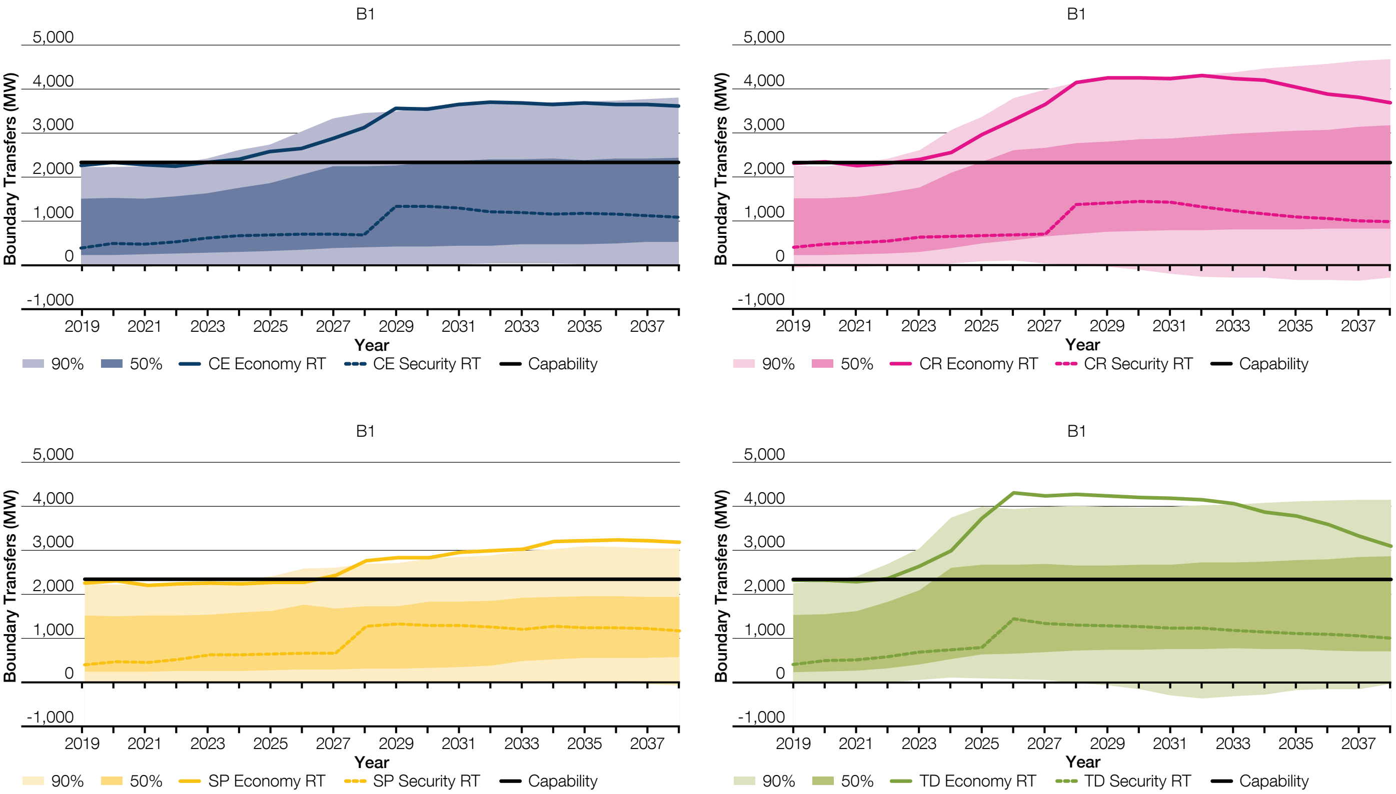


B1 crosses a 275kV double circuit, two 275/132kV auto-transformer circuits and a double circuit with one circuit at 400kV and the other at 275kV

Boundary B1 runs from the Moray coast near Macduff to the west coast near Oban, separating the north-west of Scotland from the southern and eastern regions.

The existing transmission infrastructure in this area comprises mostly 275kV and 132kV assets. The Caithness–Moray reinforcement project will increase the boundary capability allowing increased export in power across boundary B1.

Figure B1.2
Boundary flows and base capability for boundary B1



Boundary requirements and capability

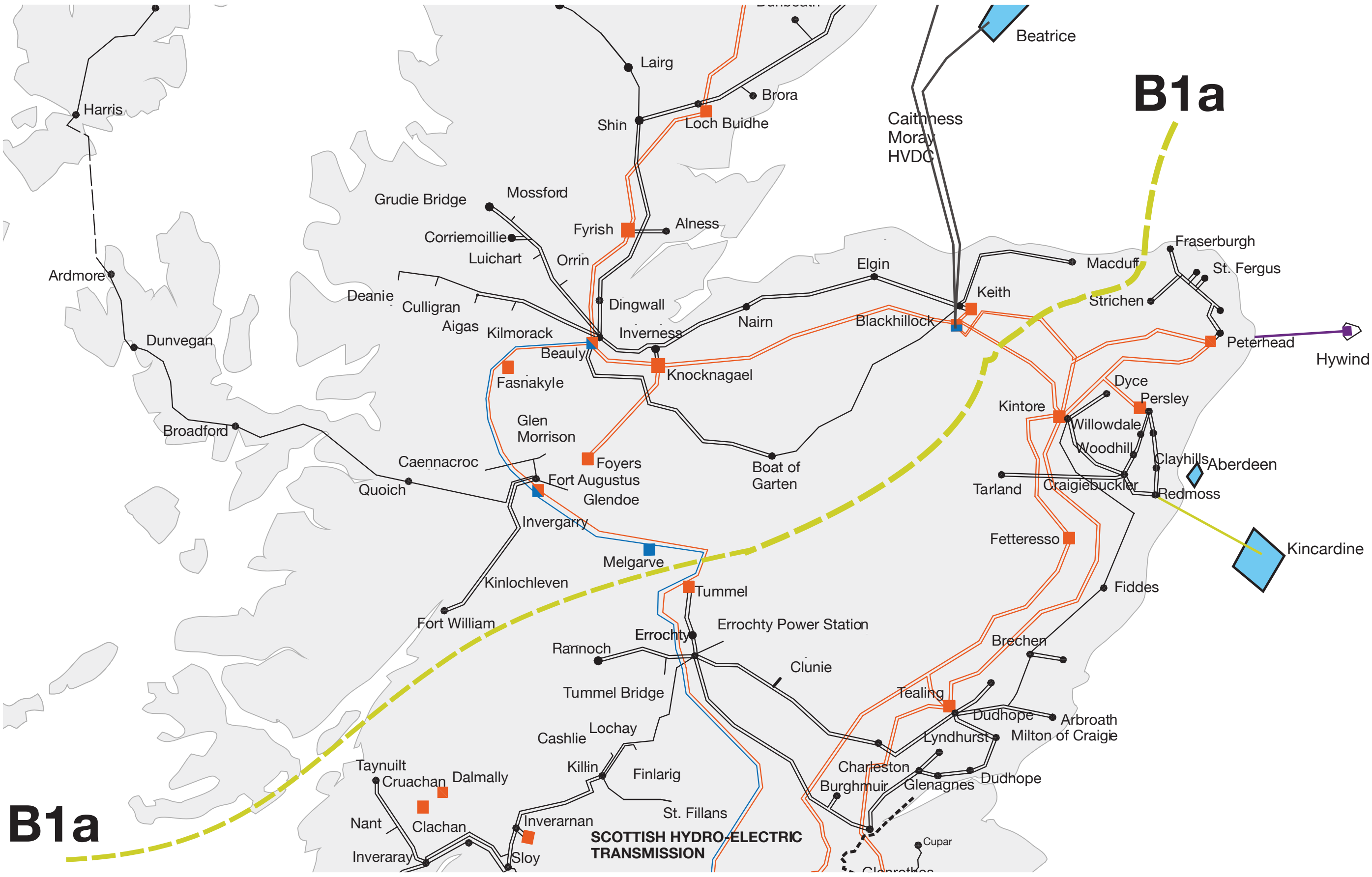
Figure B1.2 above shows the projected boundary flows for B1 for the next 20 years. The boundary capability is limited to around 2.3 GW, following the completion of the Caithness–Moray reinforcement project in December 2018, due to a thermal constraint.

New renewable generation connections north of the boundary are expected to result in a significant increase in export requirements across the boundary. All generation north of boundary B0 also lies behind boundary B1.

In all the scenarios, there is an increase in the power transfer through B1 due to the large volume of renewable generation connected to the north of this boundary. Although this is primarily onshore wind and hydro, there is the prospect of significant additional wind, wave and tidal generation resources being connected in the longer term. Contracted generation behind boundary B1 includes the renewable generation on the Western Isles, Orkney and the Shetland Isles as well as a considerable volume of large and small onshore wind developments. A large new pump storage generator is also planned in the Fort Augustus area. Some marine generation is also expected to connect in this region during the *ETYS* period. This is supplemented by existing generation, which comprises around 800 MW of hydro and 300 MW of pumped storage at Foyers.

Boundary B1a – North West 1a SHE Transmission

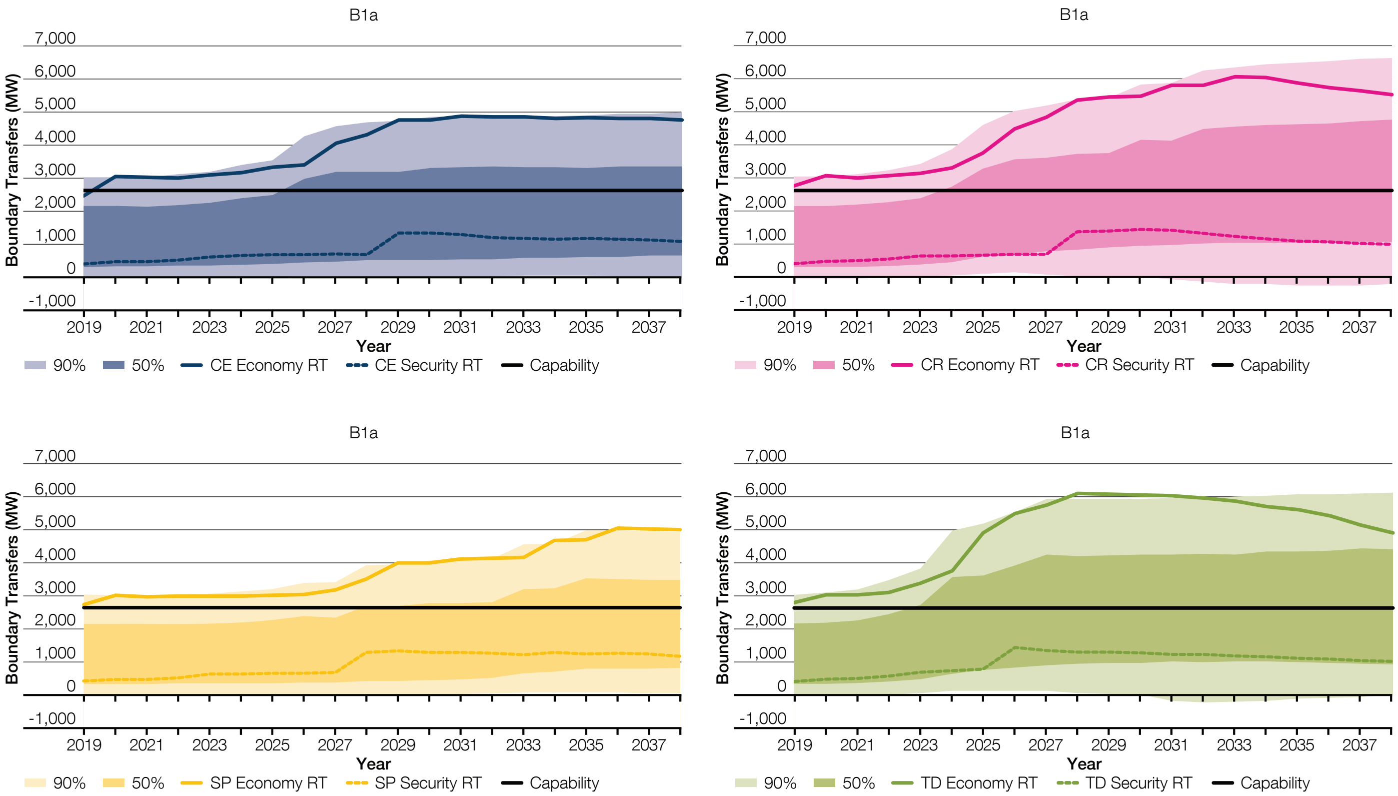
Figure B1a.1
Geographic representation of boundary B1a



B1a crosses two 275kV double circuits and a double circuit with one circuit at 400kV and the other at 275kV

Boundary B1a runs from the Moray coast near Macduff to the west coast near Oban, separating the north west of Scotland from the southern and eastern regions. High renewables output causes high transfers across this boundary. The difference from boundary B1 is that Blackhillock substation is north of the B1a boundary.

Figure B1a.2
Boundary flows and base capability for boundary B1a



Boundary requirements and capability

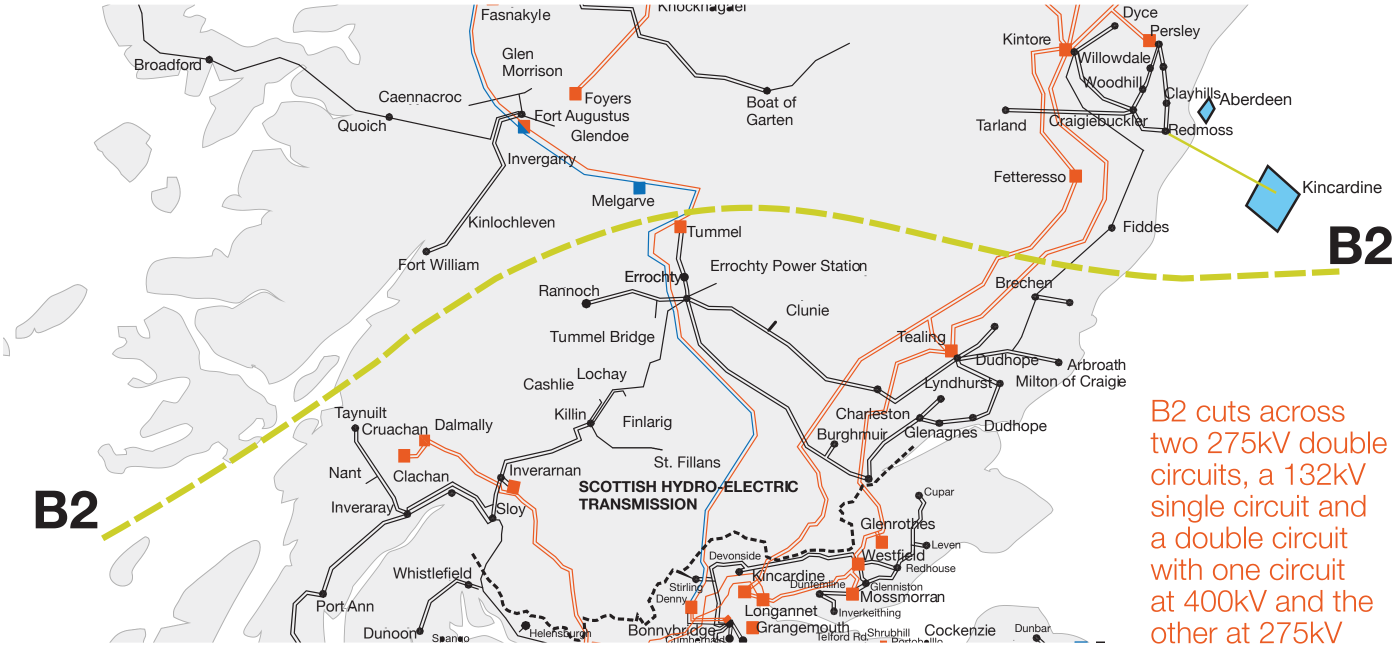
Figure B1a.2 above shows the projected boundary flows for B1a for the next 20 years. The boundary capability is currently limited to around 2.6 GW due to a thermal constraint.

New renewable generation connections north of the boundary are expected to result in a significant increase in export requirements across the boundary. All generation north of boundaries B0 and B1 also lies behind boundary B1a.

In all the *FES*, there is an increase in the power transfer through B1a due to the large volume of renewable generation connecting to the north of this boundary. Although this is primarily onshore wind and hydro, there is the prospect of significant additional wind, wave and tidal generation resources being connected in the longer term. Contracted generation behind boundary B1a includes the renewable generation on the Western Isles, Orkney and the Shetland Isles with a considerable volume of large and small onshore wind developments. A large new pump storage generator is also planned in the Fort Augustus area. Some marine generation is also expected to connect in this region during the *ETYS* period. This is supplemented by existing generation, which comprises around 800 MW of hydro and 300 MW of pumped storage at Foyers.

Boundary B2 – North to South SHE Transmission

Figure B2.1
Geographic representation of boundary B2

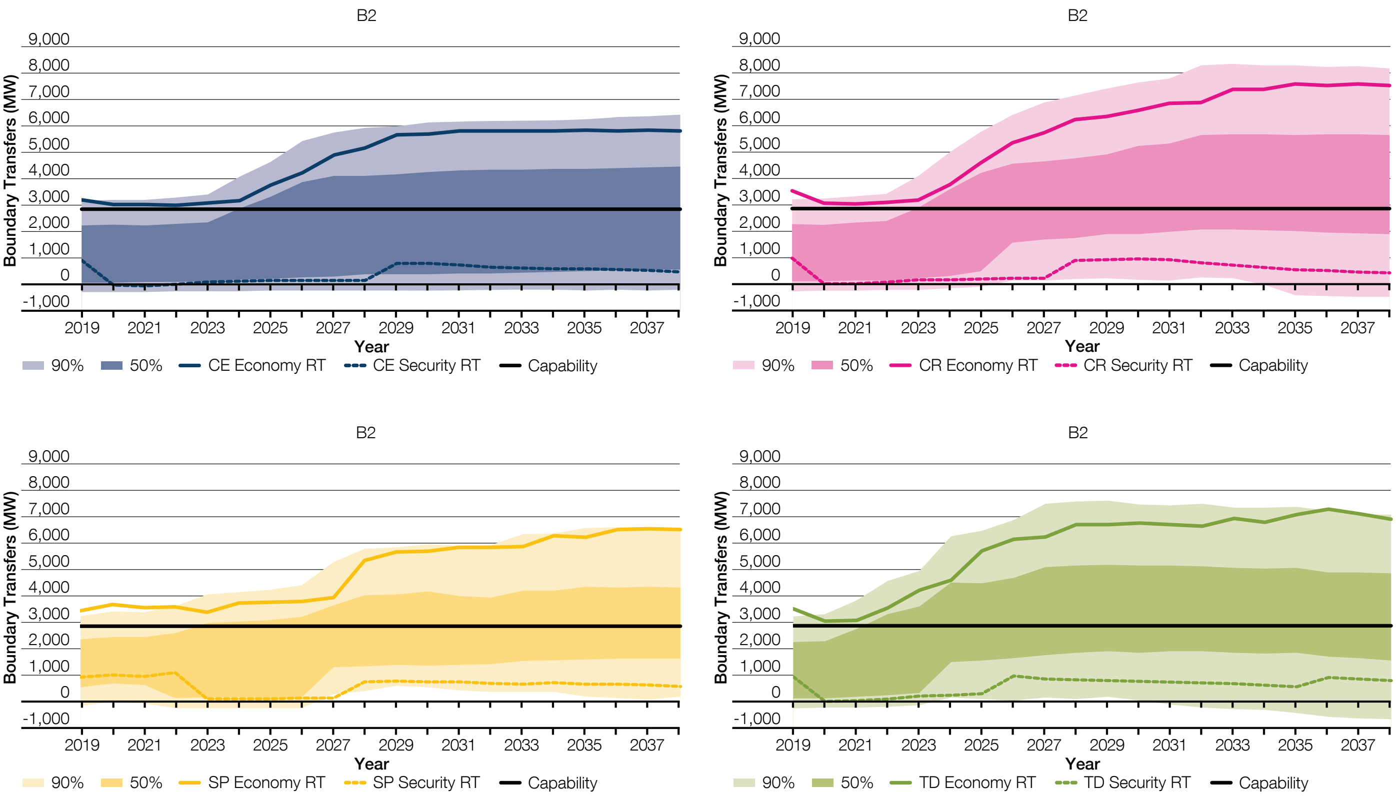


B2 cuts across two 275kV double circuits, a 132kV single circuit and a double circuit with one circuit at 400kV and the other at 275kV

Boundary B2 cuts across the Scottish mainland from the east coast between Aberdeen and Dundee to near Oban on the west coast. As a result it crosses all the main north-south transmission routes from the north of Scotland.

The generation behind boundary B2 includes both onshore and offshore wind, with the prospect of significant marine generation resource being connected in the longer term. There is also the potential for an additional pumped storage plant to be located in the Fort Augustus area. The thermal generation at Peterhead lies between boundaries B1 and B2, as do several offshore windfarms and the proposed future North Connect interconnector with Norway.

Figure B2.2
Boundary flows and base capability for boundary B2



Boundary requirements and capability

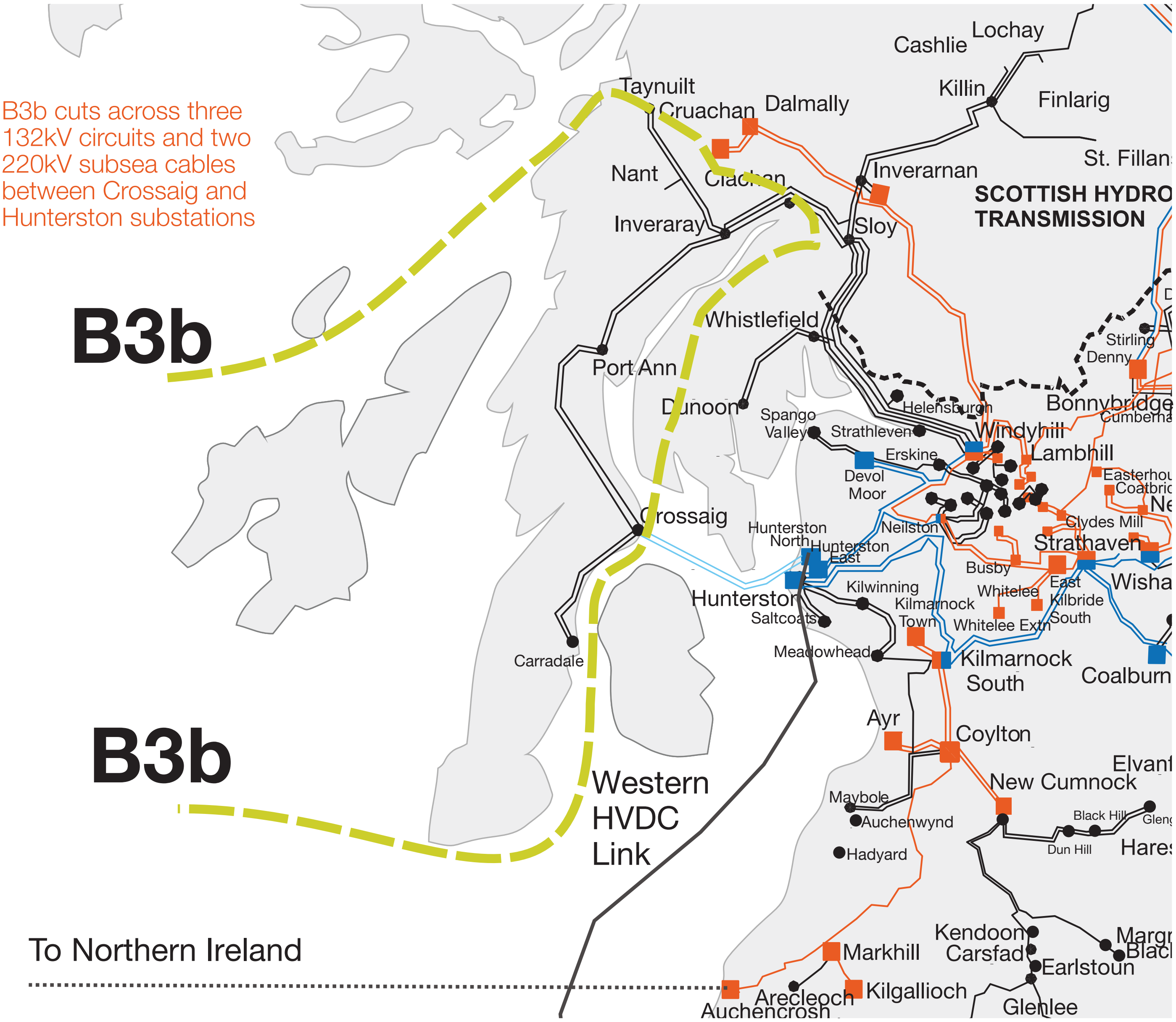
Figure B2.2 above shows the projected boundary flows for B2 for the next 20 years. The boundary capability is currently limited to around 2.9 GW due to a thermal constraint.

The potential future boundary transfers for boundary B2 are increasing at a significant rate because of the high volume of renewable generation to be connected to the north of the boundary.

The increase in the required transfer capability for this boundary across all generation scenarios indicates the strong potential need to reinforce the transmission system.

Boundary B3b – Kintyre and Argyll SHE Transmission

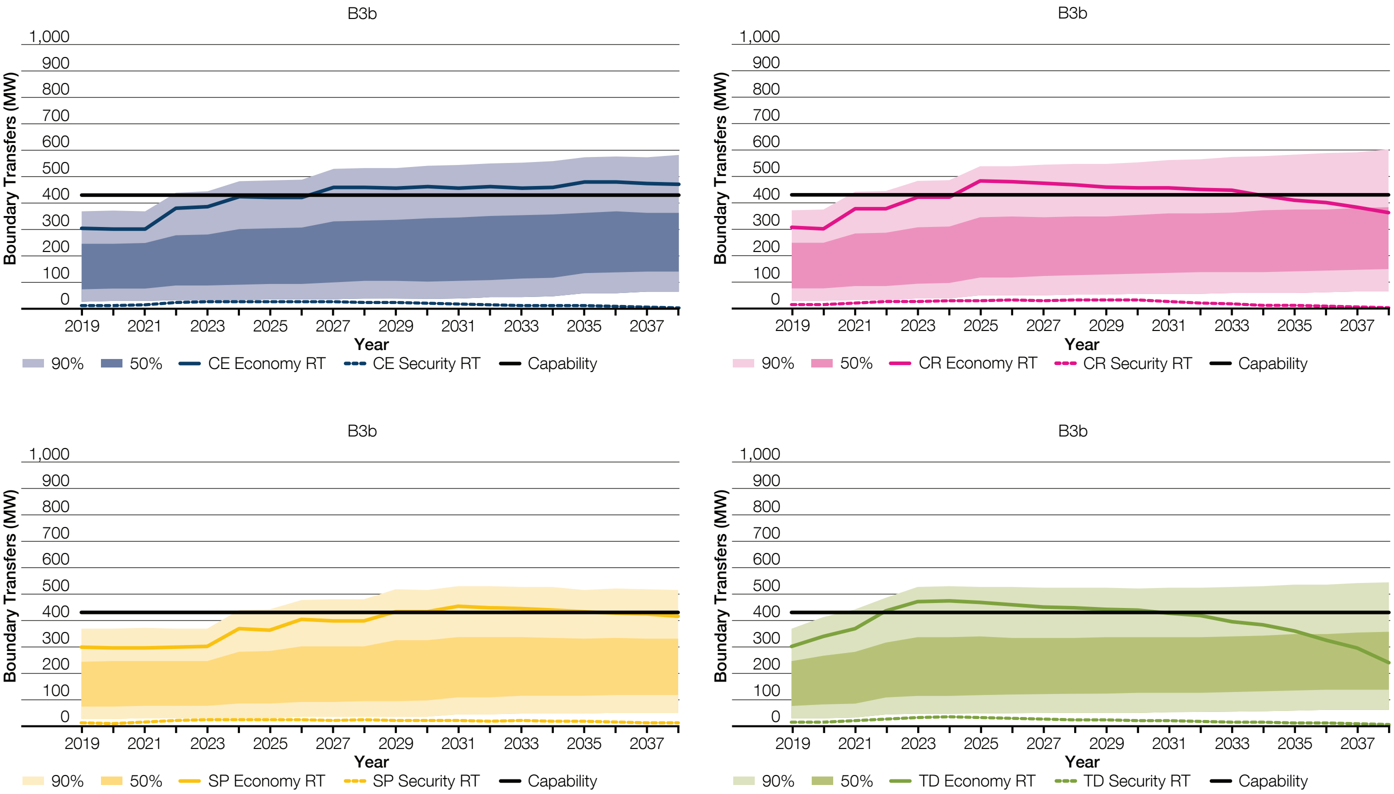
Figure B3b.1
Geographic representation of boundary B3b



Boundary B3b encompasses the Argyll and Kintyre peninsula, and boundary assessments are used to show limitations on the generation power flow out of the peninsula.

The generation within boundary B3b includes both onshore wind and hydro generation, with the prospect of further wind generation resource and the potential for marine generation being connected in the future, triggering the requirement for future reinforcement of this network.

Figure B3b.2
Boundary flows and base capability for boundary B3b



Boundary requirements and capability

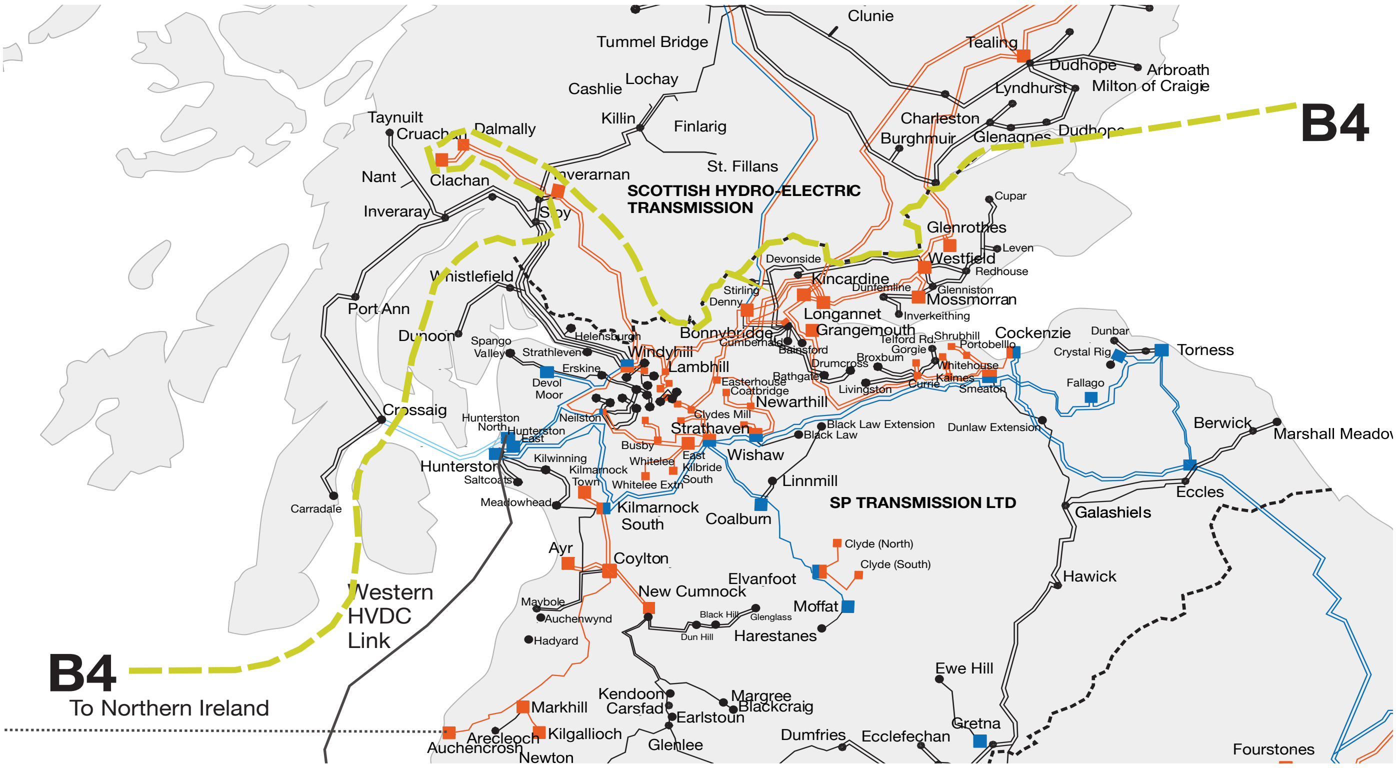
Figure B3b.2 above shows the projected boundary flows for B3b for the next 20 years. The boundary capability is currently limited to around 0.43 GW due to a thermal constraint.

In all of the *FES*, the power transfer across boundary B3b increases because of potential generation connecting within the boundary. This is primarily onshore wind generation, with the prospect of marine generation resource being connected as well.

The increase in the potential required transfer capability indicates the potential need to reinforce the transmission network across boundary B3b.

Boundary B4 – SHE Transmission to SP Transmission

Figure B4.1
Geographic representation of boundary B4

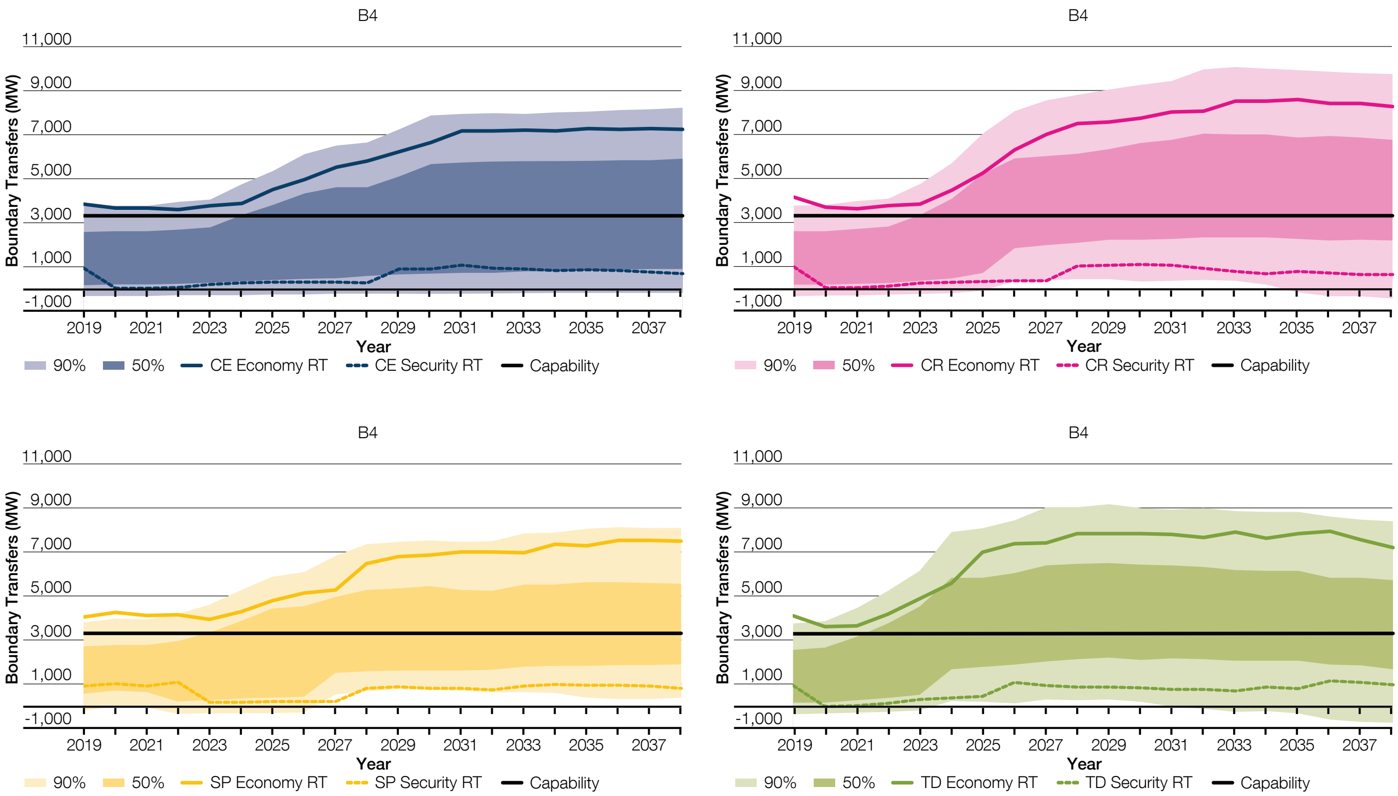


B4 cuts across two 275kV double circuits, two 132kV double circuits, two 275/132kV auto-transformer circuits, two 220kV subsea cables between Crossaig and Hunterston substations, and a double circuit with one circuit at 400kV and the other at 275kV

Boundary B4 separates the transmission network at the SP Transmission and SHE Transmission interface running from the Firth of Tay in the east to the north of the Isle of Arran in the west. With increasing generation and potential interconnectors in the SHE Transmission area for all scenarios, the required transfer across boundary B4 is expected to increase significantly over the *ETYS* period.

The prospective generation behind boundary B4 includes around 2.7 GW of offshore wind from Rounds 1-3 and Scottish territorial waters located off the coast of Scotland.

Figure B4.2
Boundary flows and base capability for boundary B4



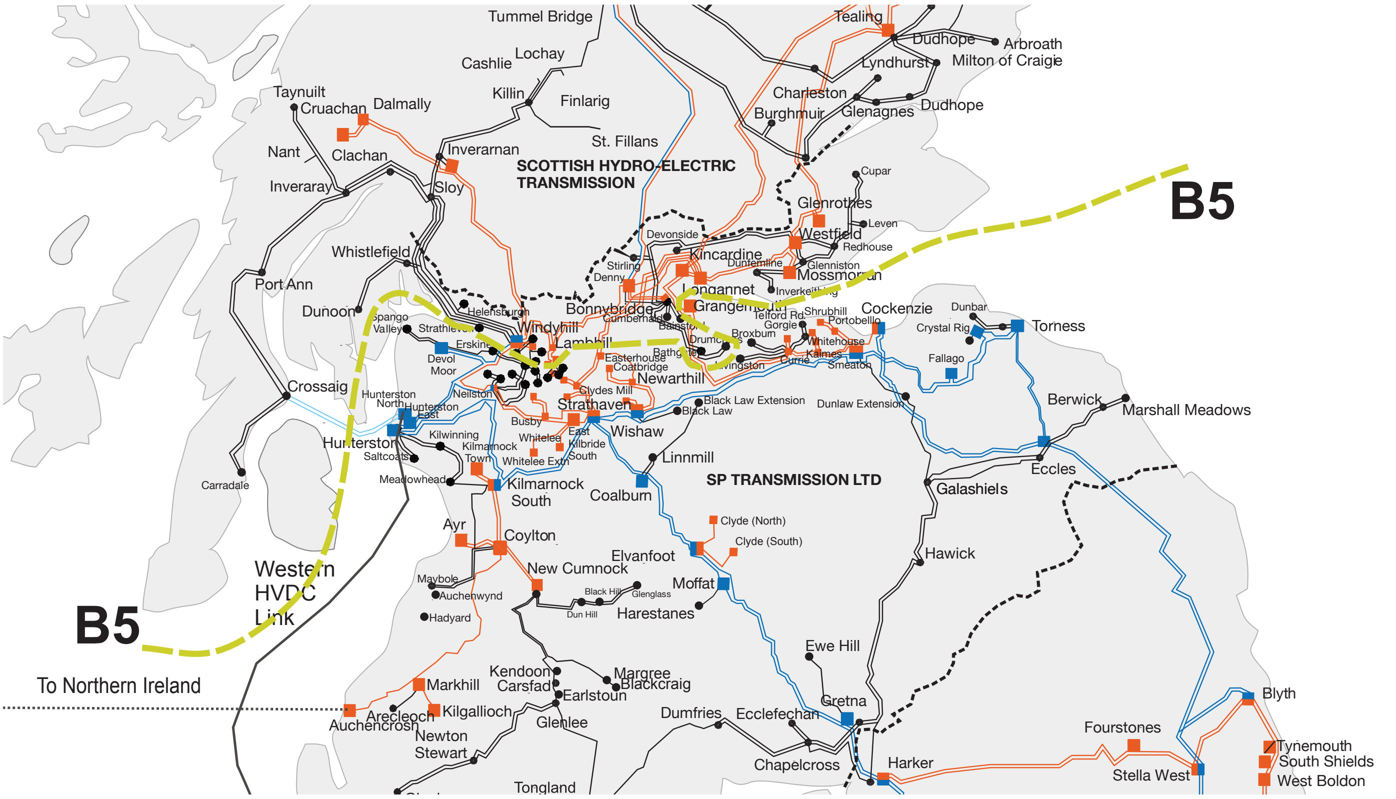
Boundary requirements and capability

Figure B4.2 above shows the projected boundary flows for B4 for the next 20 years. The current boundary capability is limited to around 3.3 GW due to a thermal constraint.

In all of the *FES*, the power transfer through boundary B4 increases because of the significant volumes of generation connecting north of the boundary, including all generation above boundaries B0, B1, B1a, B2 and B3b. This is primarily onshore and offshore wind generation, with the prospect of significant marine generation resource being connected in the longer term.

Boundary B5 – North to South SP Transmission

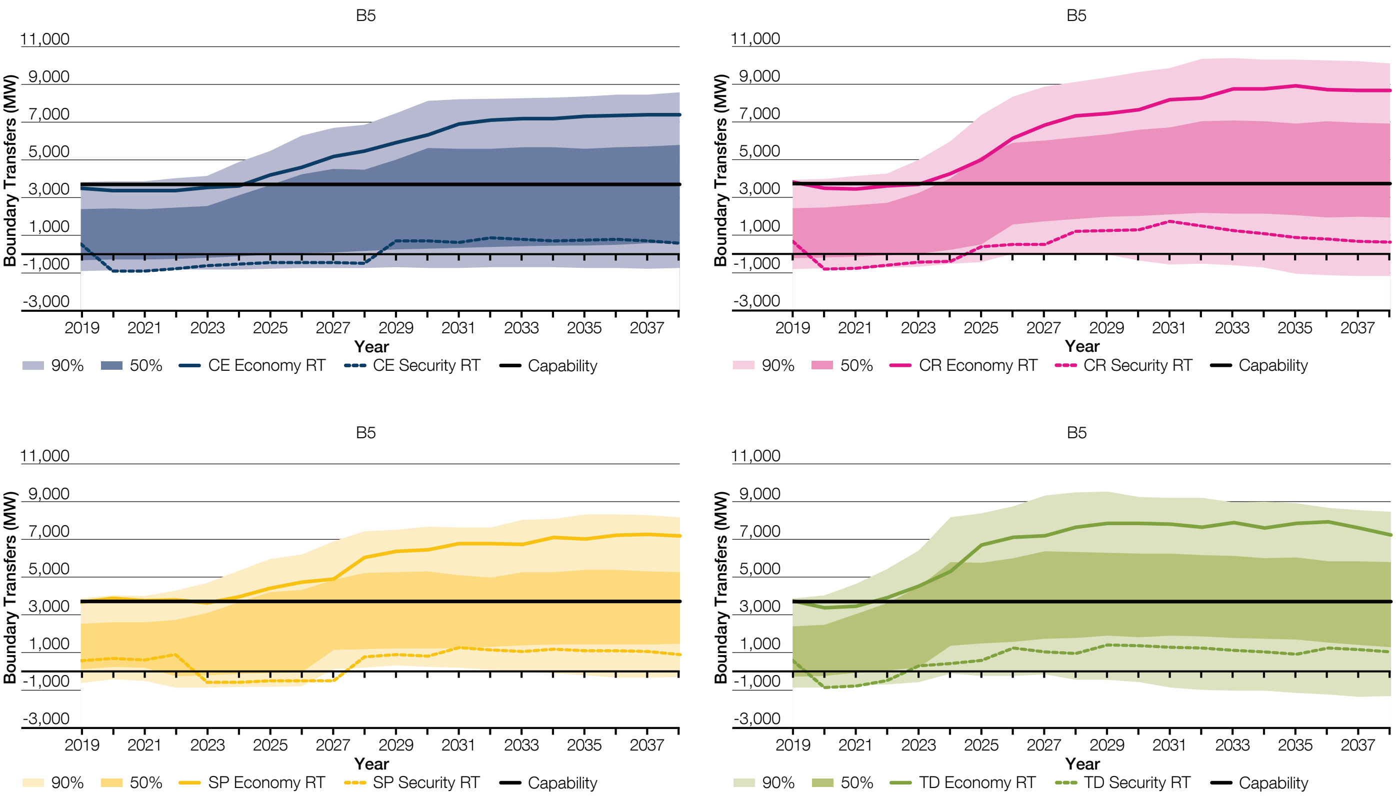
Figure B5.1
Geographic representation of boundary B5



B5 cuts across three 275kV double circuits and a double circuit with one circuit at 400kV and the other at 275kV. The Kintyre–Hunterston subsea link provides two additional circuits crossing B5

Boundary B5 is internal to the SP Transmission system and runs from the Firth of Clyde in the west to the Firth of Forth in the east. The generating station at Cruachan is located to the north of boundary B5, together with the demand groups served from Windyhill, Lambhill, Bonnybridge, Mossmorran and Westfield 275kV substations.

Figure B5.2
Boundary flows and base capability for boundary B5



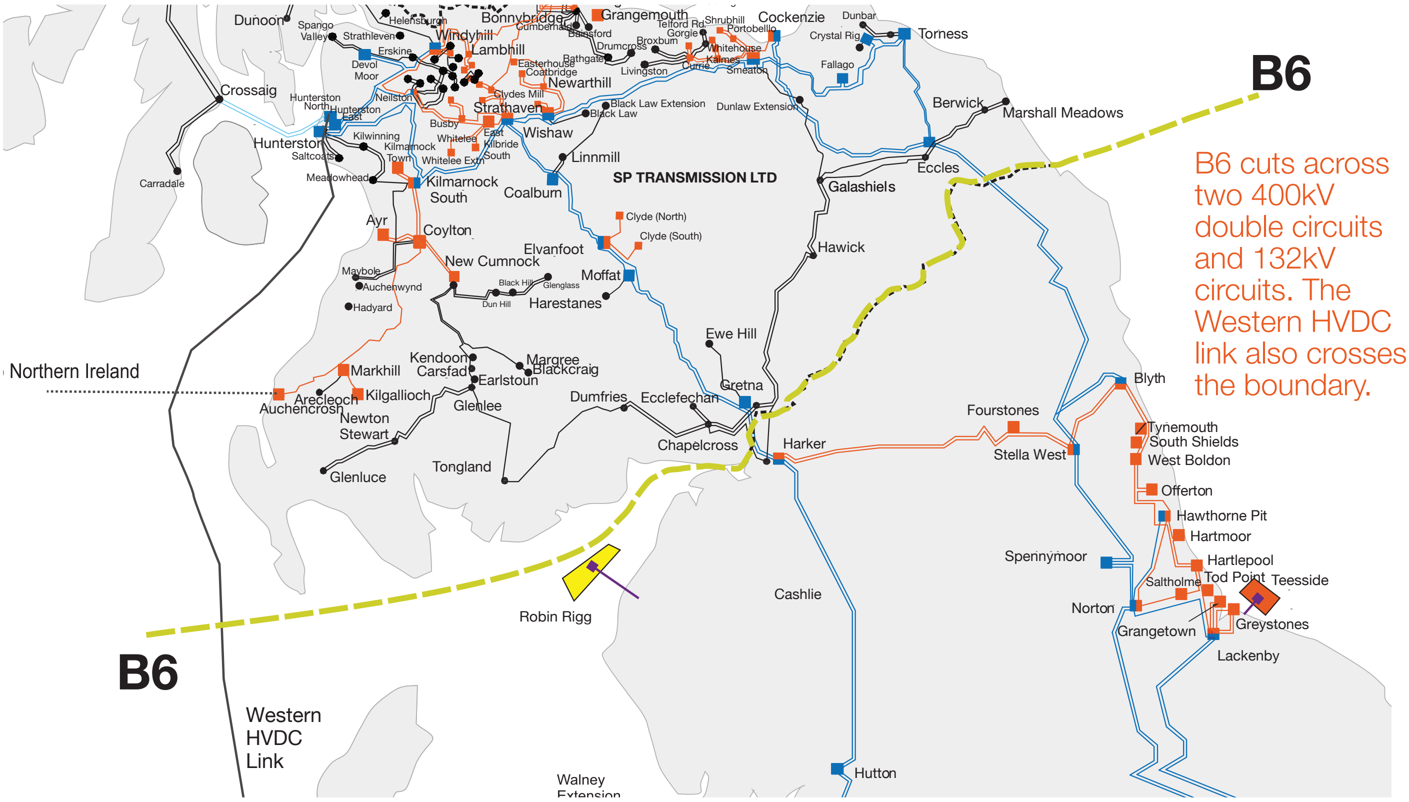
Boundary requirements and capability

Figure B5.2 above shows the projected boundary flows for B5 for the next 20 years. The capability of the boundary is presently limited by voltage constraints to around 3.7 GW.

In all of the *FES*, the power transfer through boundary B5 increases because of the significant volumes of generation connecting north of the boundary, including all generation above boundaries B0, B1, B2 and B4. This is primarily onshore and offshore wind generation.

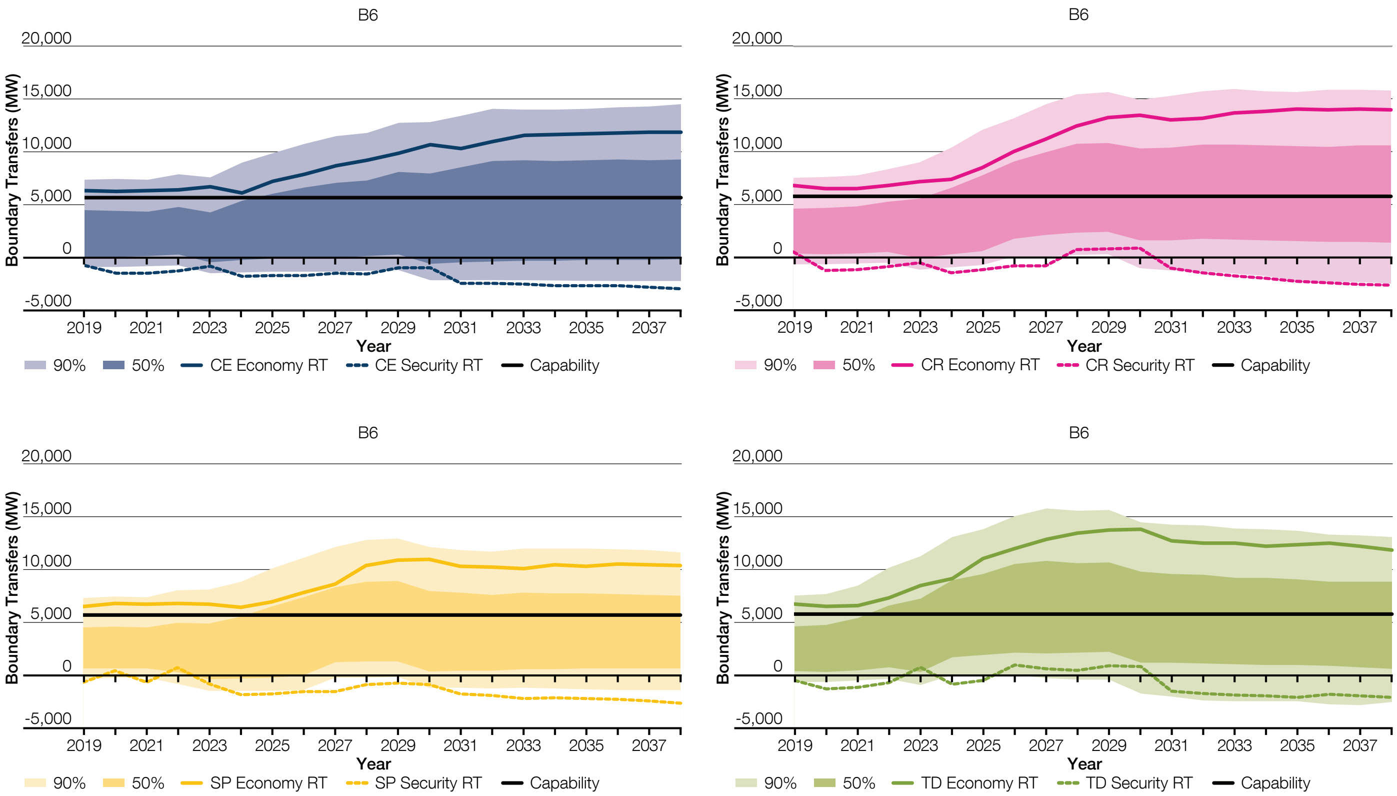
Boundary B6 – SP Transmission to NGET

Figure B6.1
Geographic representation of boundary B6



Boundary B6 separates the SP Transmission and the National Grid Electricity Transmission (NGET) systems. Scotland contains significantly more installed generation capacity than demand, increasingly from wind farms. Peak power flow requirements are typically from north to south at times of high renewable generation output.

Figure B6.2
Boundary flows and base capability for boundary B6



Boundary requirements and capability

Figure B6.2 above shows the projected boundary power flows crossing B6 for the next 20 years. The boundary capability has increased to 5.7 GW compared to last year due to the addition of the new Western HVDC circuit and upgrade of cables at Torness. The limit to the boundary capability now is a post-fault load rating of transformers at Harker.

Across all the *FES*, there is an increase in the required export capability from Scotland to England due to the connection of additional generation in Scotland, primarily onshore and offshore wind. This generation increase is partially offset by the expected closure of nuclear plants, the timing of which varies in each scenario.

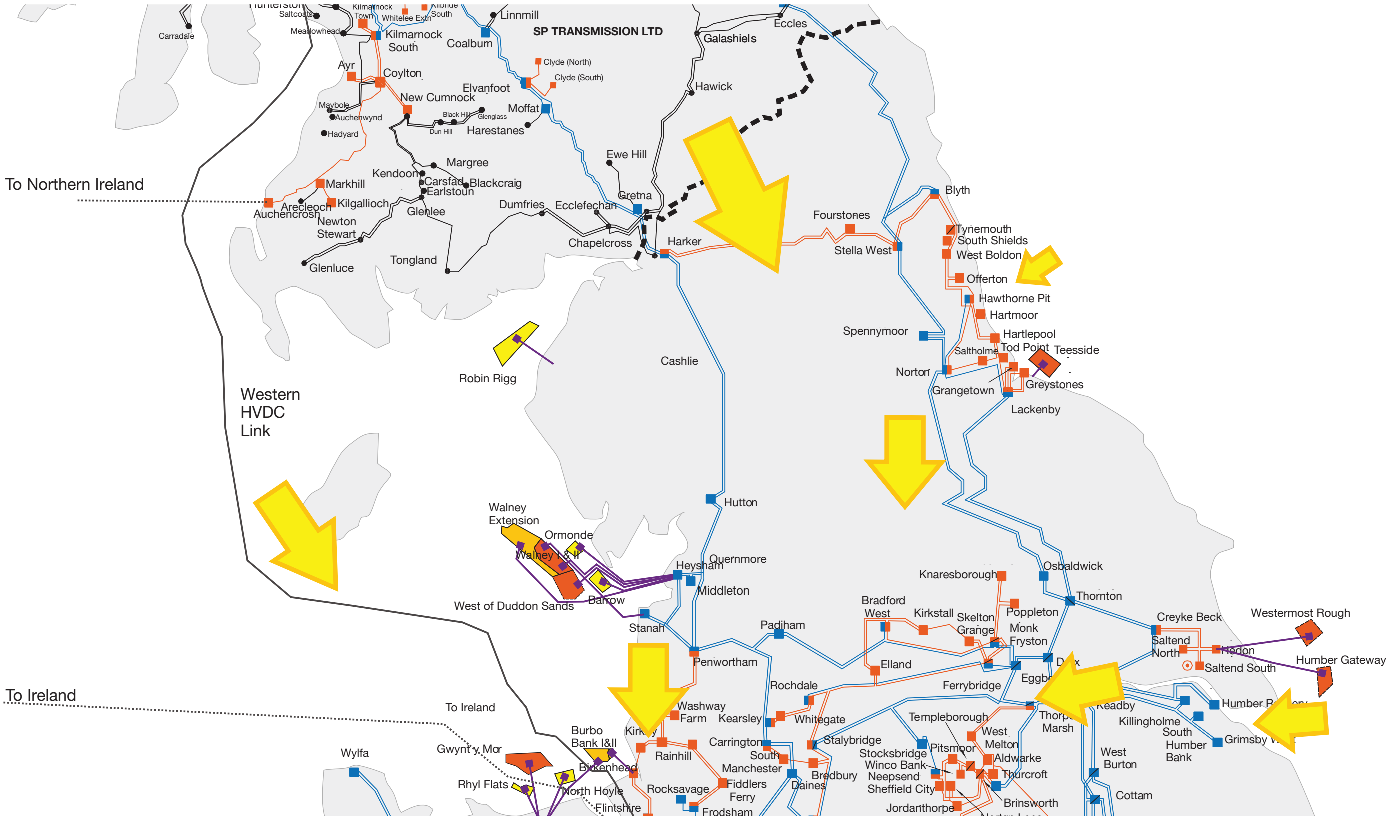
With the *FES* including many wind farms in Scotland, the spread of boundary power flows is very wide due to the intermittent nature of wind. With low generation output in Scotland it is credible to have power flowing from south to north feeding Scottish demand. The magnitude of the south to north power flows is low compared to those in the opposite direction so network capability should be sufficient to support those conditions. Some conventional synchronous generation must stay in Scotland to maintain year-round secure system operation.

3.5 Network capability and requirements by region – The North of England boundaries

Introduction

The North of England transmission region includes the transmission network between the Scottish border and the north Midlands. This includes the upper north boundaries B7, B7a and B8. The figure below shows likely power flow directions when it is windy.

Figure NE.1
North of England transmission network



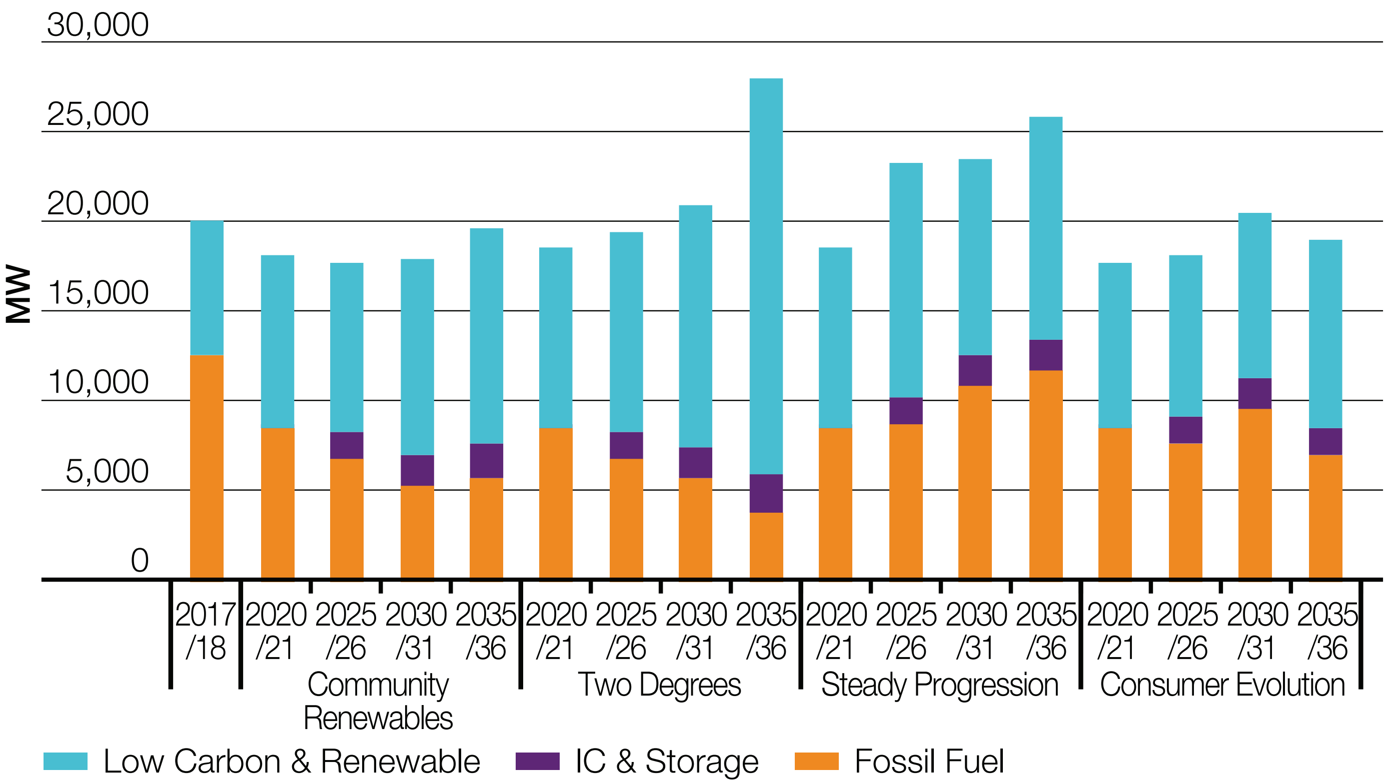
Primary challenge statement:

The connection of large amounts of new generation in Scotland and the north, most of which is intermittent renewables, will cause overloading in the northern transmission network unless appropriate reinforcements are in place. Future power transfer requirements could be more than double compared to what they are today.

Regional drivers

The *FES* suggest the northern transmission region could see a range of changes as shown in the graph below (Figure NE.2). All four scenarios suggest growth in low carbon and renewable generation in addition to new storage and interconnector developments. The connected fossil fuel generation could see either sustained decline or decline followed by growth depending on which way the scenarios develop. Large connections could cause network issues if connected to the north of the region.

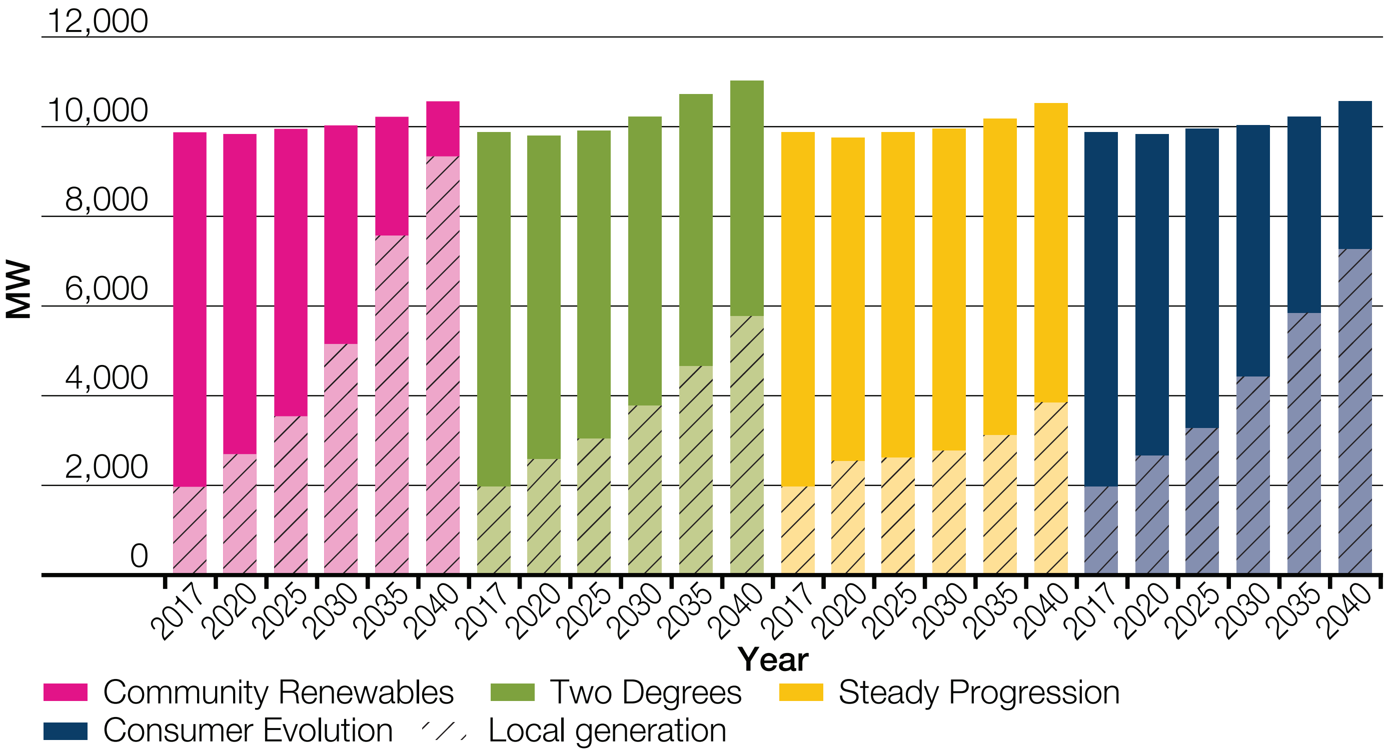
Figure NE.2
Generation capacity mix scenarios for the North of England



The gross demand in the region, as shown in Figure NE.3, could reasonably be expected to increase as can be seen for all scenarios. The amount of embedded local generation is also expected to increase, so the net demand seen by the transmission network could significantly reduce and even become net generation.

In a highly decentralised scenario like **Community Renewables**, local generation capacity connected at the distribution level in this northern region could reach up to more than 20 GW by 2040. Of that capacity, a typical total embedded generation output on average might be around 9 GW. This will vary depending on factors like wind speeds, and how other local generators decide to participate in the market.

Figure NE.3
Gross demand scenarios for the North of England



Presently, most of the northern transmission network is oriented for north-south power flows with connections for demand and generation along the way. At times of high wind generation the power flow will mostly be from north to south, with power coming from both internal boundary generation and generation further north in Scotland. When most of this area and Scotland is generating power, the transmission capability can be highly stressed. The loss of one of the north to south routes can have a highly undesirable impact on the remaining circuits.

The highly variable nature of power flows in the north presents challenges to voltage management, and therefore automatic reactive power control switching is utilised. This helps to manage the significant voltage drop due to reactive power demands which arise at times of high levels of power flow on long circuits. Operational reactive switching solutions are also used to manage light loading conditions when the voltage can rise to unacceptable levels. The region's voltage is also investigated in low demand summer hours, further details can be found in the case study presented at the end of the chapter.

The high concentration of large conventional generators around Humber and South Yorkshire means that system configuration can be limited by high fault levels. Therefore, some potential network capability restrictions in the north can be due to the inability to configure the network as desired due to fault level concerns.

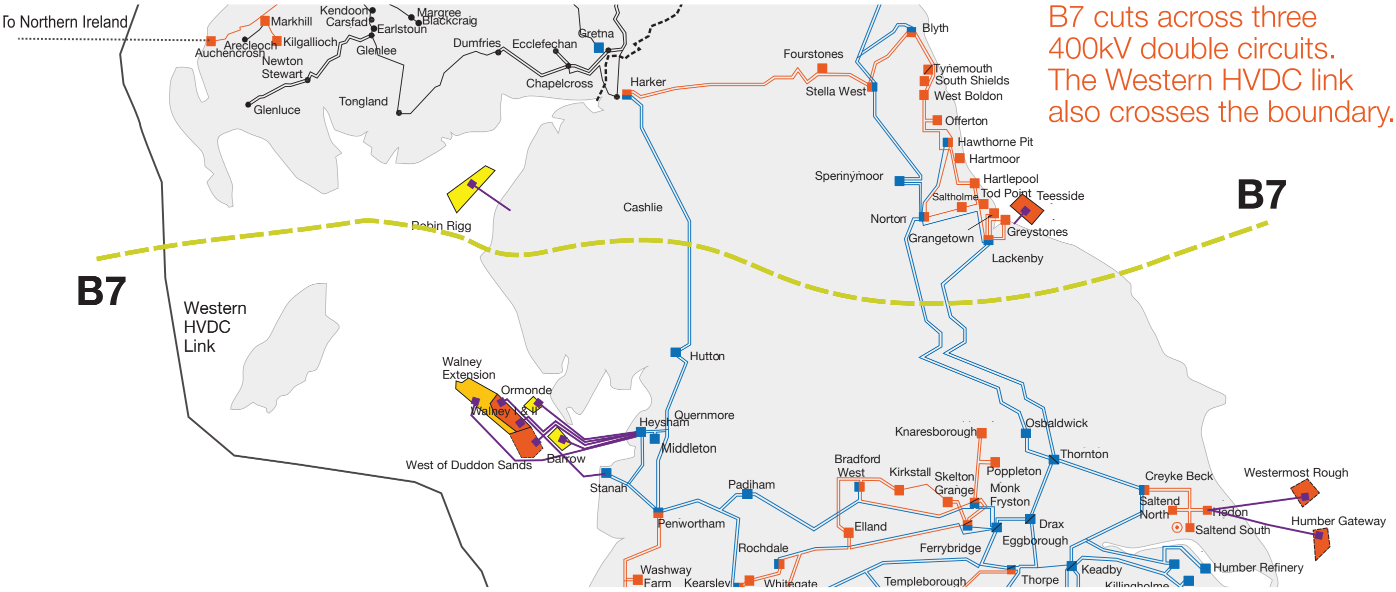
As the potential future requirement to transfer more power from Scotland to England increases, B7 and B7a are likely to reach their capability limits and may need network reinforcement. The potential future restrictions to be overcome across B7 and B7a are summarised:

- Limitation on power transfer out of North East England (boundary B7) is caused by voltage limitation for a fault on the double circuit between Hutton–Middleton–Penwortham.
- At high power transfer, thermal limitations occur on a number of circuits within the North East 275kV ring.
- Limitation on power transfer from Cumbria to Lancashire (boundary B7a) occurs due to thermal limitation at Padiham–Penwortham circuit.

The need for network reinforcement to address the above mentioned potential capability issues will be evaluated in the *NOA 2018/19* CBA. Following the evaluation, the preferred reinforcements for the North of England region will be recommended.

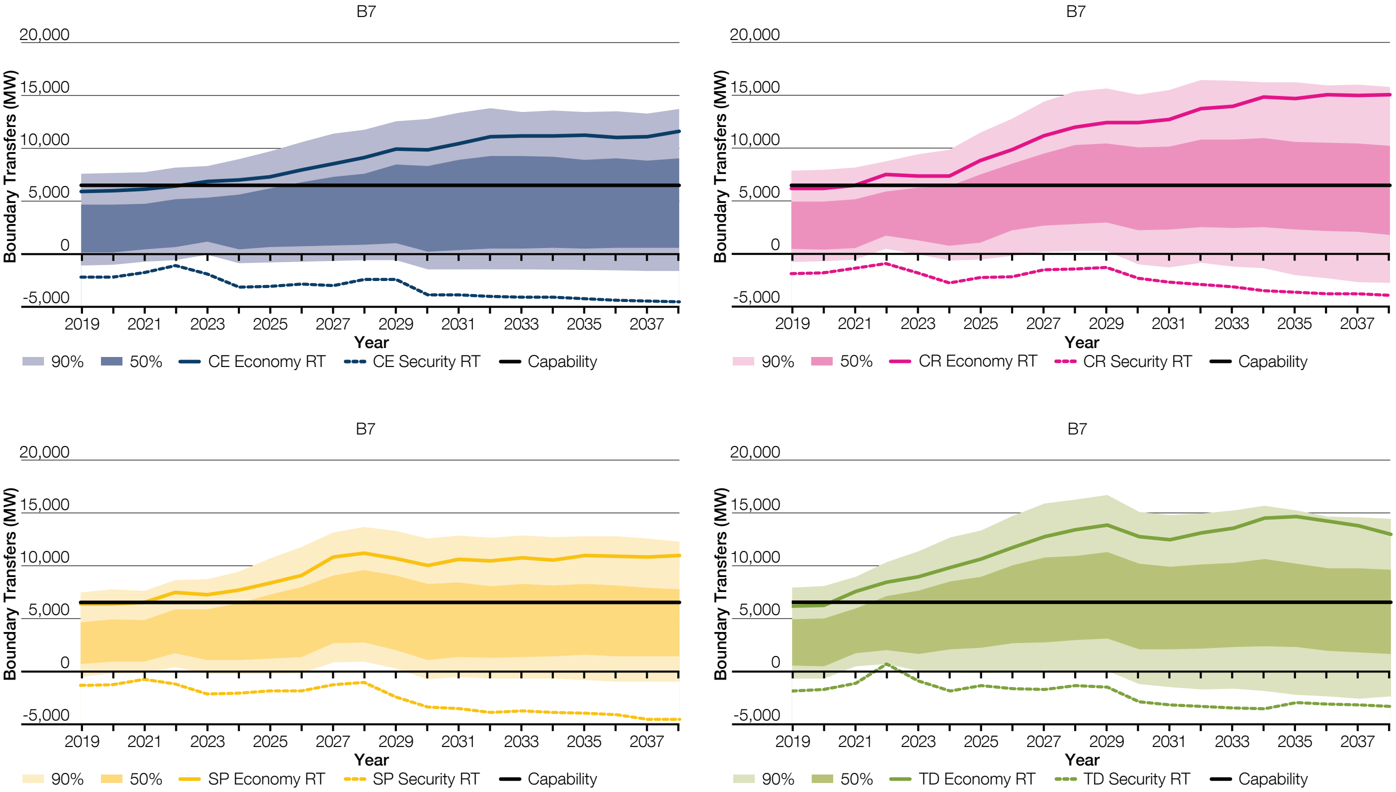
Boundary B7 – Upper North of England

Figure B7.1
Geographic representation of boundary B7



Boundary B7 bisects England south of Teesside. The area between B6 and B7 has been traditionally an exporting area, and constrained by the power flowing through the region from Scotland towards the south with the generation surplus from this area added.

Figure B7.2
Boundary flows and base capability for boundary B7



Boundary requirements and capability

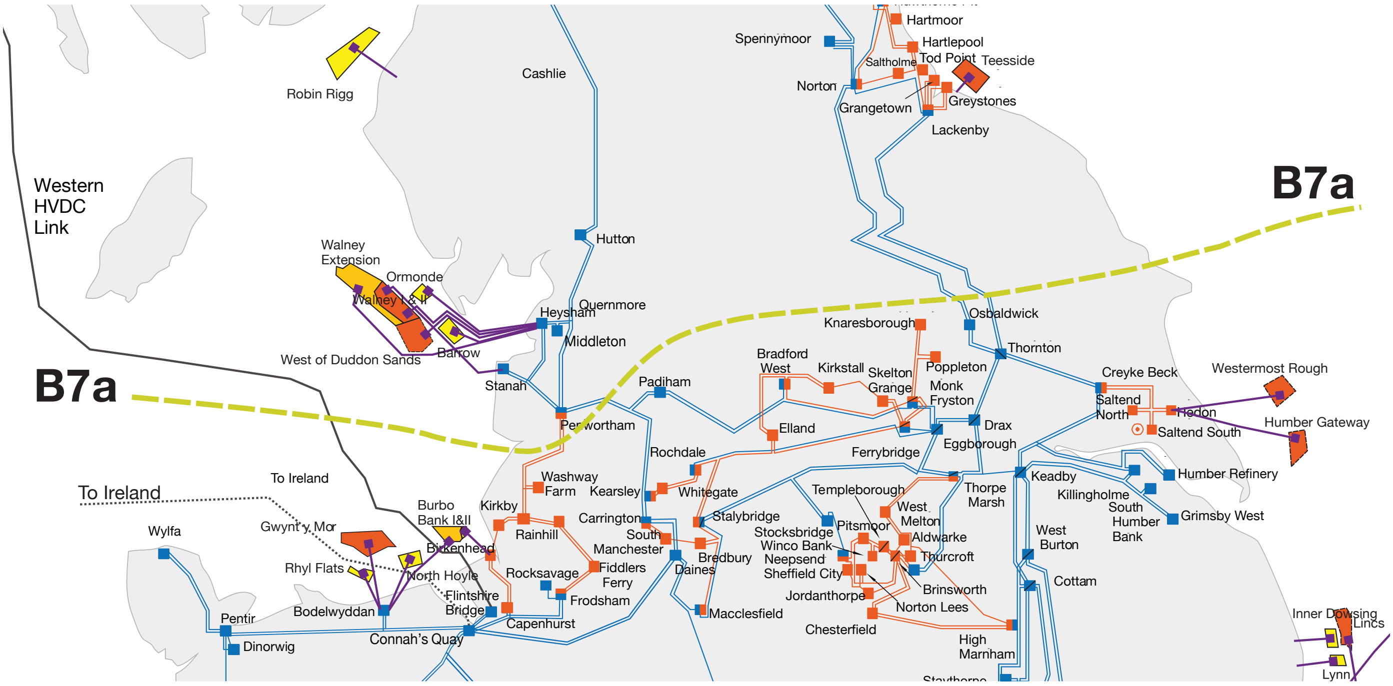
Figure B7.2 above shows the projected boundary power flows crossing B7 for the next 20 years. The boundary capability has increased to 6.5 GW compared to last year due to the addition of the new Western HVDC circuit. The limit to the boundary capability now is post-fault voltage depression close to the Scottish border.

The 2018/19 boundary capability is expected to satisfy the NETS SQSS requirements but, for all the *FES*, the SQSS Economy required transfer and expected power flows quickly grow to beyond the present boundary capability. This suggests a strong need for network development to manage the increasing power flows. Power flow requirements show a peak within ten years meaning development options will need to be delivered quickly.

The *FES* show a lot of wind farms in the north, meaning the spread of boundary power flows is very wide due to the intermittent nature of wind. With low generation output in the north it is credible to have power flowing from south to north feeding northern demand. The magnitude of the south to north power flows is low compared to those in the opposite direction so network capability should be sufficient to support those conditions.

Boundary B7a – Upper North of England

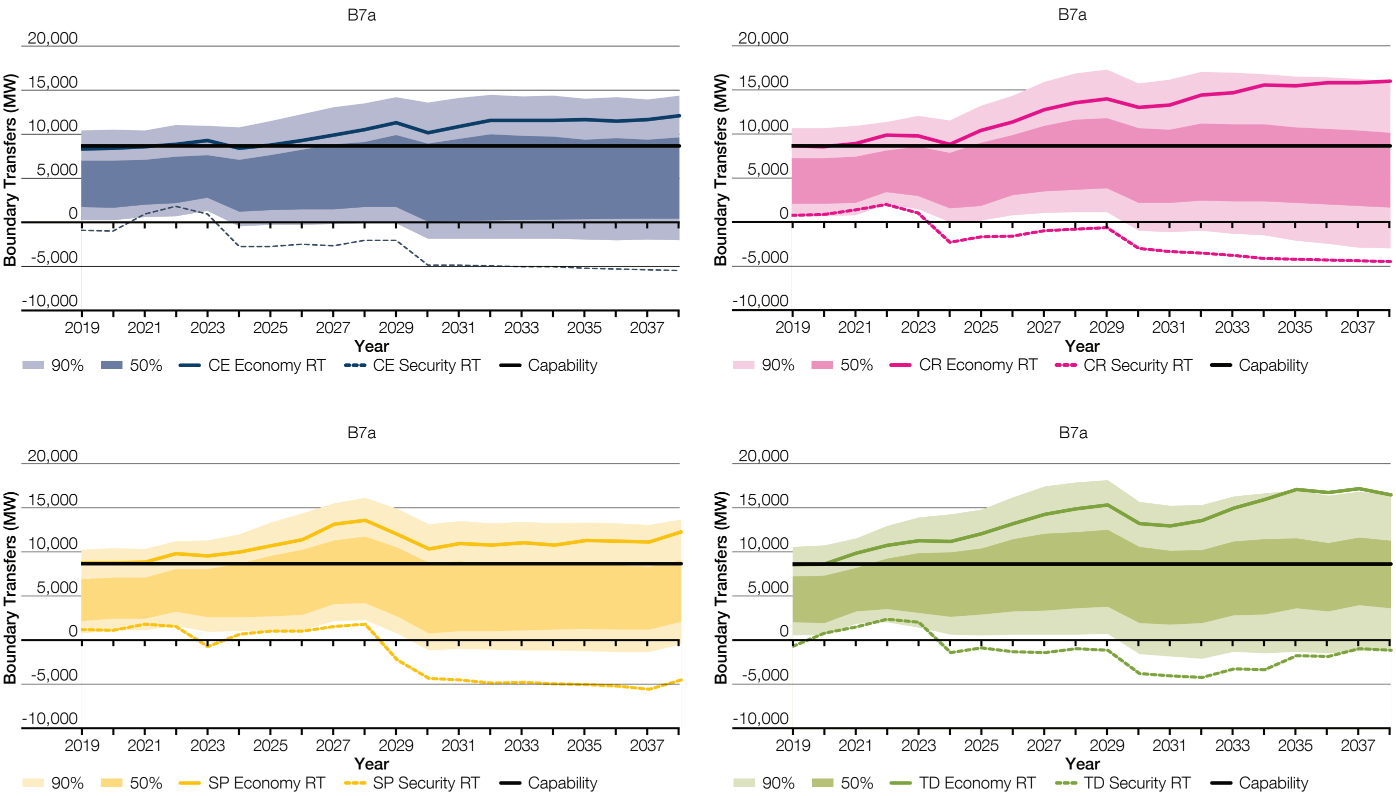
Figure B7a.1
Geographic representation of boundary B7a



B7a cuts across three 400kV double circuits and one 275kV circuit. The Western HVDC link also crosses the boundary.

Boundary B7a bisects England south of Teesside and into the Mersey Ring area. It is used to capture network restrictions on the circuits feeding down through Liverpool, Manchester and Leeds.

Figure B7a.2
Boundary flows and base capability for boundary B7a



Boundary requirements and capability

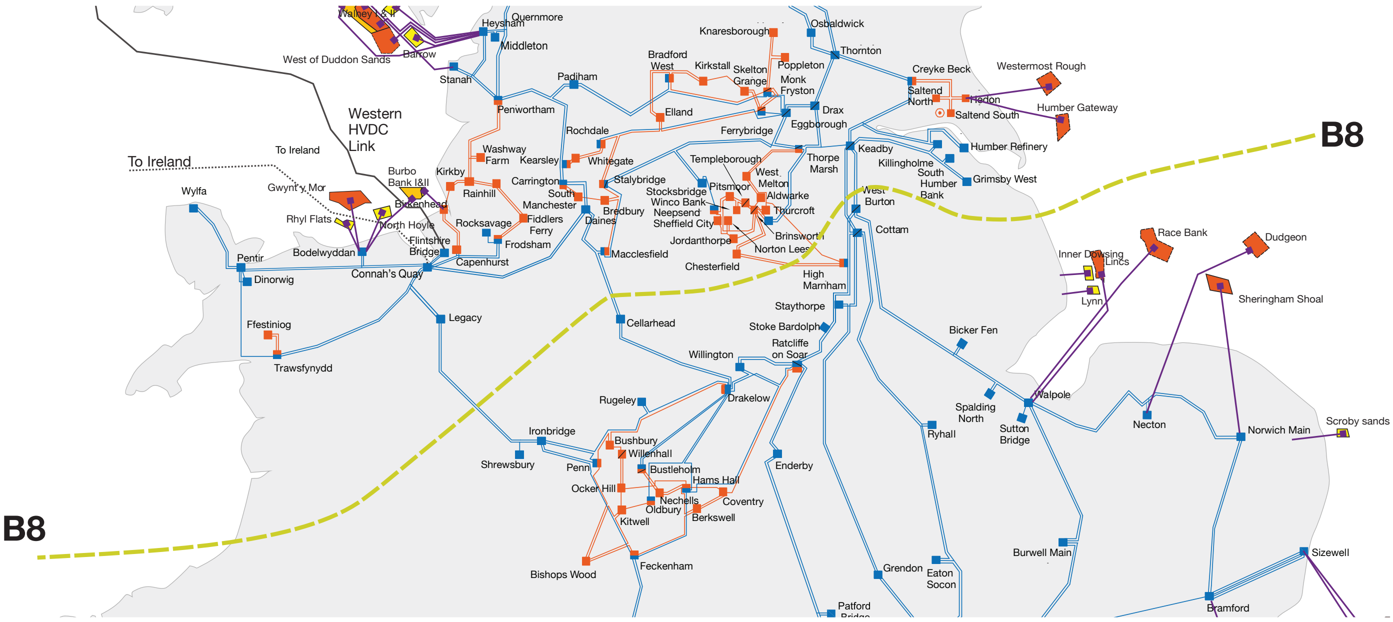
Figure B7a.2 above shows the projected boundary power flows crossing B7a for the next 20 years. The boundary capability has increased to 8.7 GW compared to last year due to the addition of the new Western HVDC circuit. The limit to the boundary capability now is the load rating of the 400kV circuits from Penwortham.

For all the *FES*, the SQSS Economy required transfer and expected power flows grow to well beyond the present boundary capability. This suggests a strong need for network development to manage the increasing power flows. There is a peak in power flow requirements within ten years, meaning development options will need to be done quickly.

Based on the *FES*, high levels of intermittent generation will be connecting to the north of the boundary, leading to a broad range of boundary power flows. With low northern generation output, it is credible to have power flowing from south to north feeding northern demand. The magnitude of the south to north power flows is low compared to those in the opposite direction so network capability should be sufficient to support those conditions.

Boundary B8 – North of England to Midlands

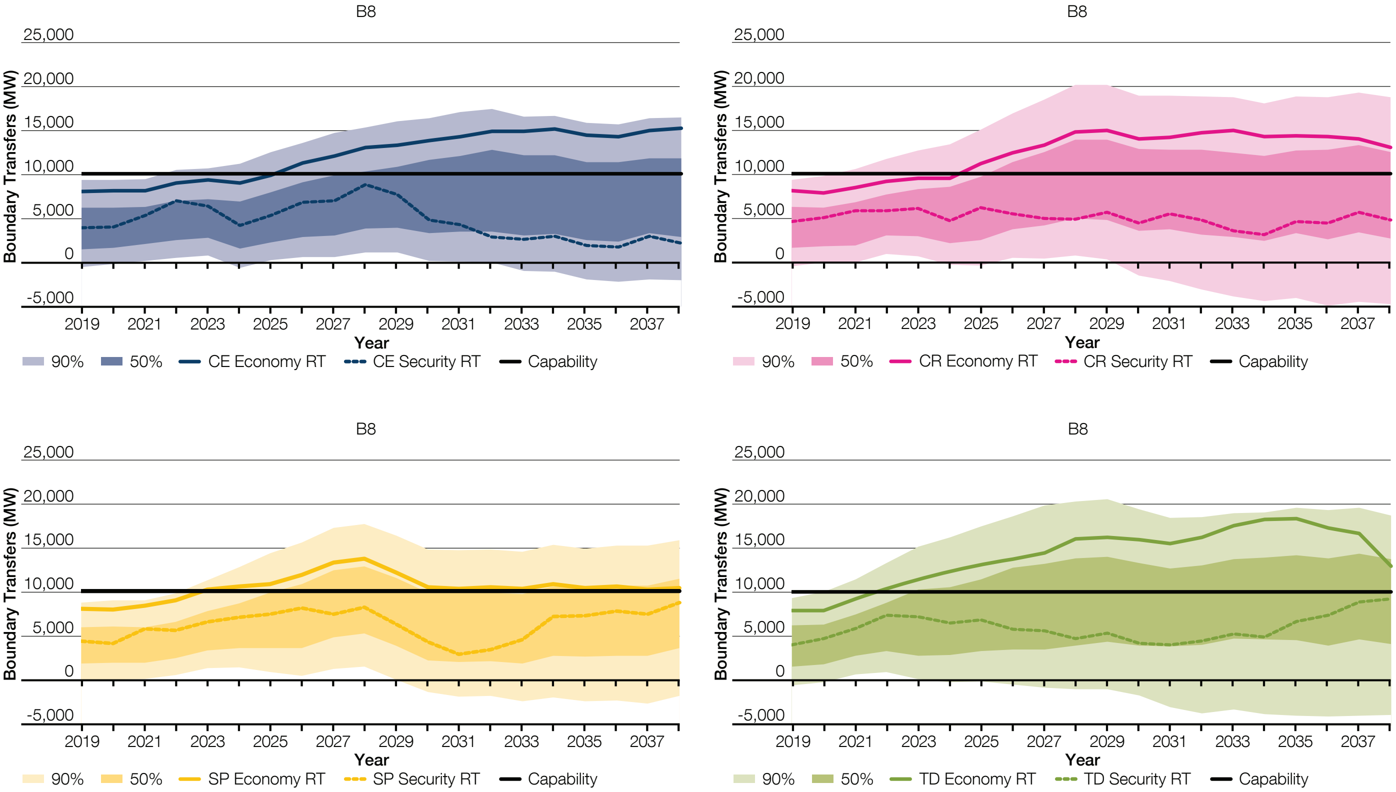
Figure B8.1
Geographic representation of boundary B8



B8 cuts across four 400kV double circuits and a limited 275kV connection to South Yorkshire.

The North to Midlands boundary B8 is one of the wider boundaries that intersects the centre of GB, separating the northern generation zones, including Scotland, Northern England and North Wales, from the Midlands and southern demand centres.

Figure B8.2
Boundary flows and base capability for boundary B8



Boundary requirements and capability

Figure B8.2 above shows the projected boundary power flows crossing B8 for the next 20 years. The boundary capability is limited to 10 GW by loading limits of a Cellarhead–Drakelow 400kV circuit.

Across all the *FES*, the SQSS Economy required transfer and expected power flows grow to beyond the present boundary capability. This suggests a need for network development to manage the increasing power flows. Some of the *FES* show a peak in power flow requirements within ten years, meaning development options could need to be done quickly.

Based on the *FES*, high levels of intermittent generation will be connecting to the north of the boundary, leading to a broad range of boundary power flows. With low northern generation output, it is credible to have power flowing from south to north feeding northern demand, although this is not significant until more than ten years into the future. The magnitude of the south to north power flows is low compared to those in the opposite direction so network capability should be sufficient to support those conditions.

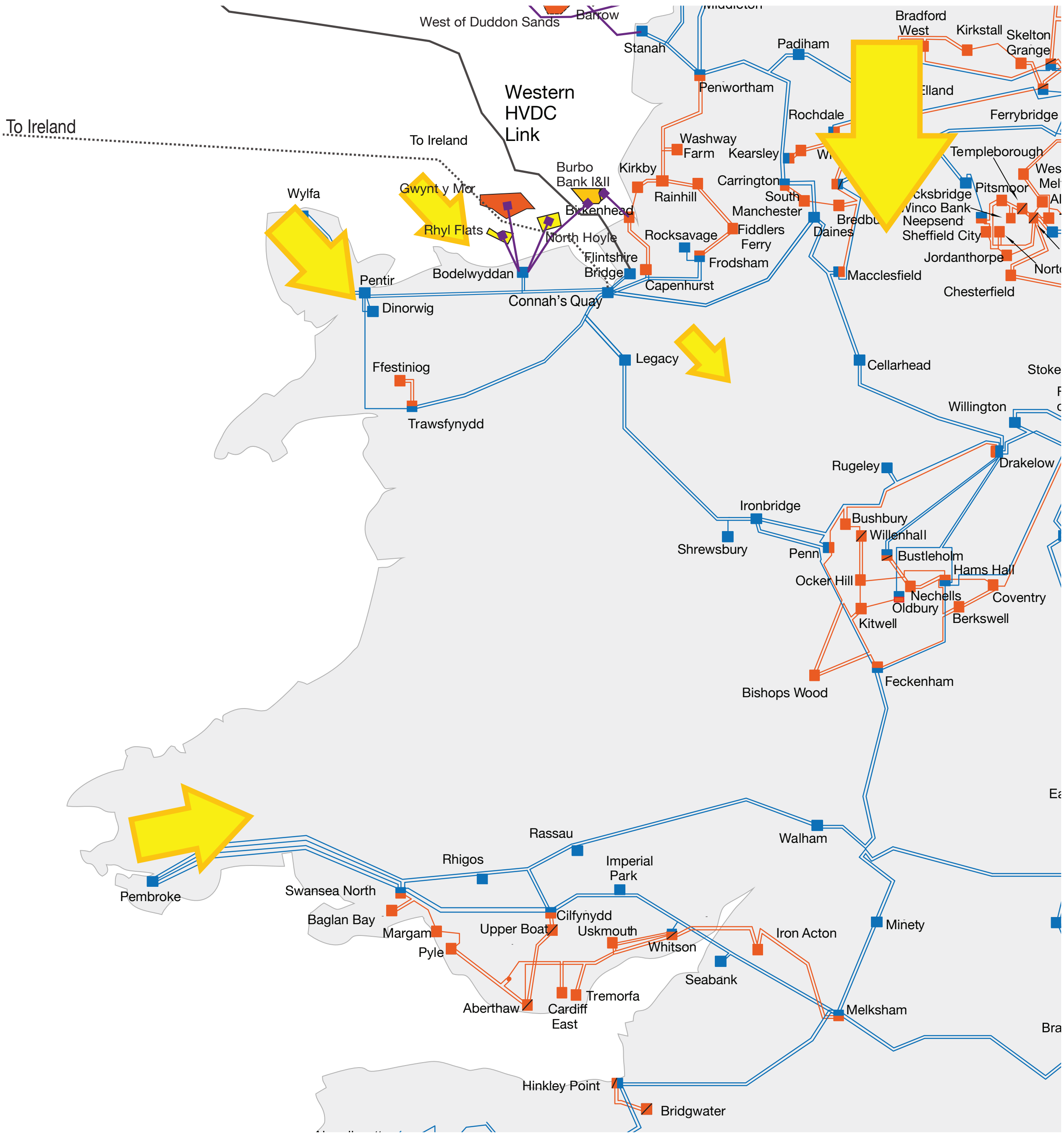
3.6 Network capability and requirements by region – Wales and the Midlands boundaries

Introduction

The Western transmission region includes boundaries in Wales and the Midlands. The figure below shows likely power flow directions in the years to come up to 2028.

The arrows in the diagram illustrate power flow directions and are approximately scaled relative to the winter peak flows.

Figure WM.1
Wales and Midlands transmission network



Primary challenge statement:

Future nuclear generation combined with wind and biomass generation, connecting in North Wales, has the potential to drive increased power flows eastward into the Midlands where power plant closures are set to occur and demand is set to remain fairly high.

Regional drivers

By 2035, in all the *FES* the total amount of generation in the region remains approximately as present or shows slight reduction (See Fig WM.2). At present, this region has significant levels of fossil fuel (about 19 GW), most of which is set to close and be replaced by a combination of low carbon technologies, interconnectors and storage.

Figure WM.2
Generation capacity mix scenarios for Wales and the Midlands

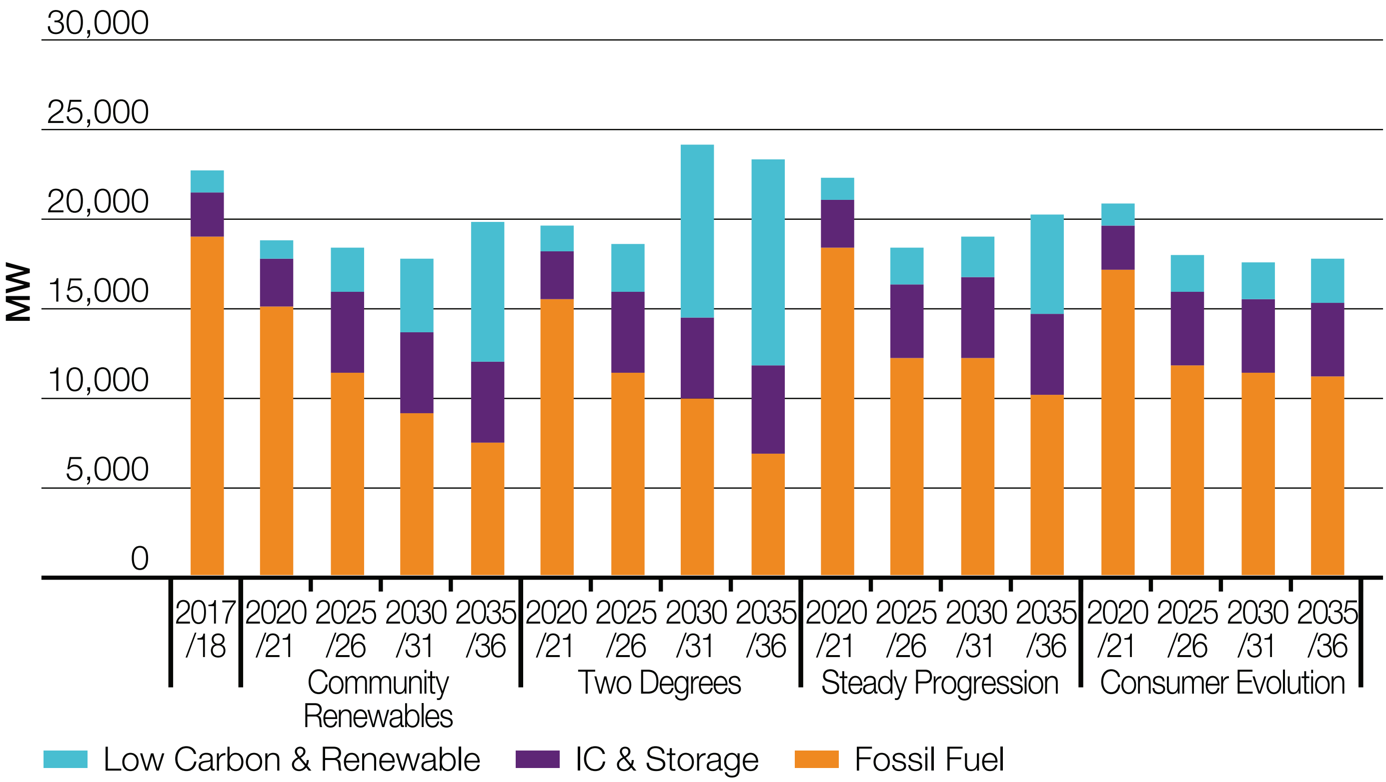
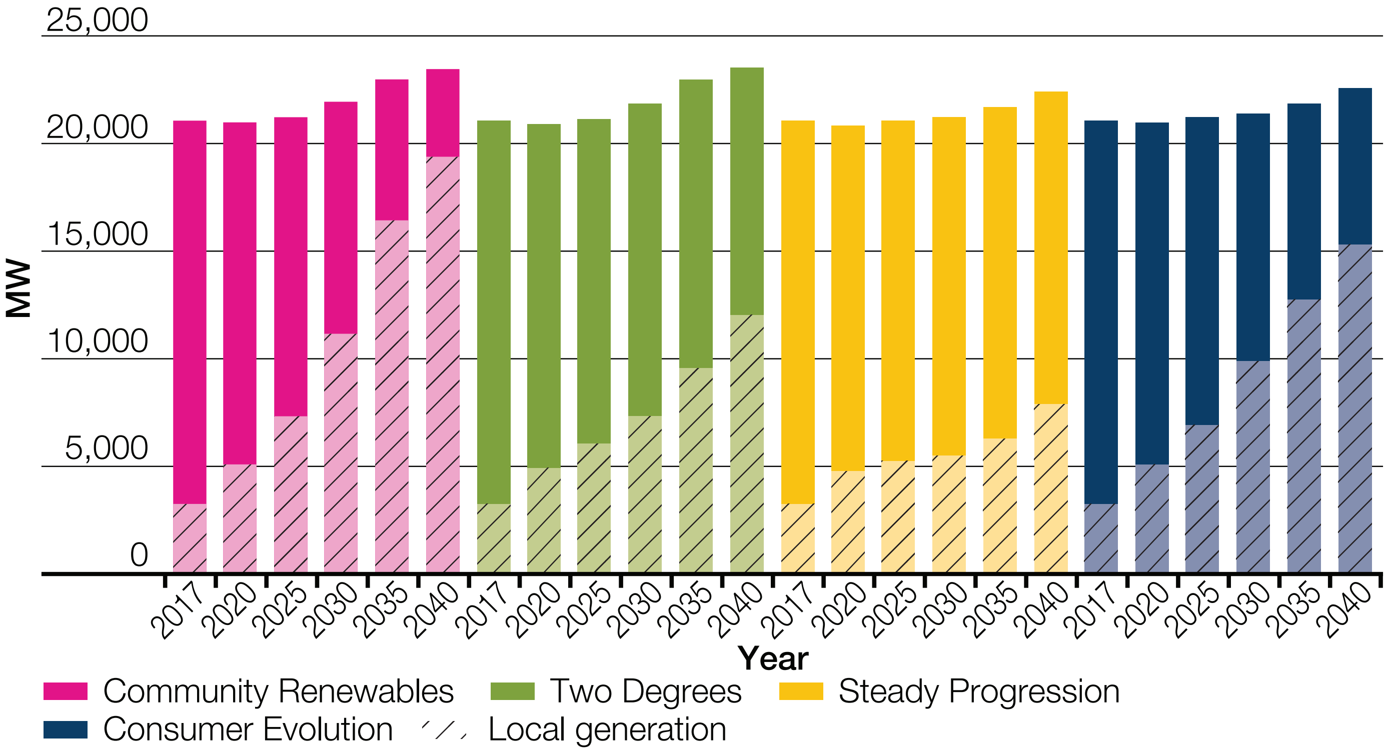


Figure WM.3 shows that the gross demand as seen from the transmission network in the region will increase across all scenarios. This is driven by the adoption of technologies such as electric vehicles, heat pumps and embedded storage.

In a highly decentralised scenario like **Community Renewables**, local generation capacity connected at the distribution level in this western region could reach up to more than 50 GW by 2040. Of that capacity, a typical embedded generation output on average might be around 19 GW. This will vary depending on factors like wind speeds, and how other local generators decide to participate in the market.

Figure WM.3
Gross demand scenarios for Wales and the Midlands



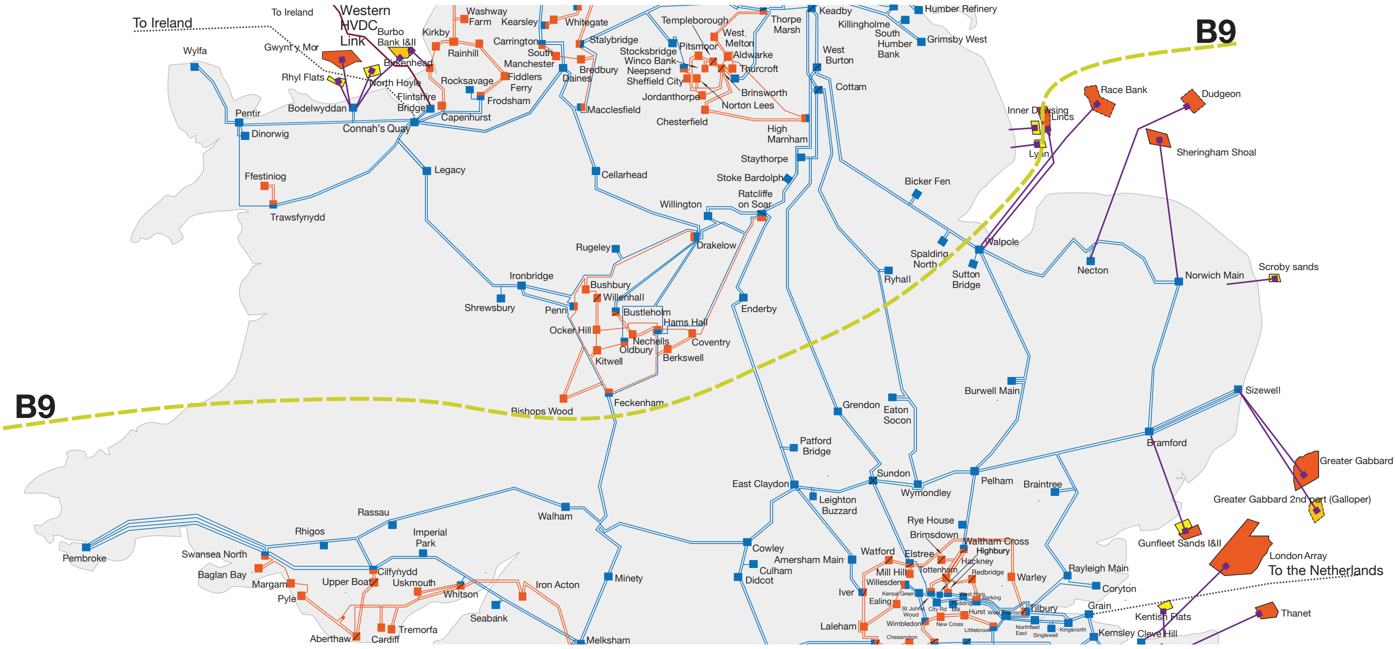
The majority of expected westerly increases in generation are from low carbon technologies, embedded generation and interconnectors. Most of this is expected in the Wales region.

The transmission network in North Wales consists of only nine 400kV double circuits with limited capacity which are likely to be stressed to their capability limits if much of the new future generation connects. The potential limitation on future power exports are covered by boundaries B9, NW1, NW2, and NW3.

The *NOA 2018/19* will assess the above mentioned potential scenarios and accordingly recommend preferred reinforcements for this Western transmission region.

Boundary B9 – Midlands to South of England

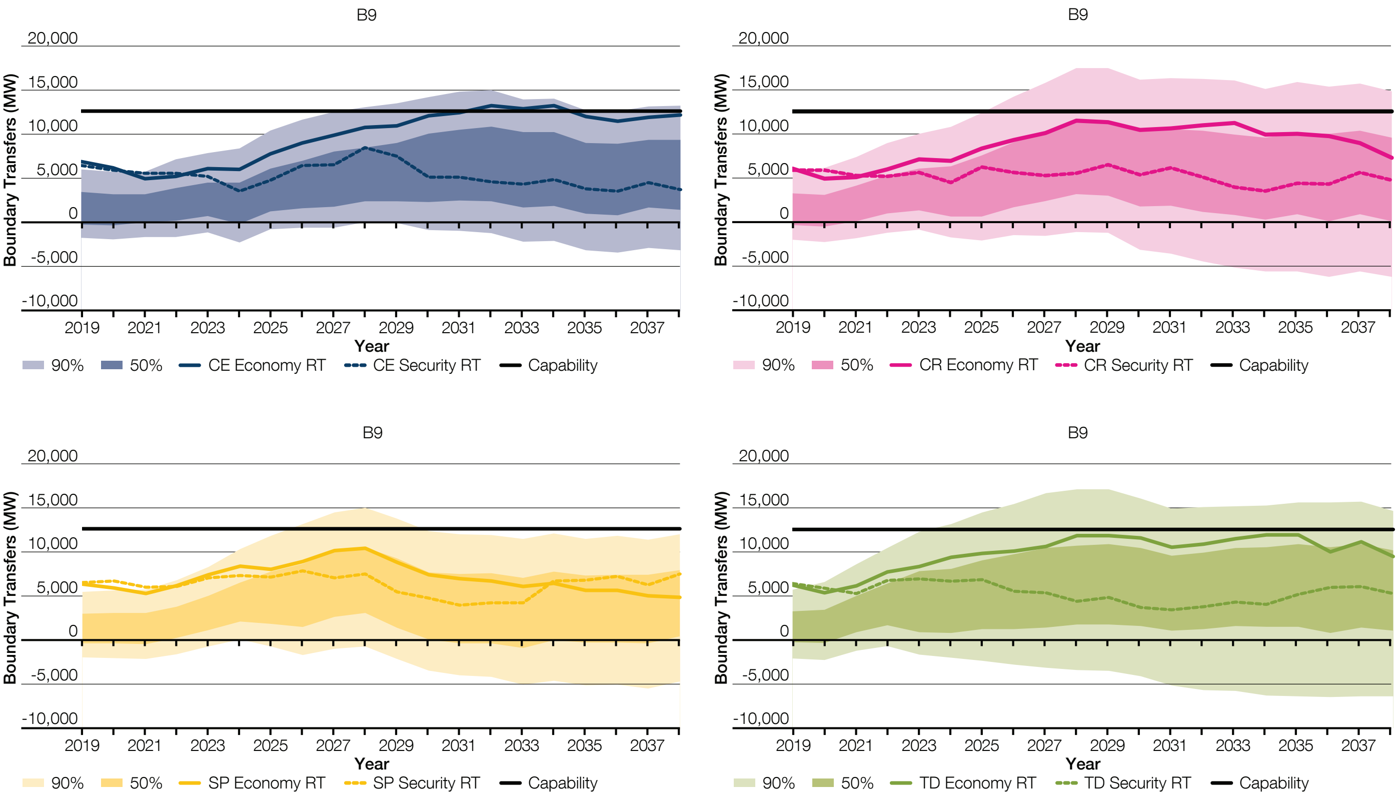
Figure B9.1
Geographic representation of boundary B9



B9 cuts across five major 400kV double circuits transporting power over a long distance

The Midlands to South of England boundary B9 separates the northern generation zones and the southern demand centres. Developments in the East Coast and the East Anglia regions, such as the locations of offshore wind generation connection and the network infrastructure requirements, will affect the transfer requirements and capability of boundary B9.

Figure B9.2
Boundary flows and base capability for boundary B9



Boundary requirements and capability

Figure B9.2 above shows the projected boundary power flows crossing B9 for the next 20 years. The boundary capability is voltage limited at 12.6 GW for a fault on the double circuit Walpole–Spalding North–Bicker Fenn which leads to low voltage at Feckenham substation.

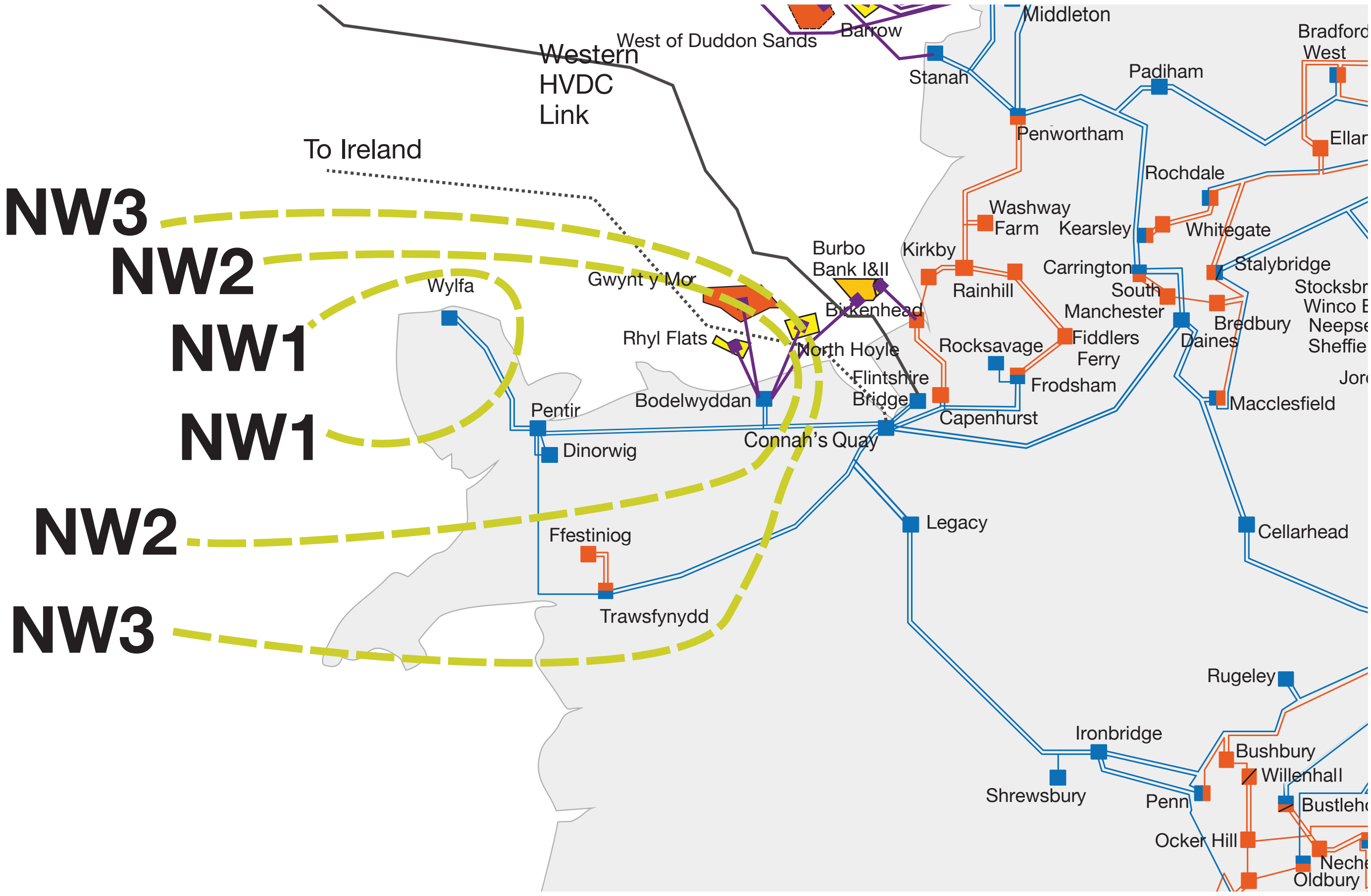
Across all the *FES*, the expected power flows grow beyond the present boundary capability. But from the diagram above it is clear that the flows beyond the capability are not significant for **Community Renewables** and **Two Degrees** scenarios and even less significant in **Steady Progression** and **Consumer Evolution** scenarios. It is unlikely to have any network development required to manage the flows through B9.

North Wales – overview

The onshore network in North Wales comprises a 400kV circuit ring that connects Pentir, Connah's Quay and Trawsfynydd substations. A 400kV double circuit spur crossing the Menai Strait and running the length of Anglesey connects the now decommissioned nuclear power station at Wylfa to Pentir. A short 400kV double circuit cable spur from Pentir connects Dinorwig pumped storage power station.

In addition, a 275kV spur traverses north of Trawsfynydd to Ffestiniog pumped storage power station. Most of these circuits are of double circuit tower construction. However, Pentir and Trawsfynydd within the Snowdonia National Park are connected by a single 400kV circuit, which is the main limiting factor for capacity in this area. The area is studied by analysing the local boundaries NW (North Wales) 1 to 3.

Figure NW
Geographic representation of North Wales boundaries

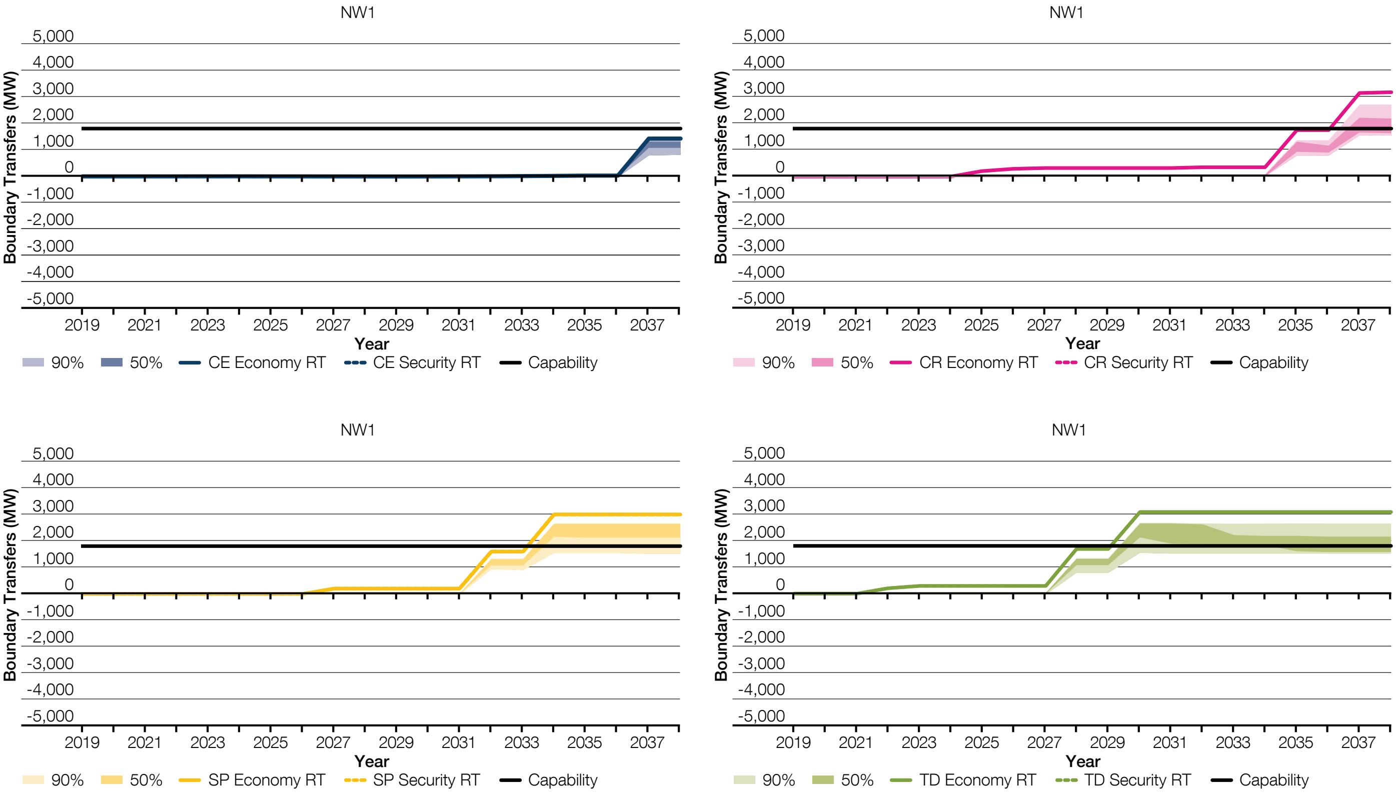


- NW1 is a local boundary crossing a 400kV double circuit.
- NW2 is a local boundary crossing a 400kV double circuit and a 400kV single circuit.
- NW3 a local boundary crossing a pair of 400kV double circuits.

Boundary NW1 – Anglesey

Figure NW1

Boundary flows and base capability for boundary NW1



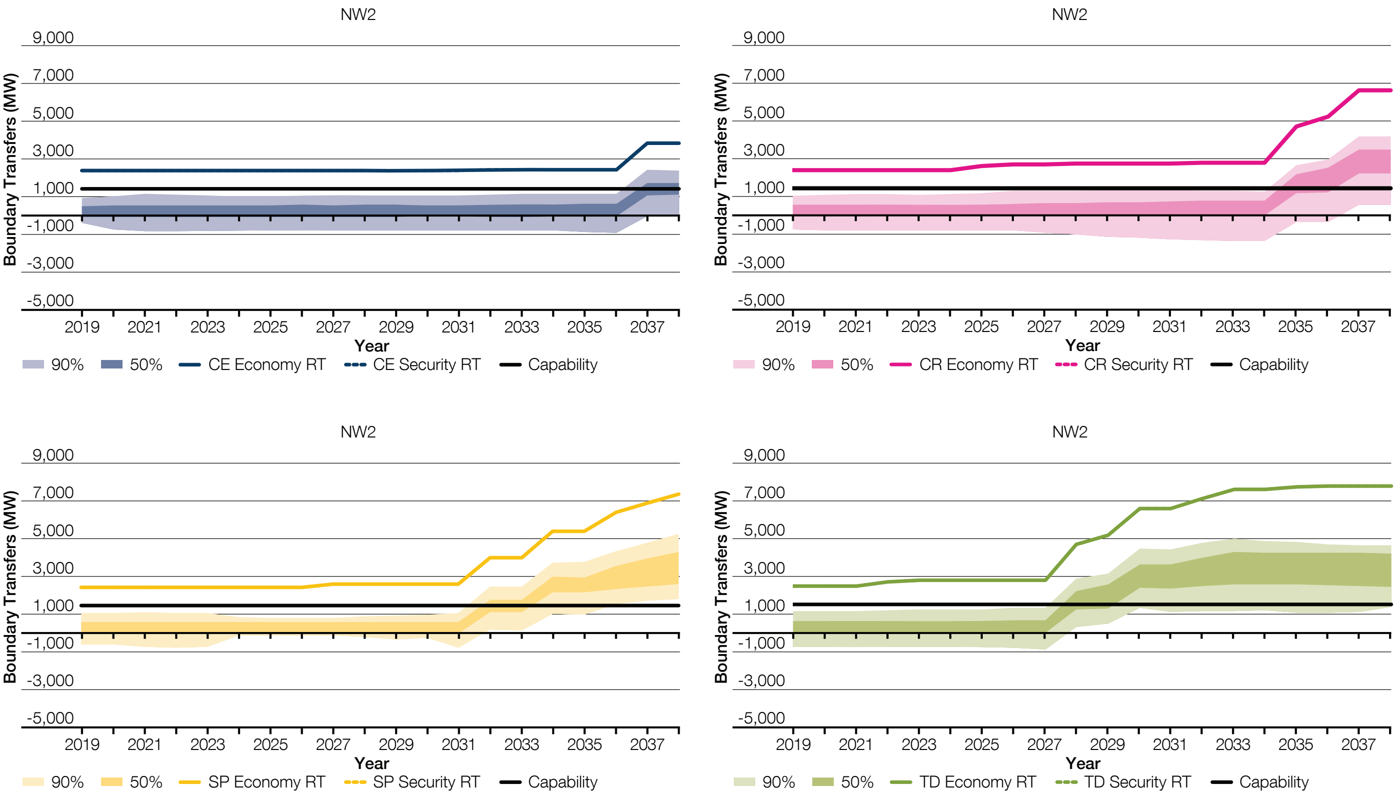
Boundary requirements and capability

Figure NW1 above shows the projected boundary power flows crossing NW1 for the next 20 years. The boundary transfer capability is limited by the infrequent infeed loss risk criterion set in the SQSS, which is currently 1.8 GW. If the infrequent infeed loss risk is exceeded, the boundary will need to be reinforced by adding a new transmission route across the boundary.

Across all scenarios, except **Consumer Evolution**, the SQSS Economy required transfer and expected power flows grow beyond the present boundary capability. All the scenarios show similar requirements until 2027, where they diverge. The only large scale generation expected behind NW1 is a new nuclear power station which appears in the background in two stages and within different time horizons.

Boundary NW2 – Anglesey and Caernarvonshire

Figure NW2
Boundary flows and base capability for boundary NW2



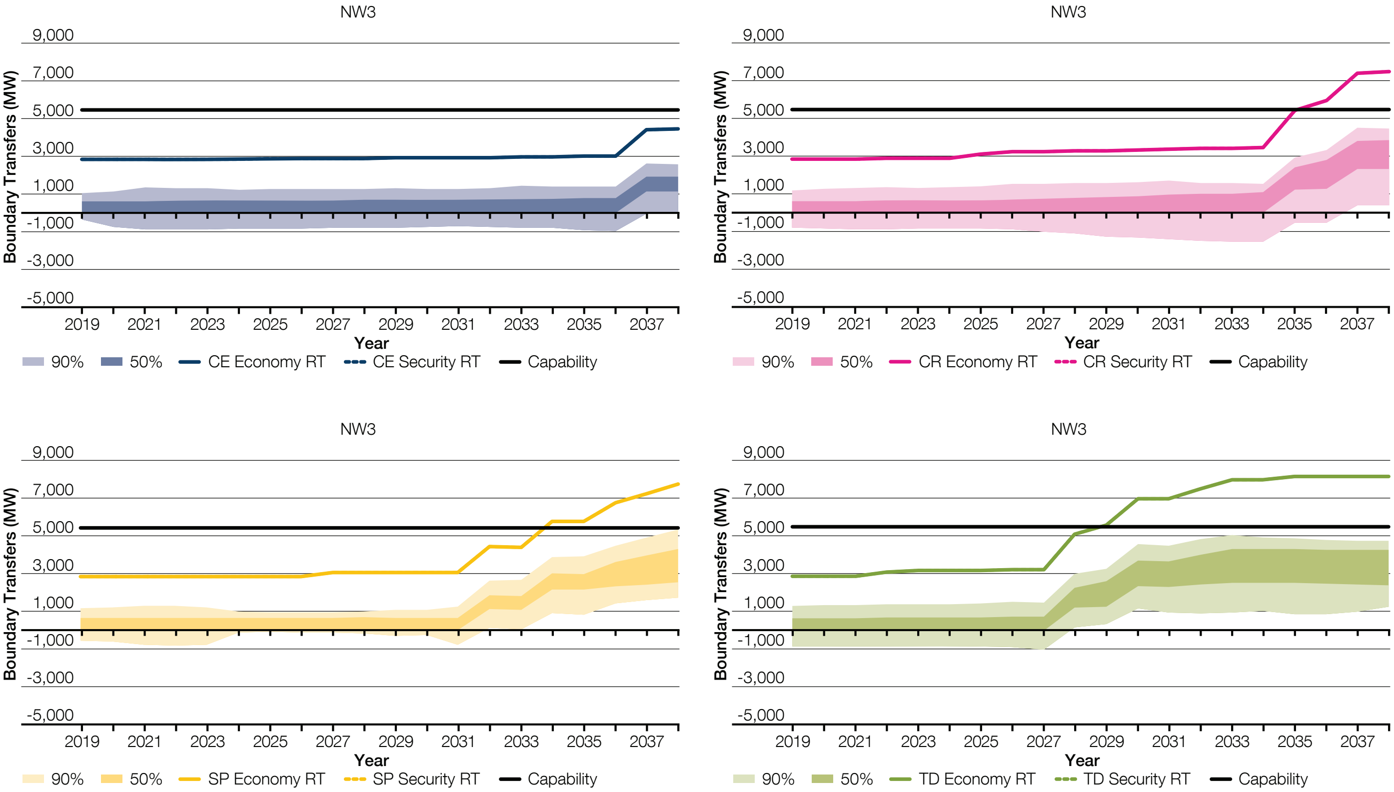
Boundary requirements and capability

Figure NW2 above shows the projected boundary power flows crossing NW2 for the next 20 years. The boundary capability is thermally limited at 1.4 GW for a double circuit fault on the Connah's Quay–Bodelwyddan–Pentir circuits which overloads the Pentir–Trawsfynydd single circuit.

Across all the *FES*, the SQSS Economy required transfer and expected power flows grow beyond the present boundary capability. The scenarios show similar requirements until 2027 where they diverge due to different assumptions of connection time and dispatching of potential interconnector, wind and nuclear generation behind this boundary.

Boundary NW3 – Anglesey and Caernarvonshire and Merionethshire

Figure NW3
Boundary flows and base capability for boundary NW3



Boundary requirements and capability

Figure NW3 above shows the projected boundary power flows crossing NW3 for the next 20 years. The boundary capability is thermally limited at 5.5 GW for a double circuit fault on the Trawsfynydd–Treuddyn–Connah's Quay Tee circuits which overloads the Connah's Quay–Bodelwyddan–Pentir Tee circuits.

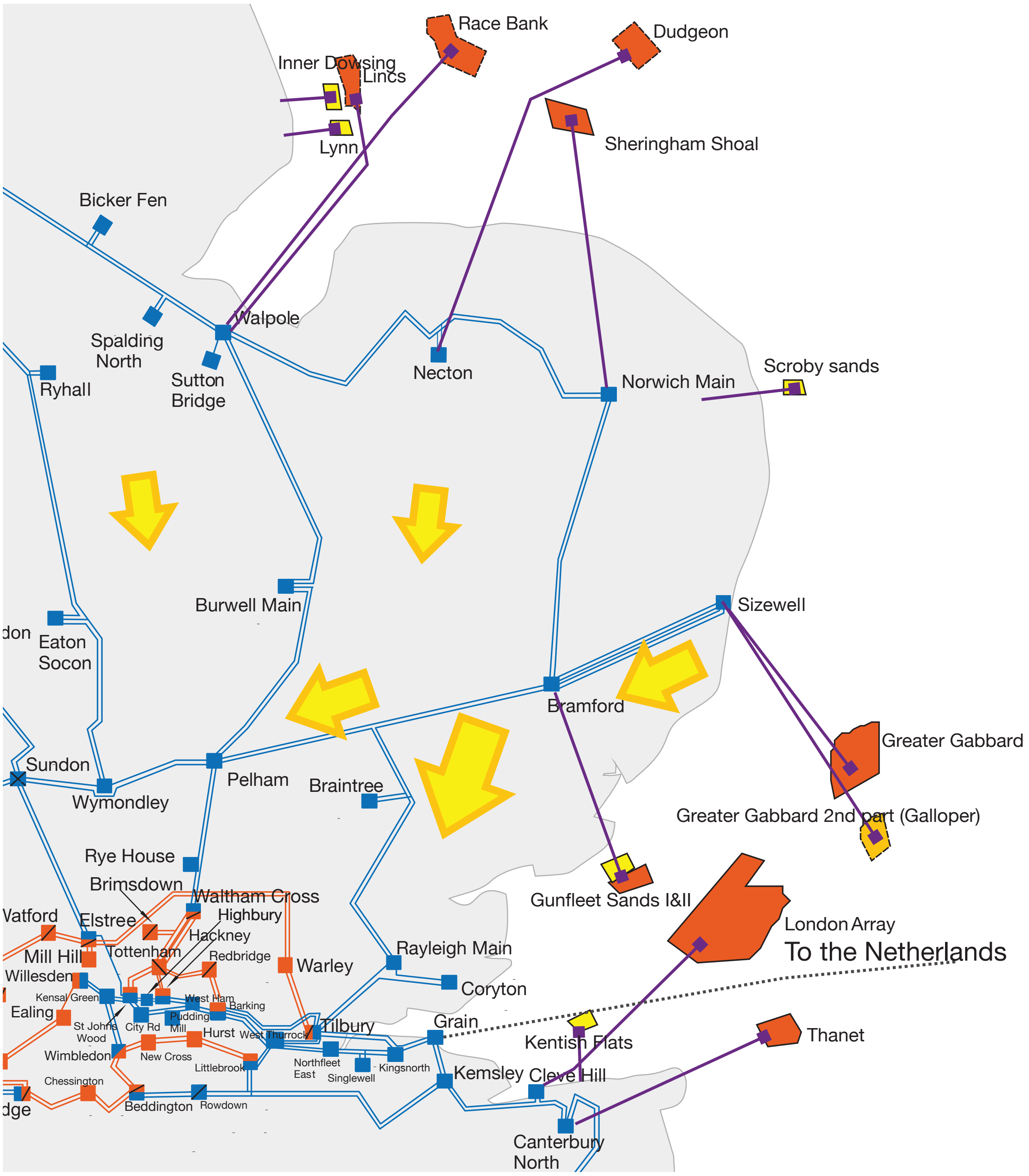
Across all scenarios except **Consumer Evolution**, the SQSS Economy required transfer and expected power flows grow beyond the present boundary capability. The scenarios show a similar requirement until 2027 where they diverge due to different assumptions of connection time and dispatching of potential interconnector, wind and nuclear generation behind this boundary.

3.7 Network capability and requirements by region – The East of England boundaries

Introduction

The East of England region includes the counties of Norfolk and Suffolk. The figure below shows likely power flow directions in the years to come up to 2027. The arrows in the diagram illustrate power flow directions and are approximately scaled relative to the winter peak flows.

Figure EE.1
East of England transmission network



Primary challenge statement:

With the large amount of generation contracted to be connected in the area, predominantly offshore wind and nuclear, supply may significantly exceed the local demand which could cause heavy circuit loading, voltage depressions and stability issues.

Regional drivers

The *FES* highlight that generation between 7 and 20 GW could be expected to connect within this region by 2035 as shown in Figure EE.2. All scenarios show that, in the years to come, large amounts of low carbon generation, predominantly wind, can be expected to connect. Fossil-fuel generation can also be expected to connect within this region. The total generation in all the scenarios will exceed the local demand; thus East Anglia will be a power exporting region.

Figure EE.2
Generation capacity mix scenarios for the East of England

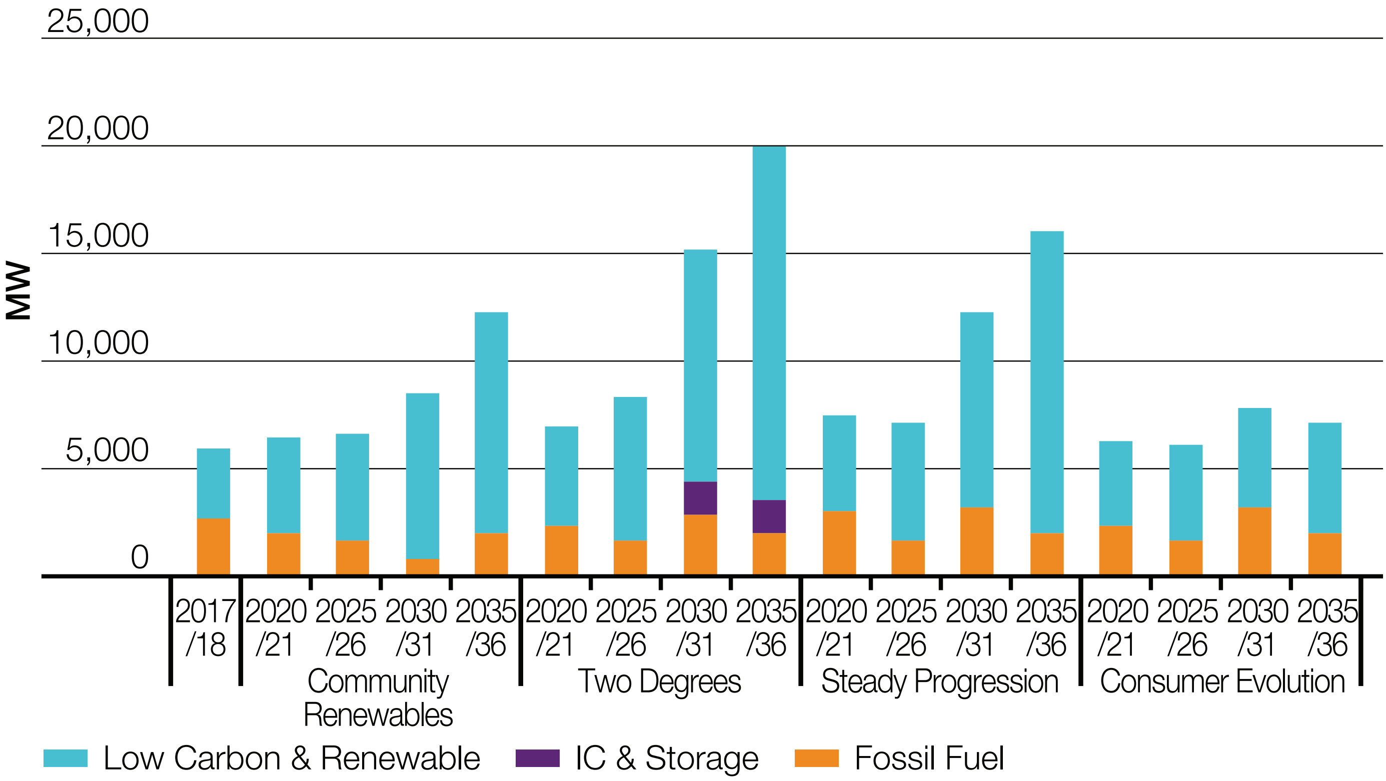
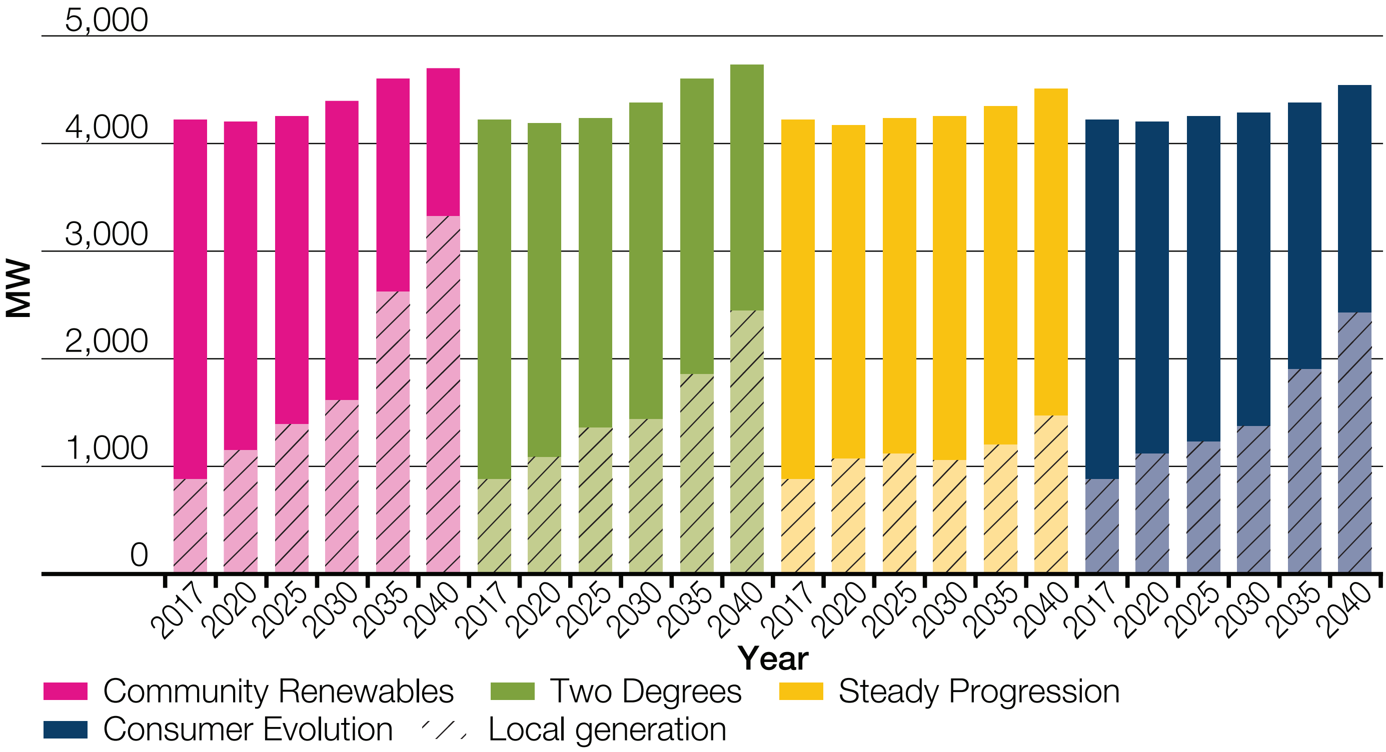


Figure EE.3
Gross demand scenarios for the East of England



Peak gross demand in the Eastern region is expected to remain less than 5 GW by 2040. Figure EE.3 shows snapshots of the peak gross demand for the East of England across the four different scenarios. In a highly decentralised scenario like **Community Renewables**, local generation capacity connected at the distribution level in this eastern region could reach more than 13 GW by 2040. Of that capacity, a typical embedded generation output on average might be around 3 GW. This will vary depending on factors like wind speeds, and how other local generators decide to participate in the market.

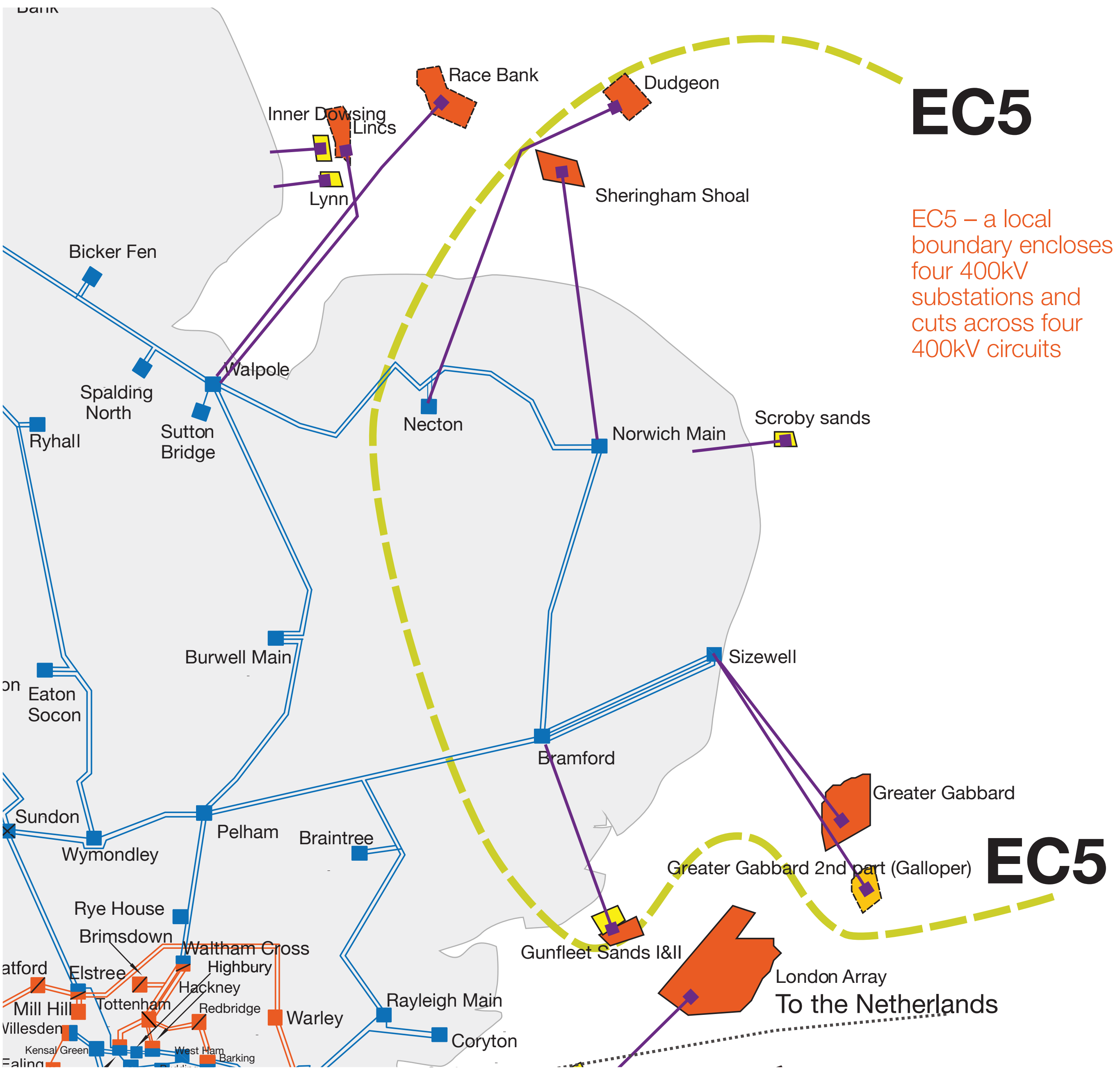
The East Anglia transmission network to which the *FES* generation will connect has eight 400kV double circuits. The potential future increase in generation within this region could force the network to experience very heavy circuit loading, stability issues and voltage depressions – for power transfer scenarios from East Anglia to London and South East England. This is explained as follows:

- The East England region is connected by several sets of long 400kV double circuits, including Bramford–Pelham–Braintree, Walpole–Spalding North–Bicker Fenn and Walpole–Burwell Main. During a fault on any one set of these circuits, power exported from this region is forced to reroute. This causes some of the power to flow through a much longer distance to reach the rest of the system, predominantly the Greater London and South East England networks via the East Anglia region. As a result, the reactive power losses in these high impedance routes will also increase. If these losses are not compensated, they will eventually lead to voltage depressions within the region.
- Stability becomes an additional concern when some of the large generators connect, further increasing the size of the generation group in the area connected to the network. Losing a set of double circuits when a fault occurs will lead to significant increases in the impedance of the connection between this large generation group and the remainder of the system. As a result, the system may be exposed to a risk of instability as power transfer increases.

The *NOA 2018/19* will assess the likelihood and impact of the above mentioned potential scenarios and accordingly recommend preferred reinforcements for the East of England transmission region.

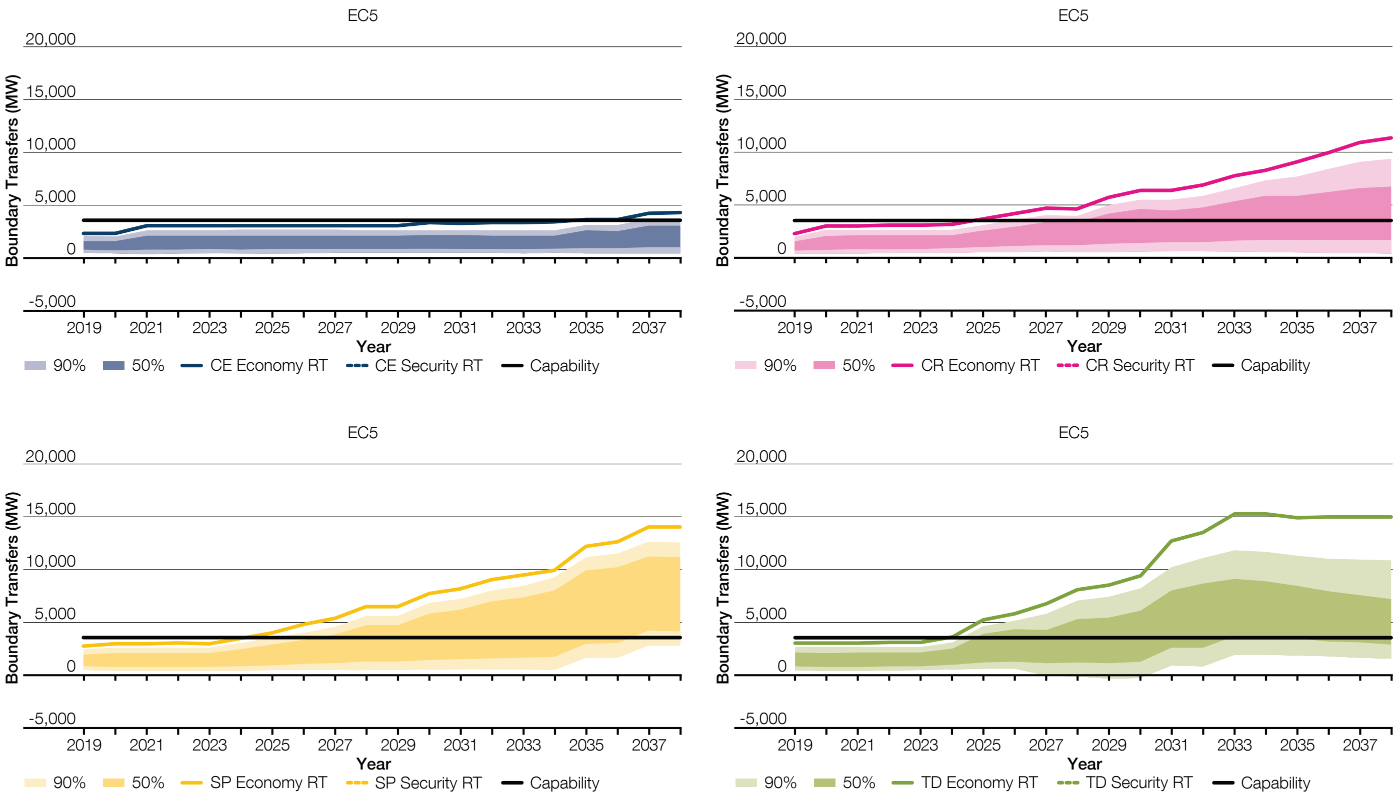
Boundary EC5 – East Anglia

Figure EC5.1
Geographic representation of boundary EC5



Boundary EC5 (East Coast 5) is a local boundary enclosing most of East Anglia. The coastline and waters around East Anglia are attractive for the connection of offshore wind projects including the large East Anglia Round 3 offshore zone that lies directly to the east. The existing nuclear generation site at Sizewell is one of the approved sites selected for new nuclear generation development.

Figure EC5.2
Boundary flows and base capability for boundary EC5



Boundary requirements and capability

Figure EC5.2 above shows the projected boundary power flows for boundary EC5 for the next 20 years. The boundary capability is currently a voltage compliance limit at 3.5 GW for a double circuit fault on the Bramford–Pelham and Bramford–Braintree–Rayleigh Main circuits causing low voltage at Burwell Main substation.

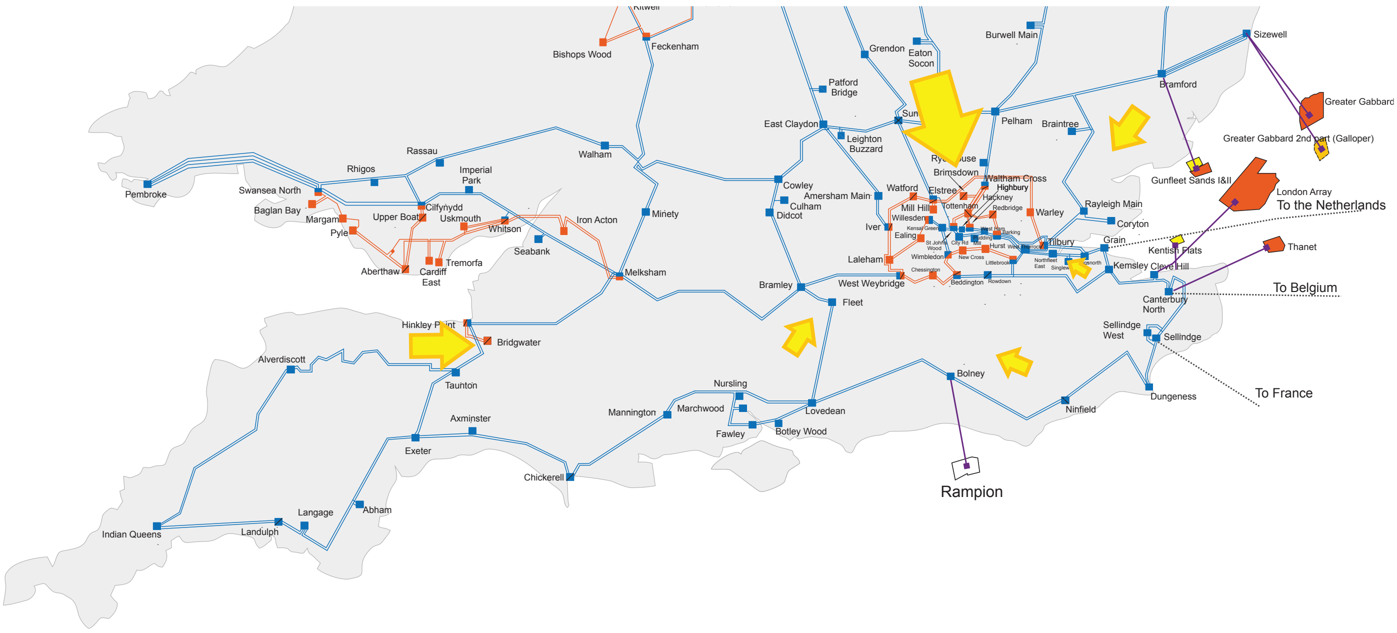
The growth in offshore wind and nuclear generation capacities connecting behind this boundary greatly increase the transfer capability requirements. This is particularly prominent with the **Two Degrees** scenario. The present boundary capability is sufficient for today's needs but potentially grossly short of the future capability requirements. Across all scenarios except **Consumer Evolution**, the SQSS Economy required transfer and expected power flows grow rapidly in a 10-year time span to beyond the present boundary capability. This suggests a need for network development to manage the increasing power flows. The required transfer is higher than expected boundary flows in all scenarios.

3.8 Network capability and requirements by region – The South of England boundaries

Introduction

The South of England transmission region includes boundaries B13, B14, LE1, SC1 and SC3. The region includes the high demand area of London, generation around the Thames estuary and the long set of circuits that run around the south coast. Interconnection to central Europe is connected along the south east coast and this interconnection has significant influence on power flows in the region by being able to both import and export power with Europe. The figure below shows likely power flow directions in the years to come up to 2028. The arrows in the diagram illustrate power flow directions and are approximately scaled relative to the winter peak flows.

Figure SE.1
South of England transmission network



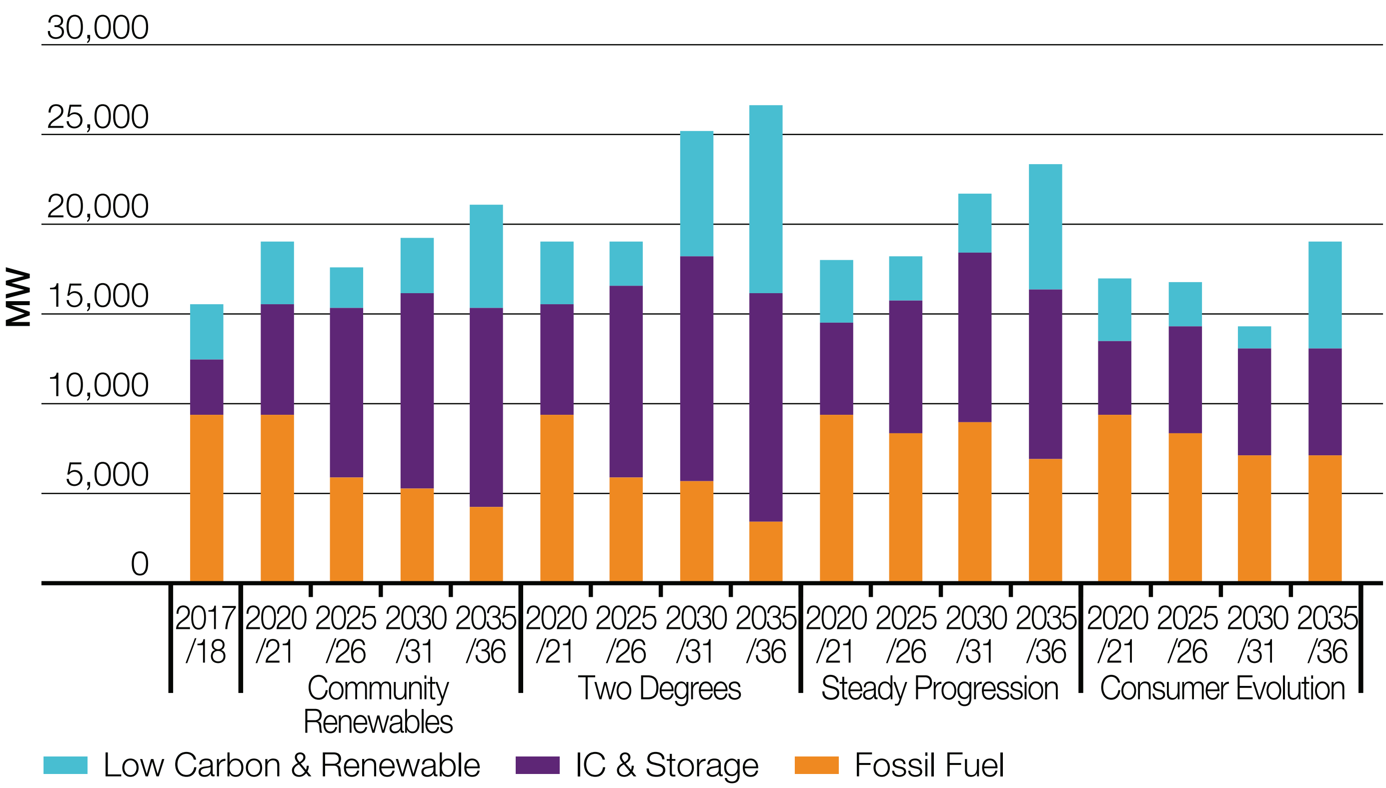
Primary challenge statement:

European interconnector developments along the south coast could potentially drive very high circuit flows causing circuit overloads, voltage management and stability issues.

Regional drivers

The **Two Degrees** scenario suggests that up to 10 GW of interconnectors and energy storage capacity may connect in the south as shown in Figure SE.2. As interconnectors and storage are bi-directional, the south could see their capacity act as up to 10 GW power injection or 10 GW increased demand. This variation could place a very heavy burden on the transmission network. Most of the interconnectors will be connected south of boundary SC1 so the impact on them can be seen in the SC1 requirements section later in the chapter.

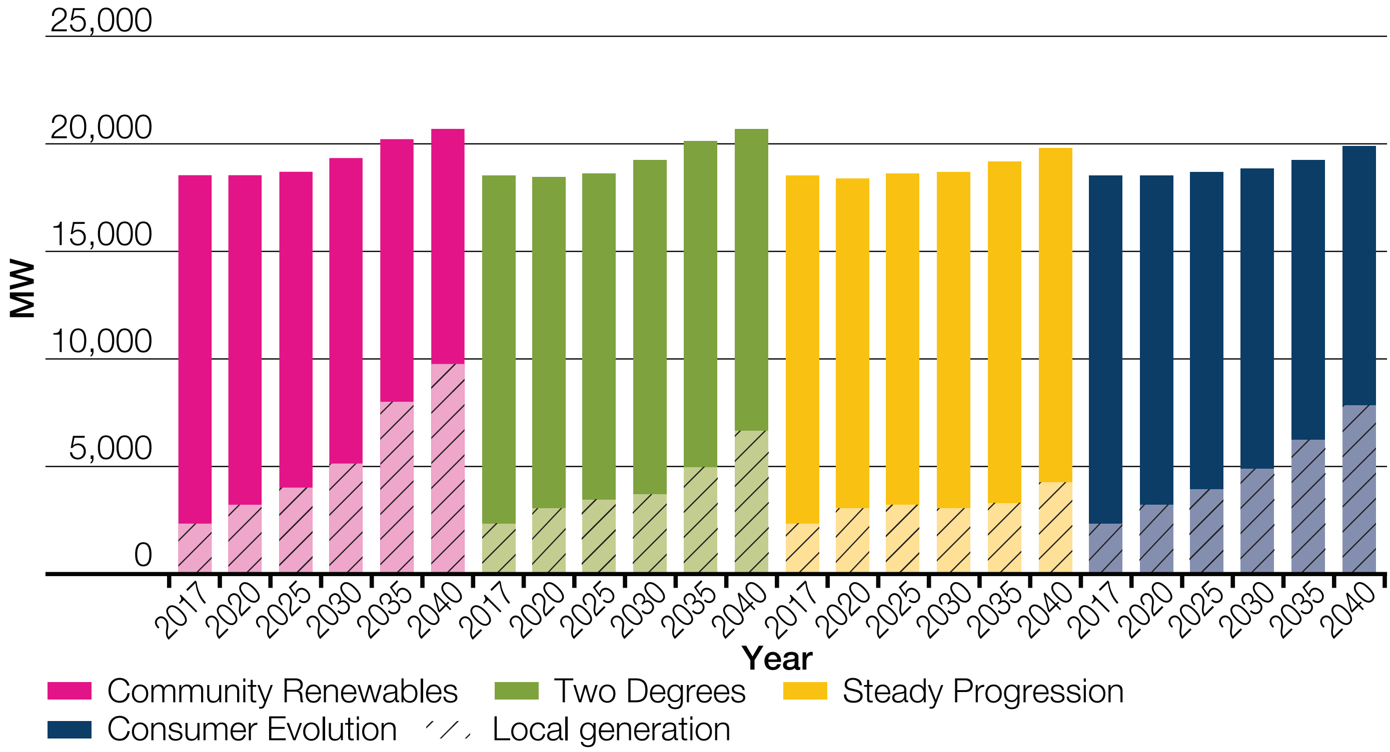
Figure SE.2
Generation capacity mix scenarios for the South of England



Peak gross demand in the south as seen by the transmission network is not expected to change significantly for most of the scenarios. By 2040, the expected peak demand is around 20 GW across all scenarios as shown in Figure SE.3.

In a highly decentralised scenario like **Community Renewables**, local generation capacity connected at the distribution level in this eastern region could reach up to 30 GW by 2040. Of that capacity, a typical embedded generation output on average might be around 10 GW. This will vary depending on factors like wind speeds, and how other local generators decide to participate in the market.

Figure SE.3
Gross demand scenarios for the South of England



The transmission network in the south is heavily meshed in and around London (B14) and the Thames estuary, but below there and towards the west the network becomes more radial with relatively long distances between substations.

In the future, the southern network could potentially see a number of issues driven by future connections. If the interconnectors export power to Europe at the same time that high demand power is drawn both into and through London then the northern circuits feeding London will be thermally overloaded. The high demand and power flows may also lead to voltage depression in London and the south east. The closure of conventional generation within the region will present added stability and voltage depression concerns which may need to be solved through reinforcements.

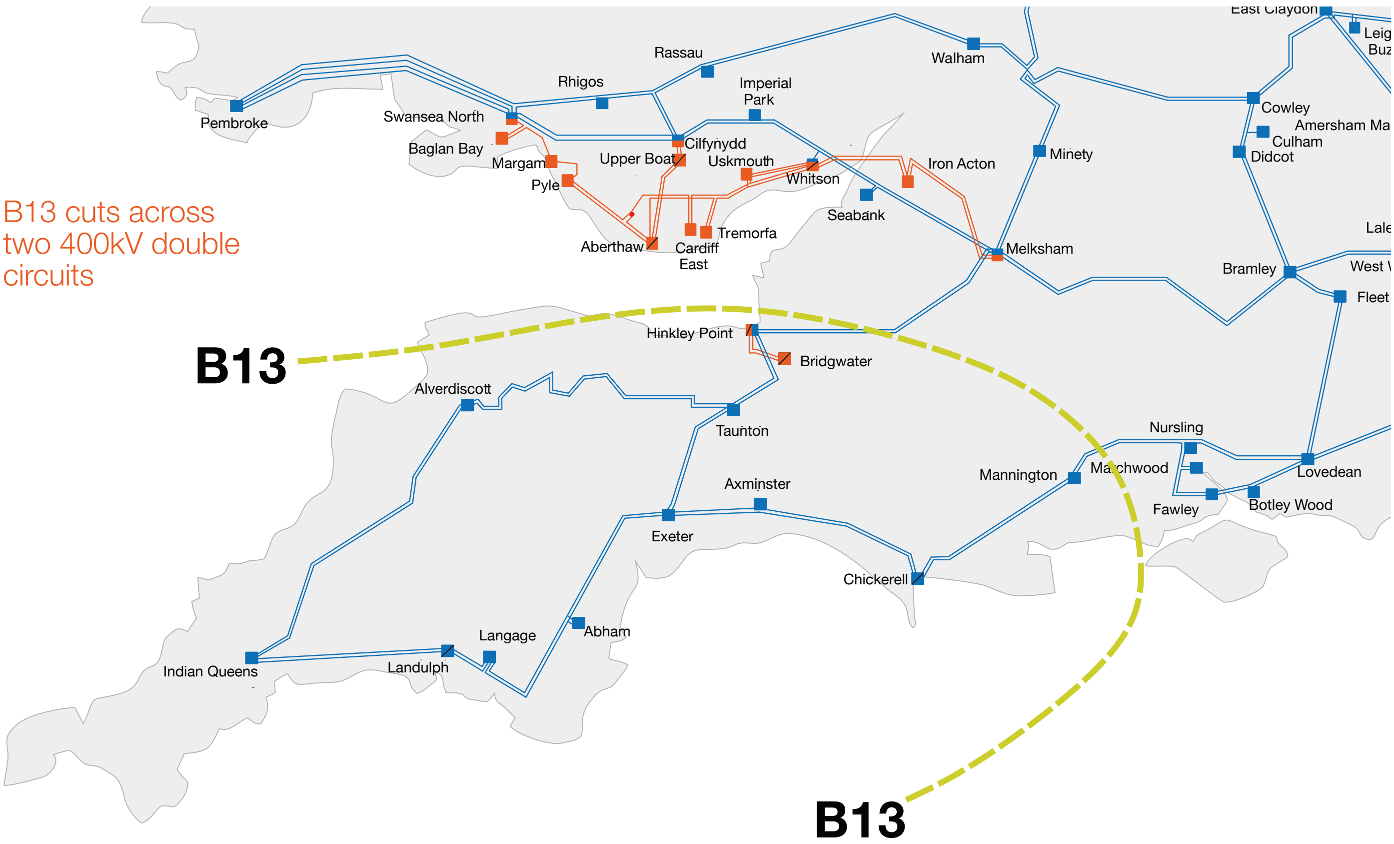
If the south-east interconnectors are importing from the Continent and there is a double circuit fault south of Kemsley, then the south-east circuits may overload and there could be significant voltage depression along the circuits to Lovedean.

With future additional interconnector connections, the south region will potentially be unable to support all interconnectors importing or exporting simultaneously without network reinforcement. Overloading can be expected on many of the southern circuits. The connection of the new nuclear generating units at Hinkley may also require reinforcement of the areas surrounding Hinkley. With new interconnector and generation connections, boundaries SC1, SC3, LE1 and B13 will need to be able to support large power flows in both directions which is different from today when power flow is predominantly in one direction. Furthermore, SC3 was investigated using probabilistic techniques as a case study to analyse the high uncertainty in the background conditions of the area.

The *NOA 2018/19* will assess the likelihood and impact of the above mentioned potential scenarios and accordingly recommend preferred reinforcements for the South of England transmission region.

Boundary B13 – South West

Figure B13.1
Geographic representation of boundary B13

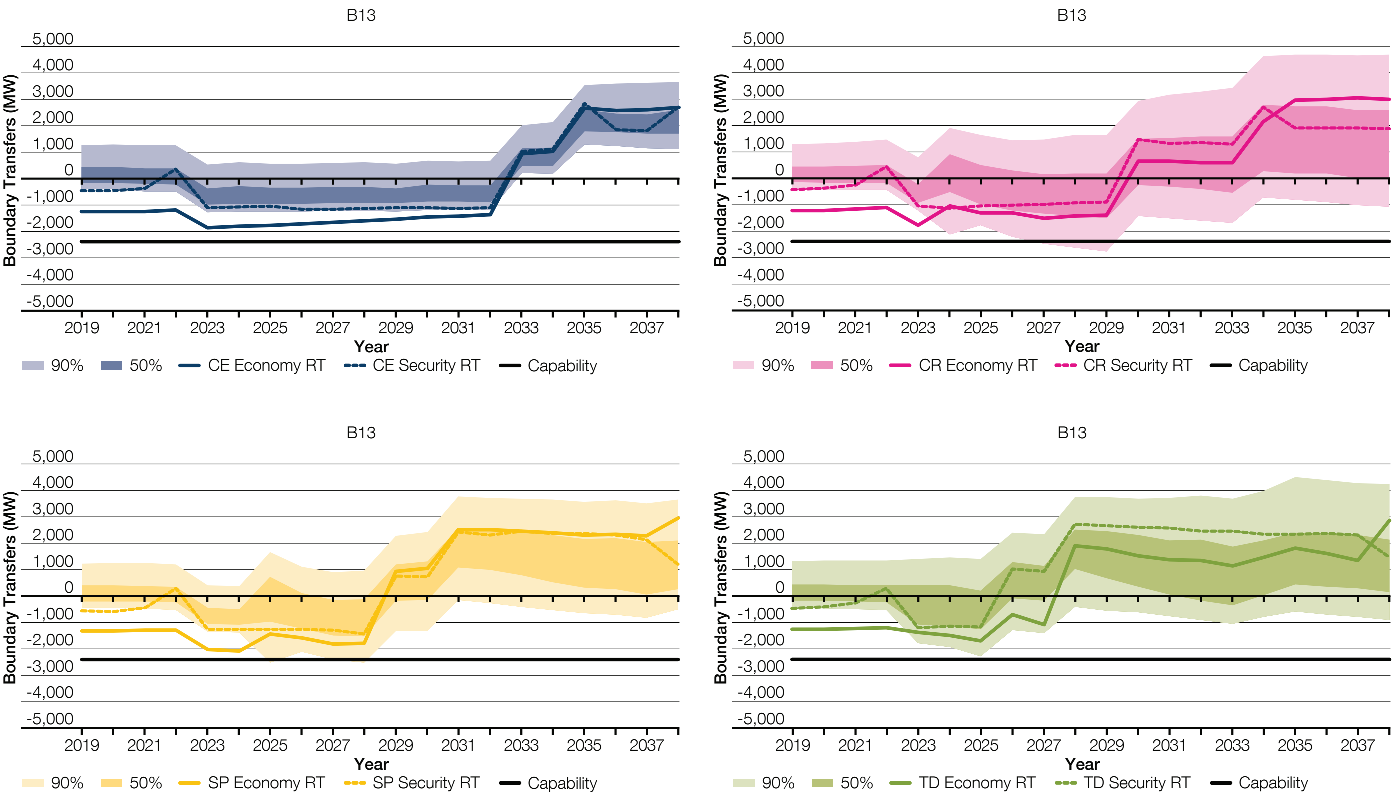


Wider boundary B13 is defined as the southernmost tip of the UK below the Severn Estuary, encompassing Hinkley Point in the South West and stretching as far east as Mannington.

The south-west peninsula is a region with a high level of localised generation and demand.

Figure B13.2

Boundary flows and base capability for boundary B13



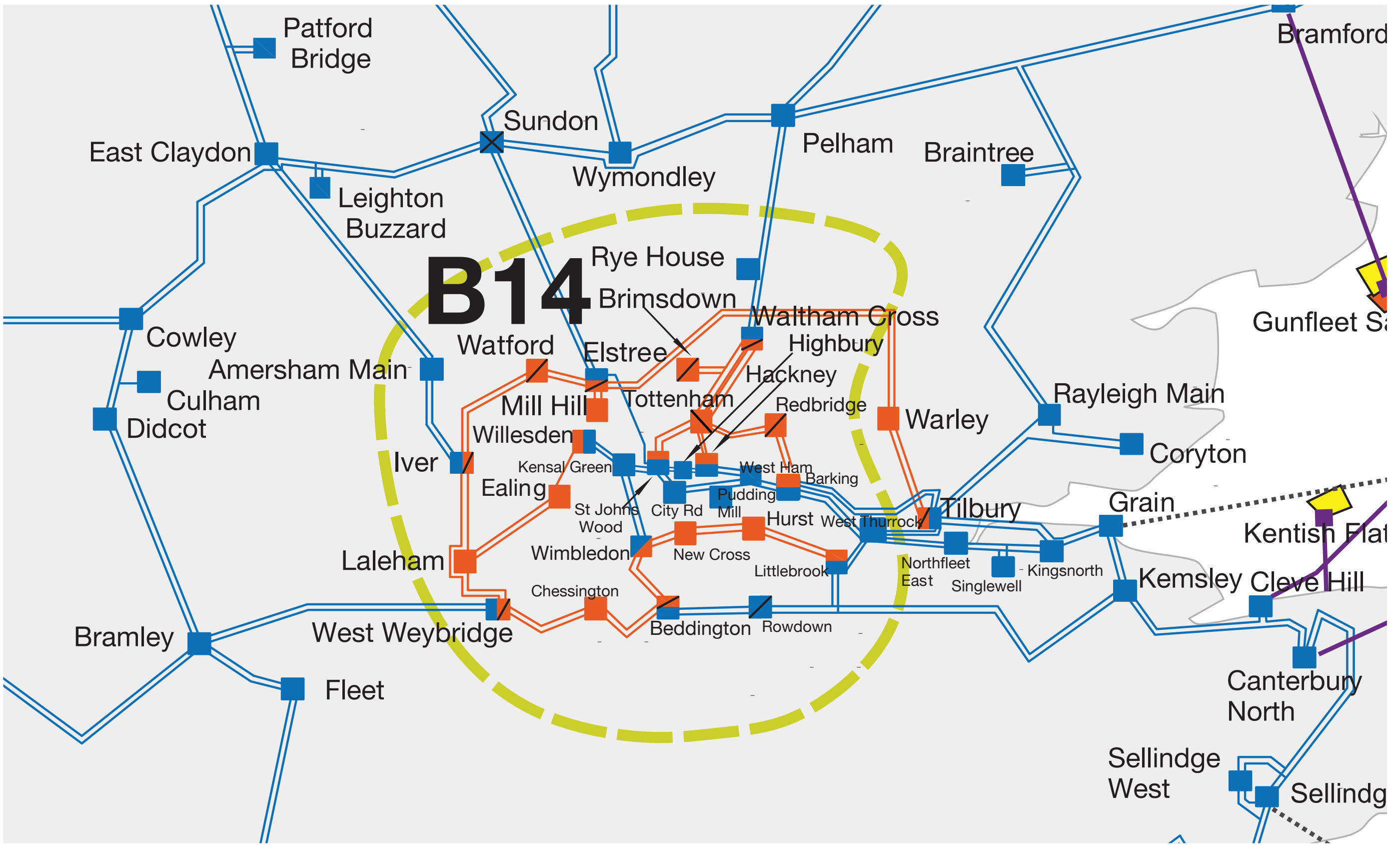
Boundary requirements and capability

Figure B13.2 above shows the projected boundary power flows for boundary B13 for the next 20 years. The boundary capability is limited at 2.4 GW due to voltage collapse post a fault on the Alverdiscott–Indian Queens double circuit.

It can be seen that until new generation or interconnectors connect there is very little variation in boundary requirements, and that the current importing boundary capability is sufficient to meet the short-term needs. The large size of the potential new generators wishing to connect close to boundary B13 is likely to push it to large exports and require additional boundary capacity. For **Consumer Evolution**, this happens after 2032 and for other scenarios takes place after 2027.

Boundary B14 – London

Figure B14.1
Geographic representation of boundary B14

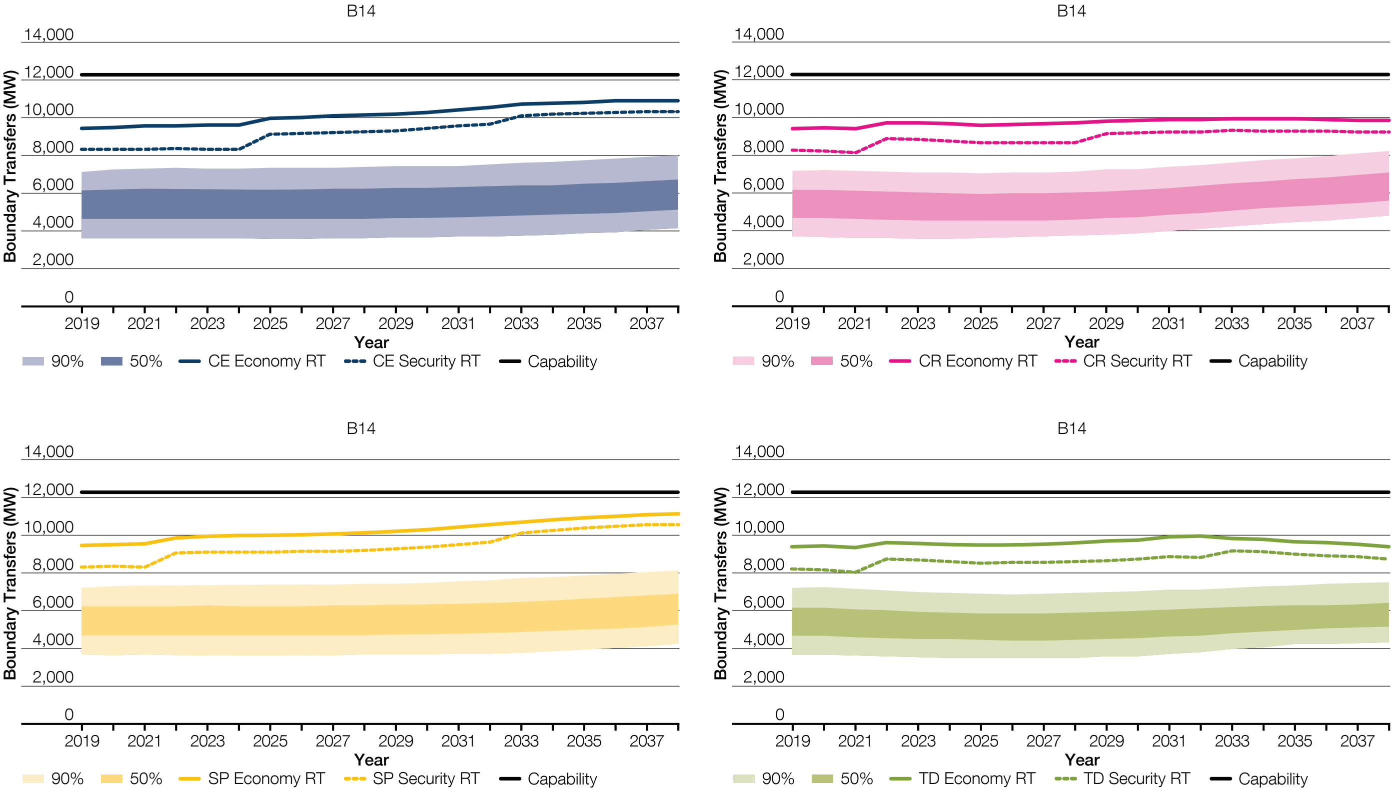


B14 cuts across eight 400kV double circuits and a 275kV double circuit

Boundary B14 encloses London and is characterised by high local demand and a small amount of generation. London's energy import relies heavily on surrounding 400kV and 275kV circuits. The circuits entering from the north can be particularly heavily loaded at winter peak conditions.

The circuits are further stressed when the European interconnectors export to mainland Europe as power is transported via London to feed the interconnectors along the south coast. The North London circuits can also be a bottleneck for power flow from the East Coast and East Anglia regions as power flows through London north to south.

Figure B14.2
Boundary flows and base capability for boundary B14



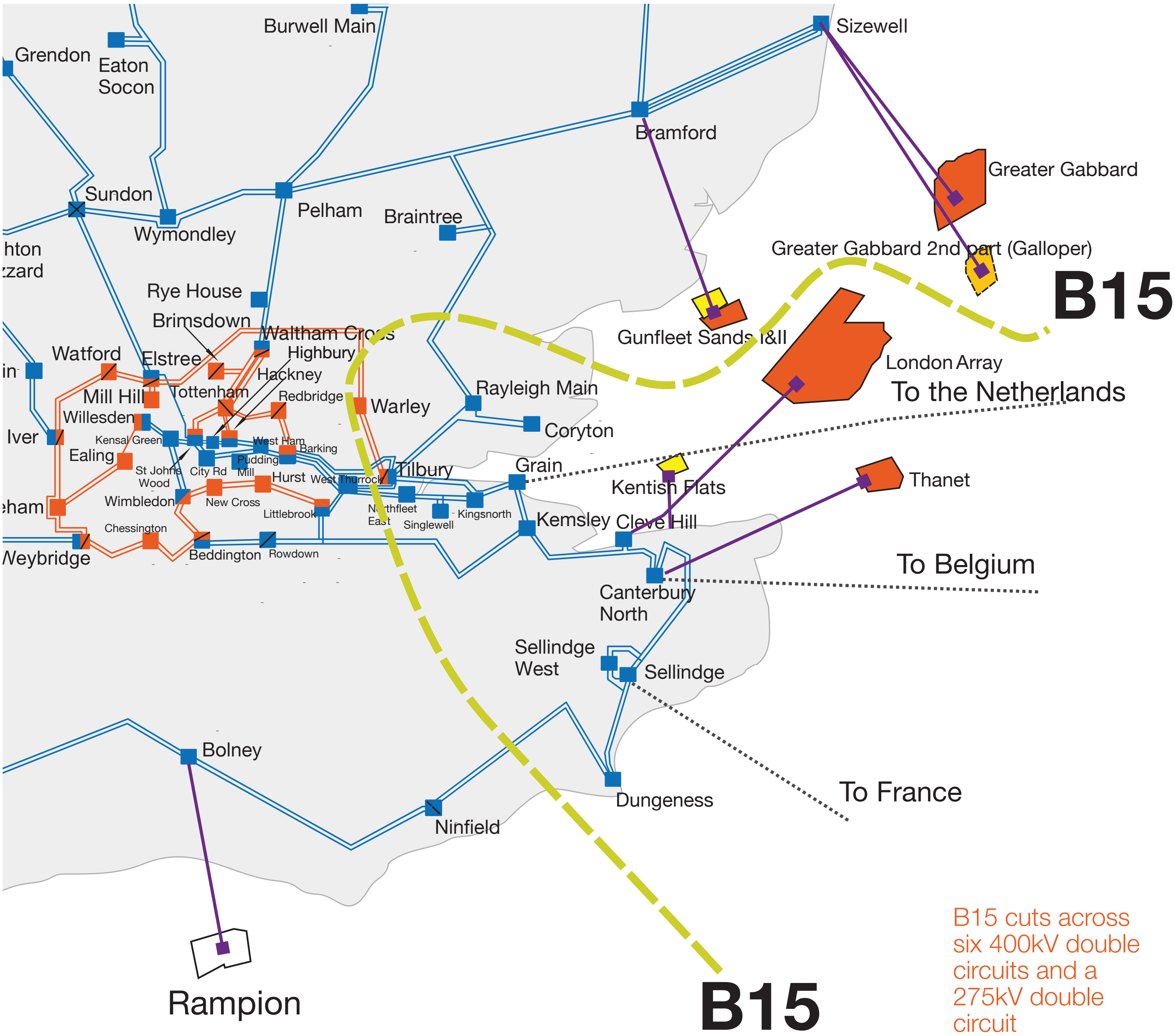
Boundary requirements and capability

Figure B14.2 above shows the projected boundary power flows for boundary B14 for the next 20 years across the *FES*. The boundary capability is currently limited by thermal constraints at 12.3 GW for a double circuit fault on the Pelham–Rye House–Waltham Cross circuits.

As the transfer across this boundary is mostly dictated by the contained demand, the scenario requirements mostly follow the demand with little deviation due to generation changes. The boundary requirements are close to each other across all four scenarios for Security and Economy required transfer. In both criteria, the required transfer is above 90% flows, meaning planning for these values covers all possible flows. Compared to last year's requirements, the boundary requirements have decreased due to the *FES* demand reduction projection around London area.

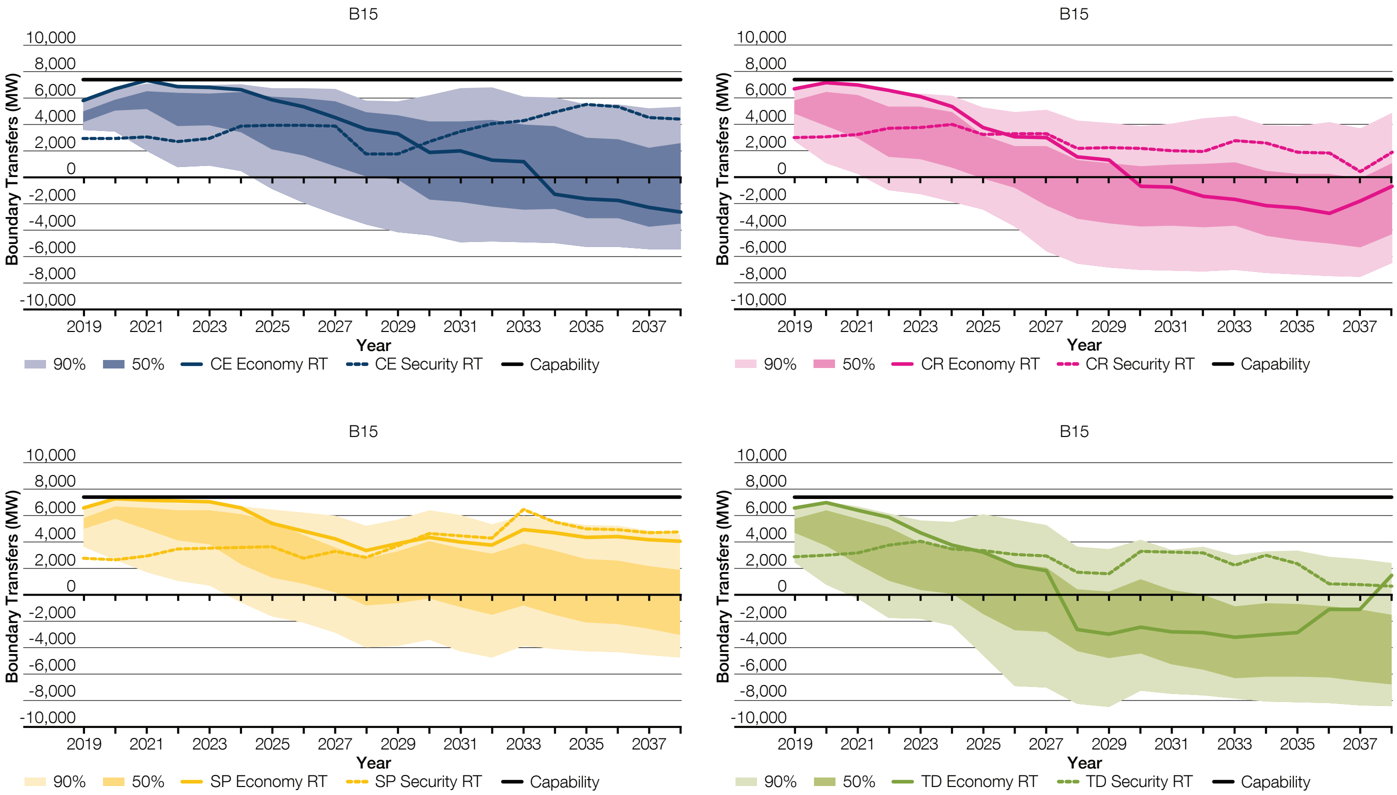
Boundary B15 – Thames Estuary

Figure B15.1
Geographic representation of boundary B15



Boundary B15 is the Thames Estuary boundary, enclosing the south east corner of England. It has significant thermal generation capacity and some large offshore wind farms to the east. With its large generation base, the boundary normally exports power to London. With large interconnectors at Sellindge and Grain connecting to France and the Netherlands, power flow of boundary B15 is greatly influenced by their power flows.

Figure B15.2
Boundary flows and base capability for boundary B15



Boundary requirements and capability

Figure B15.2 above shows the projected boundary power flows for boundary B15 for the next 20 years across the *FES*. The boundary capability currently has a thermal limit of 7.4 GW on the Littlebrook–Longfield Tee for a double circuit fault on the Grain–Kingsnorth and Grain–Tilbury circuits.

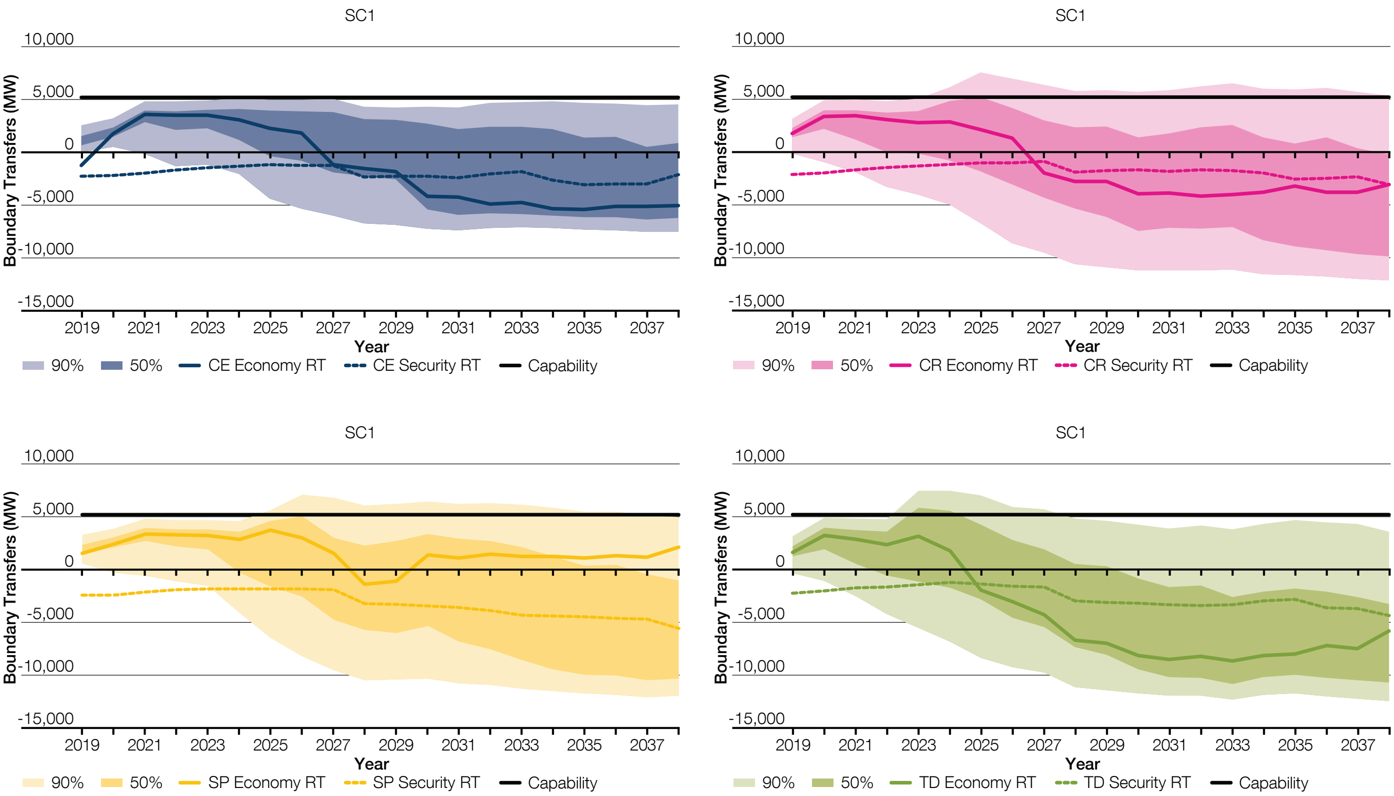
The interconnectors connected within this boundary are expected to import during winter peak. This leads to the boundary exporting. With sensitivities for the interconnectors exporting to Europe, the boundary can switch to an importing state – but only when new interconnectors connect, as shown for the **Two Degrees** scenario post 2027 and for the **Community Renewables** scenario post 2029.

Boundary SC1 – South Coast

Figure SC1.1
Geographic representation of boundary SC1

The South Coast boundary SC1 runs parallel with the south coast of England between the Severn and Thames Estuaries. At times of peak winter GB demand the power flow is typically north to south across the boundary, with more demand enclosed in the south of the boundary than supporting generation. Interconnector activity can significantly influence the boundary power flow. The current interconnectors to France and the Netherlands connect at Sellindge and Grain respectively.

Figure SC1.2
Boundary flows and base capability for boundary SC1



Boundary requirements and capability

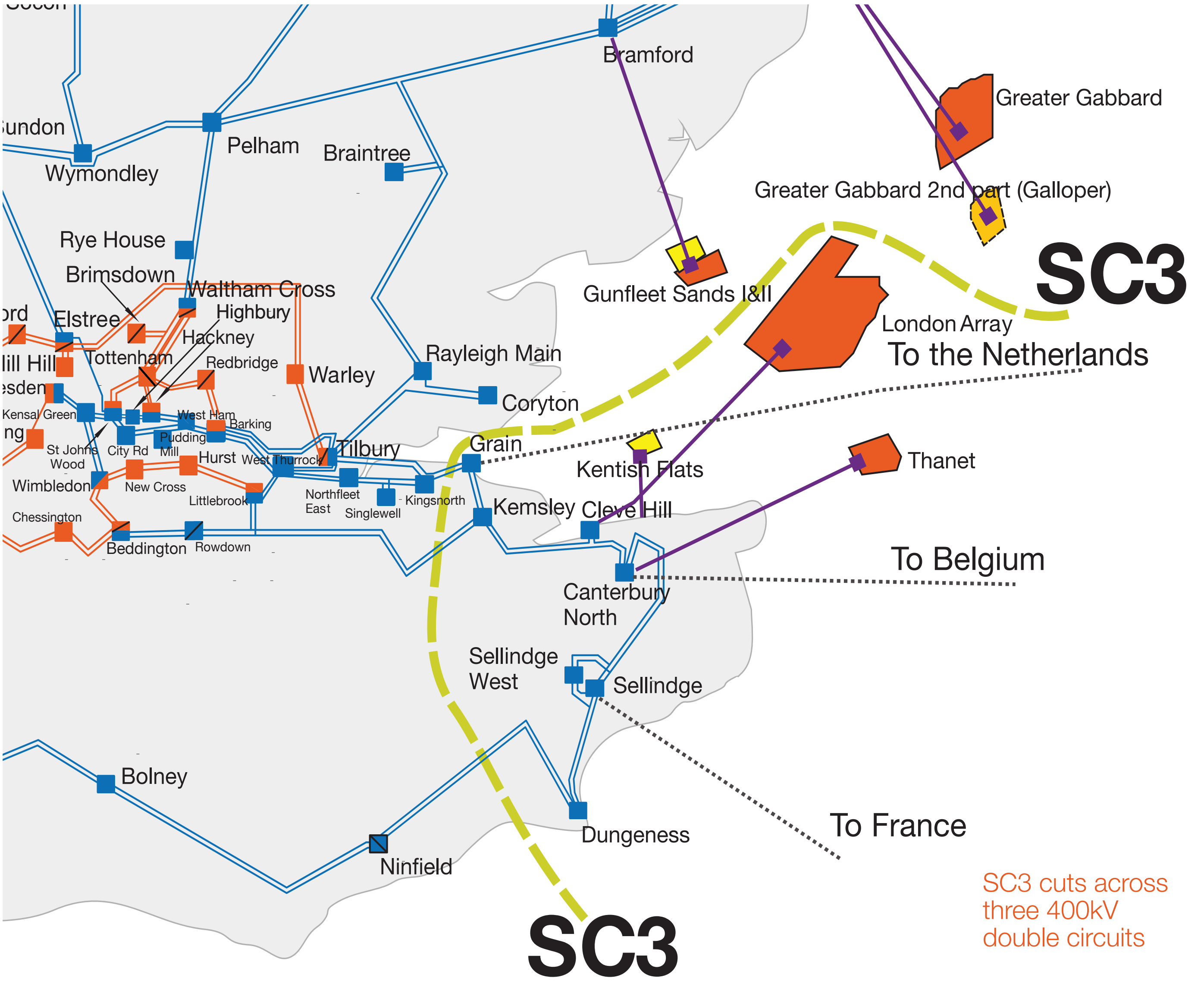
Figure SC1.2 shows the projected boundary power flows for boundary SC1 for the next 20 years across the *FES*. Positive values represent power flow across the boundary from north to south. The boundary capability is currently limited by voltage compliance at 5.2 GW for a double circuit fault on the Kemsley–Clevehill and Kemsley–Canterbury circuits for interconnector import sensitivity. For the interconnector export sensitivity, the limit is also voltage compliance at 6 GW of transfer. This happens after Hinckley Point–Taunton double circuit fault.

The interconnectors to Europe have a massive impact on the power transfers across SC1. A 2 GW interconnector such as IFA can make 4 GW of difference on the boundary from full export to full import mode or vice versa. The biggest potential driver for SC1 will be the connection of new continental interconnectors. With their ability to transfer power in both directions boundary SC1 could be stressed much harder than would normal with conventional generation and demand. Some of the scenarios suggest that up to 12 GW of interconnector capacity could connect below SC1 by 2026.

Across all *FES*, the SQSS Security required transfer follows a flat pattern whereas the Economy required transfer moves from exporting to importing in around 2026. The volatility of interconnector activity can be seen in the required transfers as the requirements swing from power flow south and north. The SQSS calculation of required transfers does not place high loading on the interconnectors so the transfers are not seen to peak at very high values. Credible sensitivities of the interconnectors operating at their rated capacities suggest that boundary power flows could exceed 10 GW which is well outside current network capability.

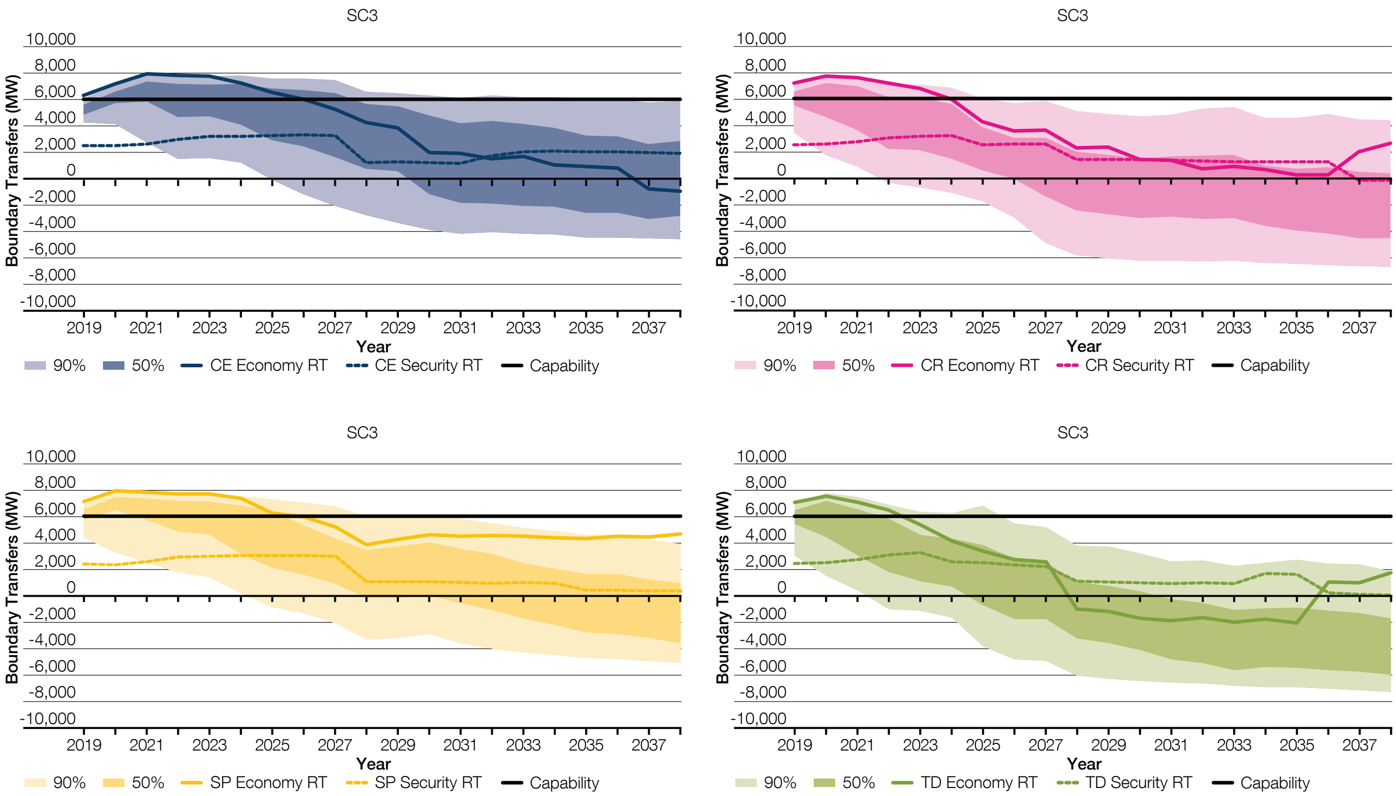
Boundary SC3 – South Coast

Figure SC3.1
Geographic representation of boundary SC3



The South Coast boundary SC3 is created to capture transmission issues specifically in the south-east part of the network. The current and future interconnectors to Europe have a massive impact on the power transfers across SC3. The current interconnectors to France and the Netherlands connect at Sellindge and Grain, respectively.

Figure SC3.2
Boundary flows and base capability for boundary SC3



Boundary requirements and capability

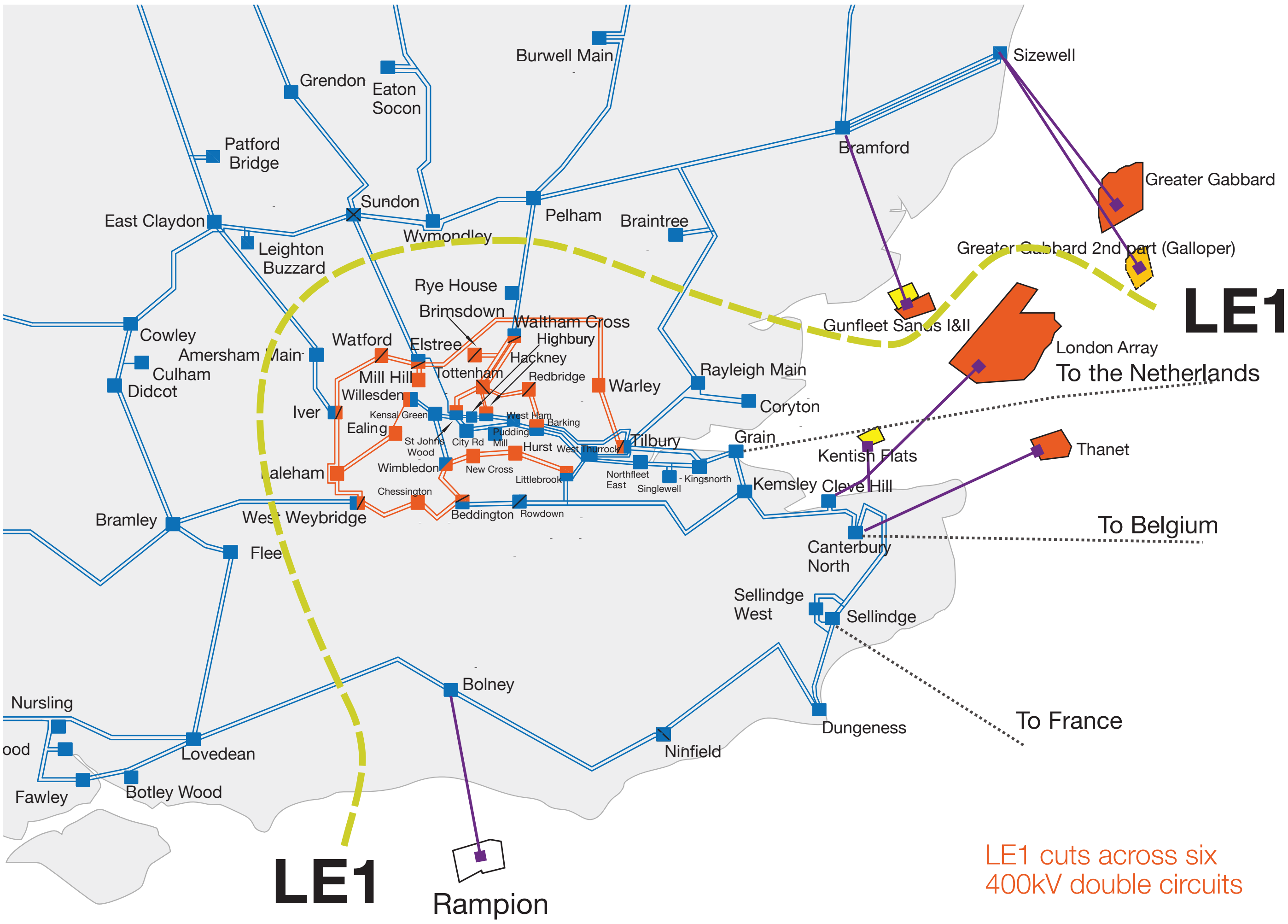
Figure SC3.2 shows the projected boundary power flows for boundary SC3 for the next 20 years across the *FES*. Positive values represent power flow across the boundary from north to south. The boundary capability is currently limited by thermal loading at 6 GW for a double circuit fault on the Grain–Tilbury–Kingsnorth circuits.

The current and future interconnectors to Europe have a massive impact on the power transfers across SC3 with their ability to transfer power in both directions.

Across all *FES*, the SQSS Security required transfer follows similar patterns and is mainly lower compared to the Economy required transfer. In general, the Economy required transfer faces a decline over time, albeit it does not reflect the interconnectors' uncertainties. The uncertainty of interconnector activity can be seen in the wide range of the boundary flows. Credible sensitivities of the interconnectors operating at their rated capacities suggest that boundary power transfers could exceed 5 GW in the opposite direction which necessitates studying the import sensitivity for future years.

Boundary LE1 – South East

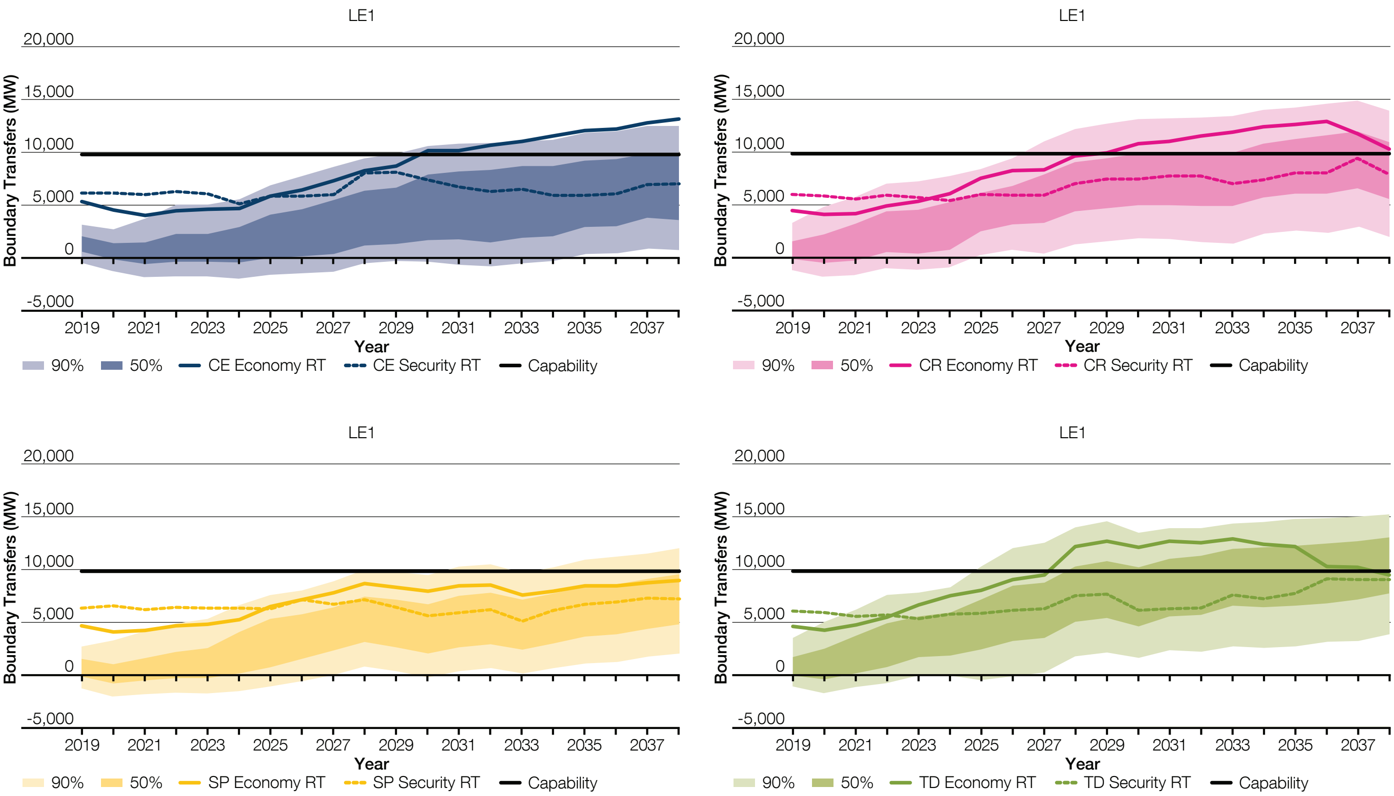
Figure LE1.1
Geographic representation of boundary LE1



Boundary LE1 (London and East) encompasses the south east of the GB network, incorporating London and the areas to the south and east of it. LE1 is characterised by two distinct areas. Within London there is high local demand and little generation. The remainder of the area contains both high demand and high levels of generation. In particular, there are a number of gas power generators in the Thames Estuary area and an interconnector to the Netherlands, while connected to the South East Coast are a number of wind farms, an interconnector to France and nuclear and gas power stations. There are several potential interconnectors to France, Belgium and the Netherlands located around the coast of both of these areas, leading to a high concentration of connections in this area.

LE1 almost exclusively imports power from the North and West into the South East, and the purpose of the boundary is to monitor flows in this direction. With the existing and proposed interconnectors importing power from the Continent, power flows enter London from all directions, so the extent of flows across LE1 reduce and no constraints are seen other than those shown by B14, B15 or the South Coast boundaries. However, with an increased number of interconnectors, and (in some scenarios) increased likelihood of them exporting power in future years, LE1 can become a high demand area, with any locally generated power feeding straight into the interconnectors. As such, the circuits entering from the North can become overloaded as power is drawn into and through London toward the South and East.

Figure LE1.2
Boundary flows and base capability for boundary LE1



Boundary requirements and capability

Figure LE1.2 shows the projected boundary power flows for boundary LE1 for the next 20 years across the *FES*. The boundary capability is currently limited by thermal constraints at 9.8 GW with overloads of the Rayleigh Main–Tilbury and Elstree–Sundon circuits.

Across all the *FES* except **Steady Progression**, the SQSS Economy required transfer follows similar patterns. The SQSS Security required transfer is similar for all scenarios. Both **Two Degree** and **Community Renewables** experience a period of high transfer requirement in later years. The uncertainty of interconnector activity can be seen in the wide range of the boundary flows.

3.9 Probabilistic thermal analysis case study

Introduction

To improve how we address the possible impacts of intermittent and volatile energy resources in the planning and operation of the NETS, it is necessary to quantify the costs/risks of the likely background conditions. The use of probabilistic risk assessment techniques in the development and operation of the NETS has the potential to quantify the magnitude and likelihood of events on the transmission system throughout a year. This will lead to more informed network investment and operational planning decisions, with clear cost/risk measures being applied.

Current approach and new requirements

The long-term development planning of the NETS has traditionally been carried out against single-snapshot "worst-case" scenarios, at winter peak demand. This is consistent with the boundary required transfer methodology in the NETS SQSS. Changes in generation and demand mean that planning to meet winter peak demand requirements might not satisfy all of the conditions that could arise through the course of a year. By simulating year-round conditions using probabilistic distribution of variables we can look at a broader range of conditions and highlight the magnitude and likelihood of events on the transmission system throughout the year.

We have carried out a case study to investigate using a probabilistic approach in one GB region. The following sections describe our probabilistic tool, methodology and some findings from this approach.

New assessment approach

The probabilistic element of our long-term assessment process is based on the Monte-Carlo[4] method to estimate the likely power flow on individual transmission circuits or a group of circuits at a boundary level.

Monte-Carlo is used to sample likely background generation and demand conditions which are then fed into an economic dispatch algorithm. This allows us to find out what would be the position of available energy resources assuming an ideal electricity market. The results are hourly generation and demand snapshots which are subsequently evaluated by power system analysis to understand their impacts on the GB NETS.

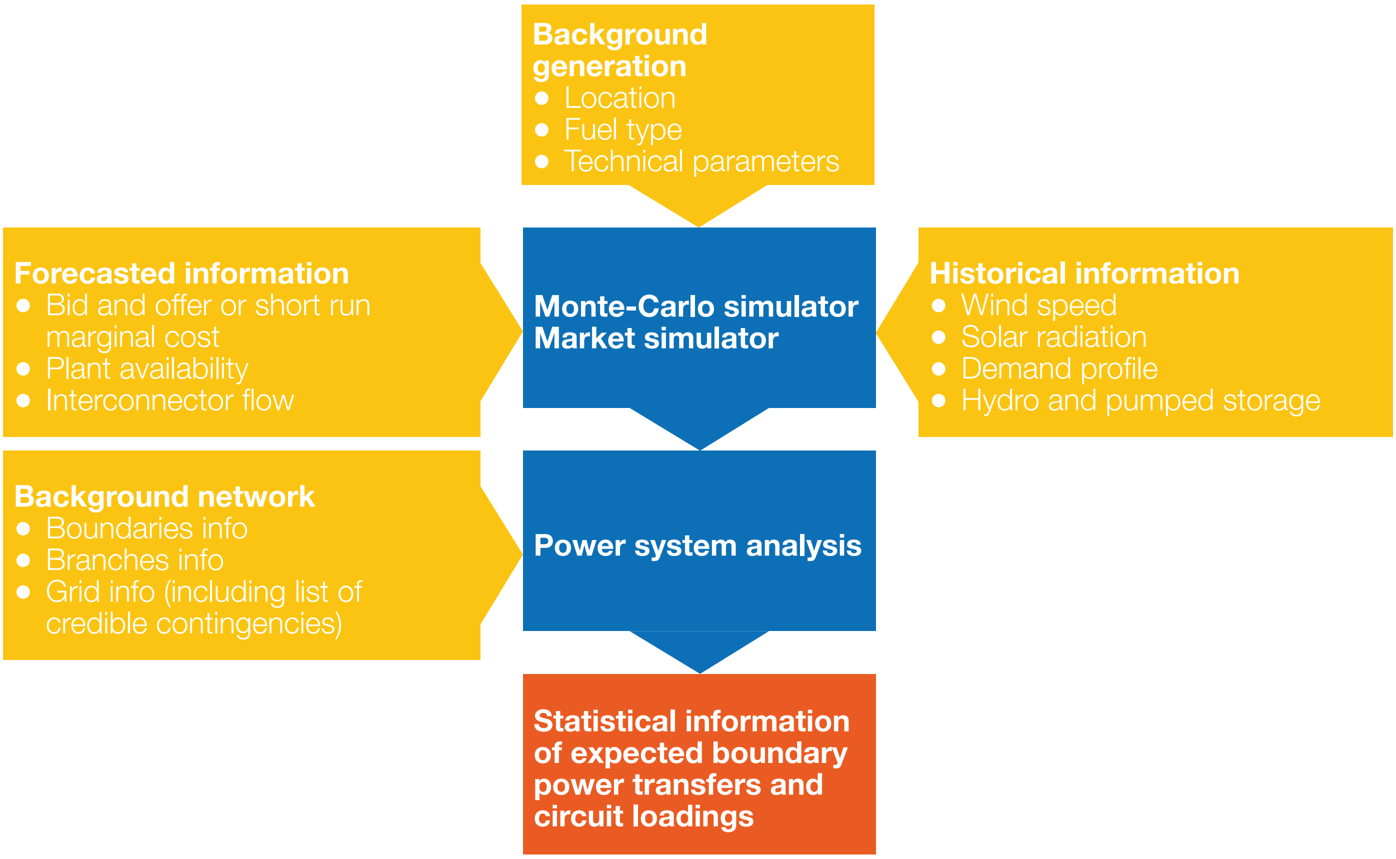
Study case and results

The case study covers the south-east region of GB and considers only network thermal constraints. The current single-snapshot approach is difficult for this area because of the highly variable power flows on HVDC interconnectors to mainland Europe. The targeted region covers a variety of energy resources such as nuclear generation, wind farms and interconnectors. We created a new boundary – South Coast 3 (SC3) – based on the contingencies in this area and associated circuits' loading. You can find its description and flow graph in the previous section. The technique described here can be used to update the existing boundaries we currently use to capture relevant network issues year-on-year.

For this case, the background generation is based on the **Two Degrees** energy scenario. For each sample year, 8,760 sequential snapshots are generated by the Monte-Carlo simulator to represent each hour of the year. Each snapshot is assessed by the electricity market simulator and finally evaluated by the power system analysis based on DC power flow approximation. This process is depicted in Figure PT.1.

[4] A mathematical technique widely used to model risk and uncertainty

Figure PT.1
Probabilistic thermal analysis diagram



Figures PT.2 and PT.3 depict the expected power transfer across SC3 during winter and summer of 2018/2019. These are based on multiple sampled scenarios of different generation, demand and outage patterns per season. Each bar shows the expected number of hours per season for the corresponding boundary transfer. Acceptable boundary transfers are shown in blue, whereas unacceptable ones are purple. An unacceptable boundary transfer means that there is at least one overloaded circuit. Boundary transfer numbers using the single-snapshot method are shown by the red number in the power transfer axis in the figures. The single-snapshot boundary capability numbers are 6,015 MW and 4,810 MW for winter and summer, respectively. The identified limiting fault and thermal constraint using single-snapshot criteria align with those found through probabilistic techniques.

We can see that the full range of boundary capability will vary based on the background conditions. The single-snapshot boundary numbers are over-estimated in this case and there are many instances that the actual boundary capability is less than these fixed capability values. In this case, the single-snapshot value is over-estimated for both summer and winter; however, for other conditions that may not be the case.

If we are going to choose a single boundary capability number per season based on the probabilistic approach, the challenge is how to choose this value. For example, the winter boundary capability number based on the probabilistic technique lies between 4,100 MW and 5,800 MW (see Figure PT.2). If we choose a number close to 4,100 MW, we are under-estimating the boundary capability; whereas a number close to 5,800 MW means we are over-estimating the boundary capability. Our current idea for this example is to use constraint forecast-error concept. The determined boundary capability based on this concept is 4,750 MW. This concept and the associated technique to calculate the boundary capability are briefly described in Appendix H. Further details will be provided in our full report in Q1 2019 and we welcome stakeholders' views on this proposed approach.

Figure PT.2
Acceptable and unacceptable SC3 power transfers (winter 2018/19) – (the red number indicates the single-snapshot boundary capability)

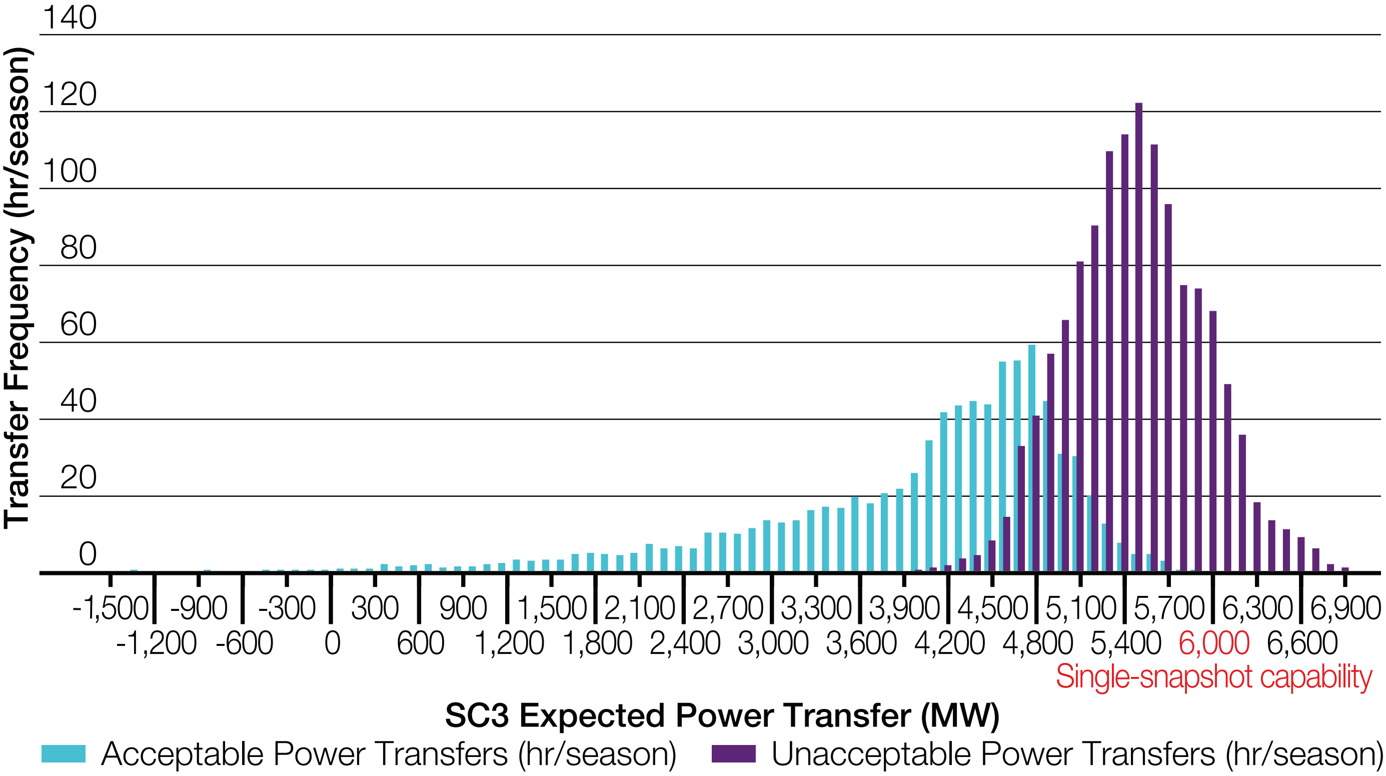
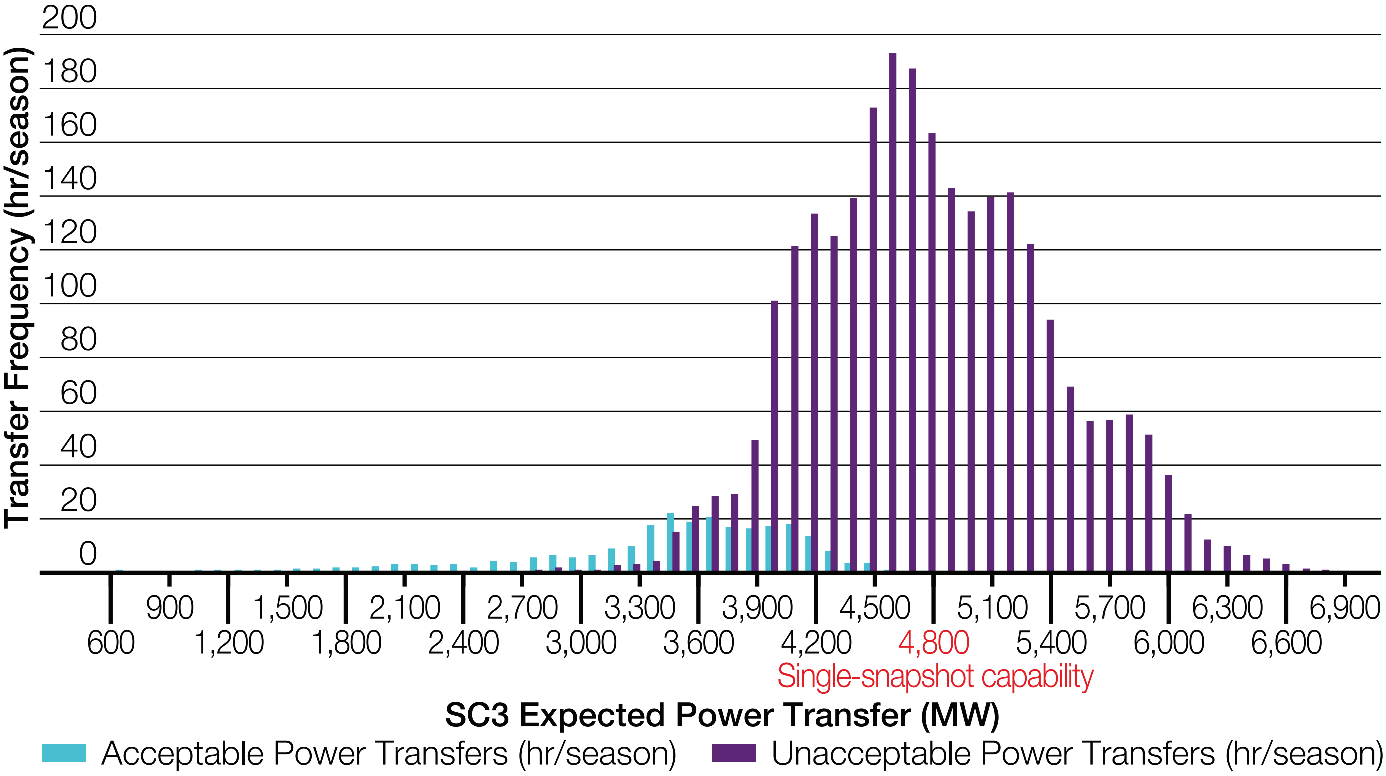


Figure PT.3
Acceptable and unacceptable SC3 power transfers (summer 2018/19) – (the red number indicates the single-snapshot boundary capability)



Remarks and way forward

From the testing of a single region of transmission network that is difficult to analyse by traditional methods due to highly variable generation and demand, we have found that the traditional single-snapshot boundary capability approach may, in this case, over-estimate boundary capability when compared to a more comprehensive probabilistic based analysis. The over-estimated boundary capability, when applied to network requirements identification, might expose the network to unforeseen risks. In this case, additional reinforcements beyond that identified through the *NOA* process could be required.

The probabilistic technique looks at a broader range of snapshots and can calculate boundary capability based on multiple background conditions. We intend to use this information to investigate what impact it will have on the *NOA* recommendation for this boundary (SC3), the outcome of which we will publish in Q1 of 2019. Note that we investigated the probabilistic approach for only one boundary and presented the results; however, the outcomes could be different for other boundaries. Although in this case we demonstrated that the single-snapshot technique might result in under-investment, it might result in over-investment for other boundaries and/or different background conditions. Thus, the results cannot be applied generically to all boundaries as background conditions can vary widely.

Stakeholder engagement
If you have feedback on any of the content of this document please send it to **transmission.etys@nationalgrid.com**, catch up with us at one of our consultation events or visit us at National Grid ESO, Faraday House, Warwick.

3.10 Regional voltage analysis case study

Introduction

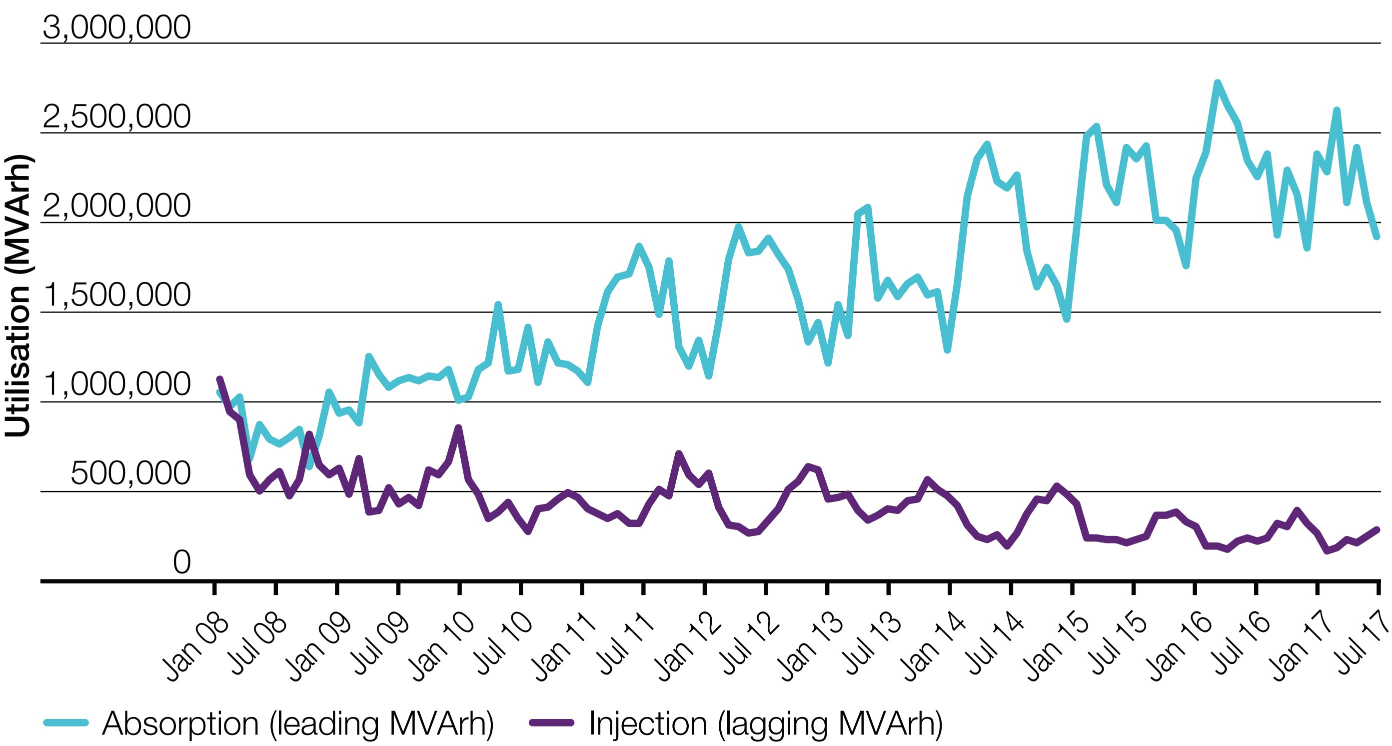
We operate the transmission system so that voltage levels remain within the normal operating ranges defined within the NETS SQSS. This ensures we operate the system safely and efficiently.

The specific voltage limits used in planning and operating the transmission system can be found in Chapter 6 of the SQSS[5].

Voltage management has become increasingly challenging

Over the last decade, operationally managing system voltages, particularly within the upper limit, has become an area of increasing challenge for the ESO. We've observed a continual decrease in both minimum demand and reactive power consumption at Grid Supply Points (GSP), as shown in Figure RV.1, which has resulted in an increasing need to absorb more reactive power on the transmission network.

Figure RV.1
Reactive power utilisation



[5] https://www.nationalgrideso.com/codes/security-and-quality-supply-standards?overview

The pace and scale of changing reactive power flows in recent years, combined with the lead times involved in the investment of network assets, has created an increased reliance on balancing services for reactive power. We currently spend over £150m per annum on these services. This shows no sign of slowing and, with further potential traditional generation plant closures, the ability to manage system voltages will become increasingly difficult. In the long term, to ensure we can operate the transmission system securely, efficiently and economically, we need to consider how to best strike a balance between the use of asset options and balancing services to meet the needs for reactive power. To improve our understanding of the system needs we have decided to undertake regional investigations of voltage performance.

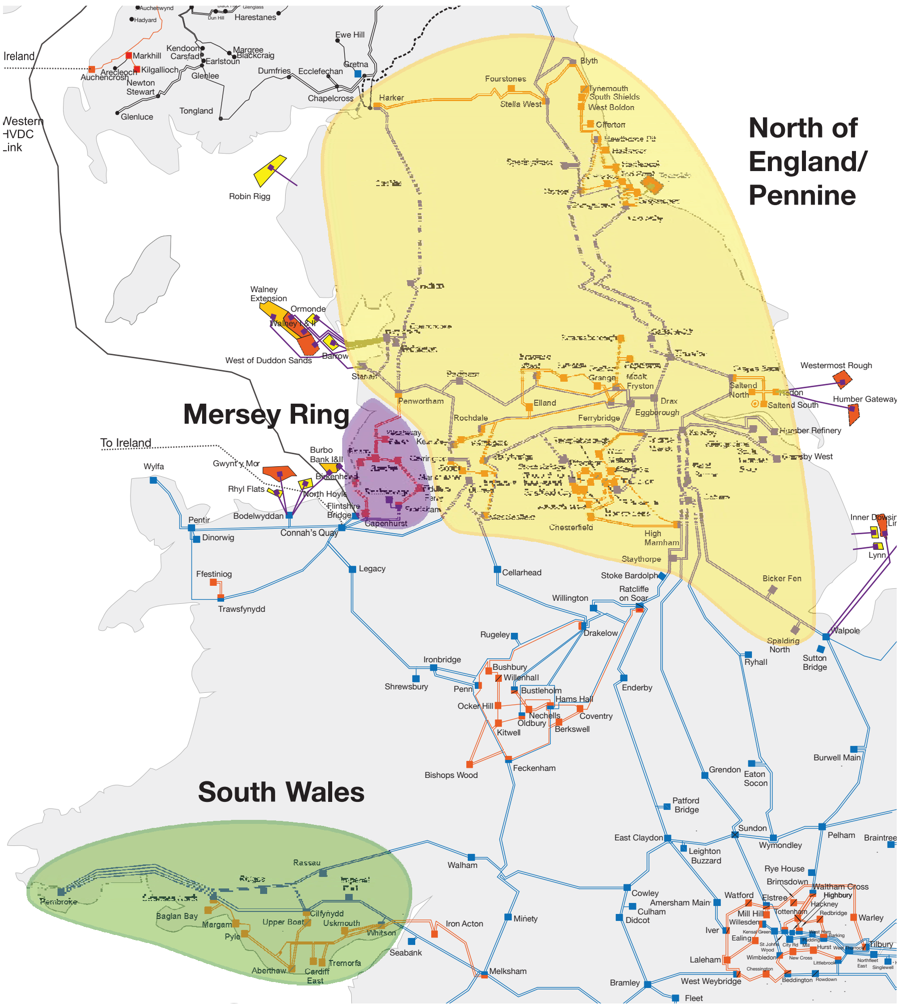
A regional approach

Voltage is a localised property of the system which means that requirements vary from one region to another. The voltage management requirements are determined by the configuration of the local network and the behaviours of generation and demand in that part of the network in real time. Since voltage is a local phenomenon, reactive power is most effective for voltage control when close to the region of imbalance. We are currently studying several regions to understand the local reactive power requirements. We will also look to identify the most economic and efficient solutions to fulfil the requirements where necessary. The plans for regional assessments are as follows:

North of England/Pennine

- Phase 1:
  - Explore solutions from Transmission Owners (TOs) and Distribution Network Operators (DNOs)
  - Publish findings of Phase 1 – Q4 2018
- Phase 2:
  - Expand to consider new commercial solutions – 2019 (following completion of a request for information for Mersey and South Wales).

Figure RV.2
Regional assessment areas



Mersey Ring

- Communicate needs to stakeholders (TOs, DNOs and commercial providers).
- Publish Request for Information.
- Explore solutions from TOs, DNOs and commercial providers.
- Solutions assessment.
- Publish recommendation.

South Wales

- Communicate needs to stakeholders (TOs, DNOs and commercial providers).
- Publish Request for Information.
- Explore solutions from TOs, DNOs and commercial providers.
- Solutions assessment.
- Publish recommendation.

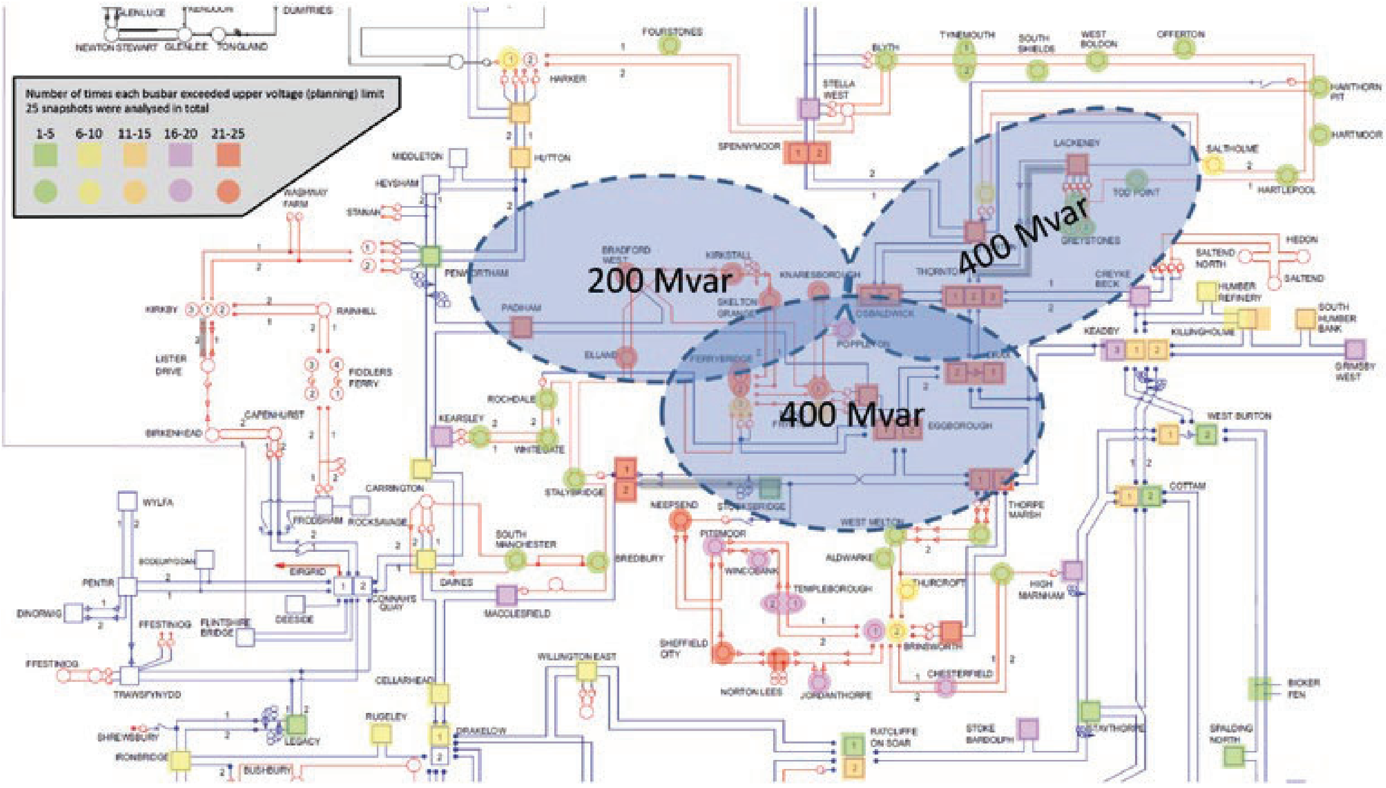
Pennine case study

The first region we studied was the North of England/Pennine area. A *NOA*-style assessment was developed through the ENA Open Networks Project to decide the most economic and efficient way to manage the voltage in this region.

We analysed a range of scenarios to identify the voltage requirements. High voltage issues are present at times of low demand in the North of England/Pennine area – this is typically during the overnight hours of the summer months. The analysis studied the existing asset and operational voltage management solutions, and concluded that the system requires extra capability to absorb excessive reactive power in this area. The voltage issues heatmap, shown in Figure RV.3, summarises the results of our analysis for the North of England/Pennine area. Further details about the assessment can be found in the ENA Open Networks Workstream 1 Product 1 report to be published by the end of 2018.

Traditionally the identification of NETS voltage issues would lead to the TO considering various transmission asset options as reinforcement to relieve the problems. As part of this case study, we also explore the potential of using distribution asset options. We worked closely with the TO (NG ET) and DNOs (Electricity North West and Northern Powergrid) that cover the North of England/Pennine area to explore the options available. Now that Phase 1 of the Pennine case study has concluded, we have assessed a range of options, at both transmission and distribution levels, that can absorb approximately 1 GVAr of additional reactive power. Although the technical analysis identified regional reactive absorption needs of 1 GVAr, the economic analysis found only 800 MVAr absorption requirement could be justified. We plan to publish our findings of the work to-date by the end of 2018 as part of the ENA Open Networks Workstream 1 Product 1 report.

Figure RV.3
Heatmaps of the voltage issues in the North of England/Pennine area



Mersey Ring and South Wales

For the Mersey Ring and South Wales areas, we have completed our analysis on the voltage requirements. We are currently collating our data in preparations for communicating the system needs in these areas to our stakeholders. Like the Pennine case study, we plan to work with the TO and DNOs that cover the areas to explore the potential network asset options to fulfil the requirements. We also intend to expand our option analysis to include commercial options.

Next steps

We are working on improving the approach we took for the case studies so that it can be built into our enduring process. What we learn from these case studies will be used to further develop the process and it will form part of the *NOA* methodology.

Examples of areas identified for further development include:

- A screening process which identifies high priority regions to consider in terms of analysing system voltage needs. We will develop a screening tool which uses data we hold as the ESO to inform the conditions and situations which we should focus on through power system studies.
- Improving the way we represent the system needs for voltages to our stakeholders, including TOs, DNOs and commercial providers. We welcome any stakeholder views on this.
- Expanding our long-term option analysis of voltage to include distribution asset options and commercial options.

We are committed to work closely with our stakeholders to further develop our process for addressing the long-term reactive requirements for high voltage issues. Any new proposed methodologies will be consulted on with stakeholders as part of our annual consultation on the *NOA* methodology.

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APPENDIX 5 - GN36 BREEAM, CEEQUAL AND HQM ECOLOGY CALCULATION METHODOLOGY – ROUTE 2

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GN36 BREEAM, CEEQUAL and HQM Ecology Calculation Methodology – Route 2

GN36 Version 0.0 PN343 May 2018

Contents

1. Scope and Applicability

1.1 Applicability of this Guidance Note to the BREEAM Family of Schemes (BREEAM, CEEQUAL, HQM)

This guidance note is applicable for BREEAM, CEEQUAL and HQM schemes used in the UK which opened for registrations from 2018 onwards.

The relevance of this document to a project undergoing an assessment under any of these schemes is dependent on the version of the scheme being used. Reference should be made to the scheme Technical manual to determine this. Where there is no reference to this document, the method set out here is not relevant and cannot be used to demonstrate compliance with the assessment criteria in those versions of those schemes.

Where the term Assessor is used in this document this refers to the BREEAM, CEEQUAL or HQM Assessor as appropriate.

1.2 Purpose and Scope of this Guidance Note

This guidance note sets out the calculation methodology and process used within the above schemes for the purpose of calculating a 'change in ecological value' resulting from the project being assessed. It forms a part of the technical manual for these schemes and as such the methodology and process described forms an integral part of these scheme requirements. There are four core assessment issues which relate to ecology:

- Identifying and understanding the risk and opportunities for the project
- Managing negative impacts on ecology
- Change and enhancement of ecological value
- Long term ecology management and maintenance

The methodology and process set out in this document must be carried out by a Suitably Qualified Ecologist (see the 'Identifying and understanding the risks and opportunities for the project' assessment issue for the definition of a Suitably Qualified Ecologist). It is used to calculate the change in ecological value resulting from a project for the purposes of the Assessment.

This methodology is directly relevant for calculating change in ecological value and therefore is an integral part of the 'Change and Enhancement of Ecological Value' assessment issue. However it is also relevant for other issues and appropriate stages must be considered as part of the 'Identifying and understanding the risks and opportunities for the project' assessment issue.

The considerations and outputs generated from the methodology set out in this guidance note will also inform the assessment and achievement of the following issues or their equivalents:

- Managing negative impacts on ecology
- Long term ecology management and maintenance

See the relevant assessment issue in the appropriate technical manual.

The outputs of this calculation are used by the Assessor to determine the reward (e.g. credits/points) available for the 'Change and Enhancement of Ecological Value'. It forms part of the assessment route 2 in ecology related assessment issues.

This route is defined as follows:

1.3 Route 2: For Sites Where Complex Ecological Systems are Likely to be Present

This is the more comprehensive route of assessment and as such can achieve a higher level of reward than Route 1 (See GN 34: BREEAM CEEQUAL and HQM Ecology Risk Evaluation Checklist for a definition of Route 1 and details of when it can be applied). Route 2 results in a higher potential overall reward and as such is better able to provide recognition for project teams' actions and project outcomes under an Assessment.

The methodology outlined in this document does not apply to assessments being assessed under Route 1.

2. Background to the Methodology Development

Significant advances in understanding, measurement, calculation and data quality have occurred since BREEAM started evaluating the change in ecological value in 1998. These changes have been taken into account in determining the methodology set out in this document. It has been developed with input and guidance from a range of public and professional bodies, practising ecologists and other relevant experts and stakeholders. The approach and calculation methodology in this note was developed by WSP, with input from Balfour Beatty and Footprint Ecology, under contract with BRE.

It builds on the work of Defra and Natural England in calculating Biodiversity Units (see Appendix A: Definitions) (the 'Defra Metric') and as such, is supportive of government policy in terms of environmental protection and enhancement of biodiversity. This approach is being increasingly adopted by developers, local authorities and others, and relates well to other requirements and processes required of project teams through planning and elsewhere. However the methodology is intended for use within the BREEAM, HQM and CEEQUAL assessment schemes used in the UK and should not be used for other purposes without careful consideration of its relevance.

BRE intends to update this methodology as appropriate as and when the Defra Metric is amended, to avoid conflicts with current best practice and unnecessary burdens or duplication when determining and demonstrating the ecological impacts of development and management activities.

3. Overview of the Methodology

The methodology used within the BREEAM family complements, but does not negate or replace the need for, any legally required ecological assessment.

This methodology uses the change in 'Biodiversity Units' as an indicator of a site's change in ecological value overall and is based on the approach set out in the Defra Metric. It uses a simplified set of key ecological attributes and assessment characteristics to provide an appropriate degree of consistency and comparability.

Go to Appendix A: Definitions to understand more about:

- **Biodiversity Unit**
- **Linear Habitats**
- **Area Based Habitats**
- **Condition**
- **Distinctiveness**
- **Development Footprint**
- **Zone Of Influence**
- **Low Impact Developments**

The methodology requires the calculation of Biodiversity Units for both linear and Area Based Habitats impacted by a project and is carried out Pre and Post Development. It provides a simple and accessible means of estimating changes, promoting ecological protection, mitigation and enhancements in relation to the built environment.

The methodology is therefore an accounting tool, used to demonstrate biodiversity losses and gains and so determine the awarding of credits/points as relevant to the scheme. It should not be used for other purposes without careful consideration of its relevance to the task being undertaken.

The methodology is based on three main attributes:

i. the area or length of habitats (dependent on their type),

ii. their condition and,

iii. their distinctiveness.

These attributes are assigned numerical values to allow Biodiversity Units to be calculated for each habitat type. The number of Biodiversity Units can then be compared before and after the development to determine a change and so give an indication of the change in overall ecological value.

Whilst many sites have significant ecological value (often, but not always, recognised through the planning process), many others have limited value Pre Development but these still have potential to enhance value through development and management changes. For many sites, overall value is and will remain relatively insignificant. It is, therefore, important that an appropriate level of rigour is used to consider ecological impacts commensurate with the complexity and scale of potential impacts and the risks involved. For this reason the methodology is split into a full approach and a simplified approach. The simplified approach can only be used for developments with low level risks to ecological value and biodiversity. The following section provides more detail about this approach.

Both the full and simplified approaches follow the format set out within the Defra Metric (Defra 2012 a, b and c), and are adapted to ensure that it is appropriate for the built environment and hence the BREEAM family of schemes.

The calculation methodology requires the Suitably Qualified Ecologist (SQE) to undertake site visits and surveys of the existing habitats within the Development Footprint and (if relevant) any areas of habitat affected indirectly as well as land offsite that is being used for habitat creation or enhancement to mitigate or offset on-site impacts. These surveys are used to establish a value for three attributes (described in the following sections of this document) and should be undertaken before any works commence, including preparatory works such as site clearance. They should be carried out alongside any other required ecological surveys wherever possible (e.g. for planning purposes).

Figure 1 - Change in Ecological Value Methodology Overview

Step 1: Survey, Evaluation and Determining the Approach

Step 1A

- Determine the area to be assessed, i.e. the **Development Footprint**
- Identify the Zone of Influence

Step 1B

- Determine whether the development will affect SSSIs, ASSIs, internationally designated sites, legally protected species and/or irreplaceable habitats.

Step 1C

- Determine the calculation method to use, i.e.:
- The **full method**; or
- The **simplified method**

FULL CALCULATION METHOD

Step2A

- Carry out a Phase 1 Habitat survey to classify habitats into distinctiveness categories, or (if all habitat has low distinctiveness) following the guidelines set out by CIEEM for Preliminary Ecological Appraisal.

Step 2B

- Survey the site to assess the condition of each of the habitats using Natural England's Farm Environment Plan (FEP manual).

SIMPLIFIED CALCULATION METHOD

Step 2A

- Carry out a site walk over to classify each habitat and assign distinctiveness based on Habitat information within Appendix C.

Step 2B

- Assume the condition of all habitats is moderate, unless there is evidence that they are in a good condition.

Step 3: Calculating the Change in Ecological Value

Step 3A

- Calculate the linear (foliage related and watercourse) and/or area pre and post development biodiversity units for each habitat identified

Step 3B

- Compare the pre and post development biodiversity units to reflect whether any change is likely to occur for each habitat.

Step 3C

- Determine the total biodiversity units separately for each of the three possible outputs (linear (foliage related and watercourse) and area based)

Step 4 : Identifying the Level of Reward (Credits / Points)

- Identify the BREEAM family reward level available for the development using the worst biodiversity unit score from the three possible outputs referred to in step 3c. The number of credits / points assigned by the Assessor to each reward level may vary depending on the BREEAM family scheme under which the project is being assessed. See the relevant scheme technical manual for the number of credits / points available.

4. Determining the Applicable Change in Ecological Value Calculation Approach

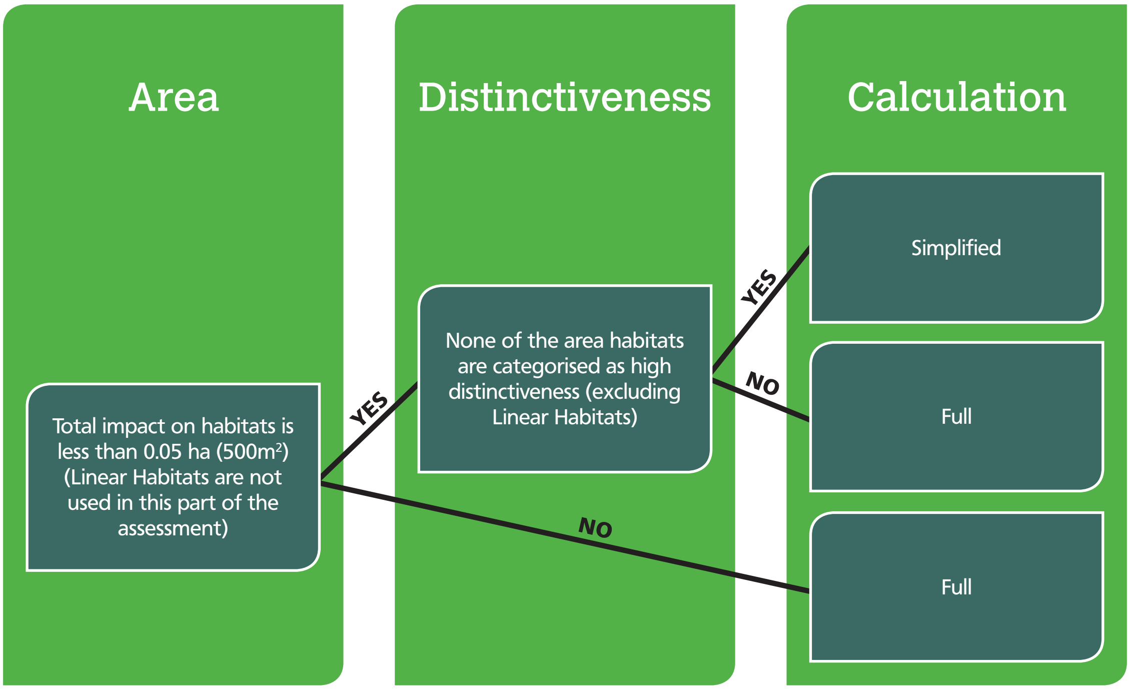
The calculation methodology applied by the SQE to determine the change in ecological value will follow either the full or simplified approach as set out in Figure 2.

The simplified approach can be used for projects where Pre Development ecological value is likely to be low and where there is deemed to be a low risk of impact on biodiversity. For the purposes of BREEAM, these are defined as projects that have a total area less than 0.05 hectares (ha) of habitats within the Development Footprint in total Pre Development and where there are no habitats present that are assigned a high level of distinctiveness (see Table 1: Habitat Distinctiveness Bands and Scores) for further details.

To determine which approach should be followed, the area of all habitats within the Development Footprint (see definitions appendix) should be identified using data from (in priority order, where available) recent ecological assessments, recent aerial photography, local environmental record centres and web based map such as MAGIC (http://magic.defra.gov.uk/). This should provide the necessary information to identify the most appropriate type of site survey required, before visiting the site. If there is any doubt on whether the above criteria are met, the full method should be used.

The following diagram (Figure 2) outlines the steps to identify the appropriate approach for the calculation of 'change in ecological value'.

Figure 2 - Steps to Identify the Applicable Change in Ecological Value Calculation Approach



Habitats of high distinctiveness are equivalent to the habitats of principal importance identified in the Natural Environment and Rural Communities Act (NERC) Act (2006). The presence of these can be checked using data provided by Natural England or equivalent body on MAGIC or data from the relevant local environmental record centre.

If the data gained from any site walk-over or survey differs from that used to select the route (e.g. using only aerial photography and data from MAGIC) so that a different methodology would have been appropriate, the SQE should re-assess the required approach selection accordingly.

5. Change in Ecological Value Calculation Methodology

5.1. The Defra Metric and its Link to this Methodology

This methodology follows the biodiversity metric approach as set out by Defra (2012 a, b and c). It enhances and evolves this version of the Defra metric in the following ways:

- It uses Phase 1 habitat classification,
- It includes a number of additional urban habitats in addition to the list of Phase 1 habitat types,
- Individual trees and lines of trees are treated in the same way as Area Based Habitats,
- Linear features are included through the multiplication of their length and condition to determine Linear Biodiversity Units,
- The spatial risk factor has been predefined rather than leaving this to be set at the project level,
- The scoring within the spatial risk factor has been altered to better reflect the relative importance of the proximity of the habitat creation to the area of impact within the methodology. This decreases the impact that the spatial multiplier has, and
- The difference between enhancement and creation of habitats has been set out.

5.2. DEFRA Steps for Determining Pre Development Biodiversity Units

In line with Defra's guidance, the following steps are required to calculate Pre Development Biodiversity Units:

- Score each habitat for distinctiveness as high (6), medium (4) or low (2). For hedgerows and watercourses assume distinctiveness is high,
- Assess the condition of the habitat using the methodology described in Natural England's Farm Environment Plan (FEP) Manual (Natural England 2010). Score each habitat for condition as good (3), moderate (2) or poor (1). Please note that if a different methodology is used its use needs to be justified within the report,
- Measure the area (in hectares or square metres) or length (in metres) of the habitat (ensuring the same unit is used throughout the assessment).

Linear Biodiversity Units and the Defra Metric

Linear Biodiversity Units are not described within the Defra metric but used in this methodology to provide clarity on habitat types and to keep these separate in calculation approaches.

5.3. Habitat Distinctiveness, Condition and Risk Factors

Habitat Distinctiveness

Habitat distinctiveness is a measure of biodiversity that has regard for the number and variety of species found there (richness and diversity), how rare the species are, and how many species the habitat supports that are not common elsewhere.

For the purpose of the BREEAM family assessments habitat distinctiveness is scored against a three category scale (high, medium and low) as detailed in Table 1. Broadly, all Habitats of Principal Importance will be assigned high distinctiveness, other habitats which are not Habitats of Principal Importance will be assigned medium distinctiveness and any habitats which have been intensively managed such as improved grassland or arable pasture will be assigned low distinctiveness.

Table 1 – Habitat Distinctiveness Bands and Scores

Distinctiveness Band	Distinctiveness Score	Habitats Types Included
High	6	Habitats of Principal Importance i.e. those which meet the criteria to qualify as Habitats of Principal Importance (JNCC 2011) as they are not included in the assessment. This excludes ancient woodland and other habitats which are irreplaceable.
Medium	4	Other semi-natural habitats that do not fall within the scope of Habitats of Principal Importance definitions, i.e. all other areas of woodland (e.g. mixed woodland), other grassland (e.g. semi-improved grasslands), uncultivated field margins, road verge and railway embankments (excluding those that are intensively managed).
Low	2	Improved grassland, arable fields (excluding any uncultivated margins), built up areas, domestic gardens, regularly disturbed bare ground (e.g. quarry floor, landfill sites etc.), verges associated with transport corridors.

For some habitat types within the Phase 1 classification, multiple distinctiveness bands can apply, depending on the quality of the habitat. For example, it is important any Habitats of Principal Importance can be identified alongside the Phase 1 classification. Appendix C details these habitat types and provides information to help to assign the appropriate distinctiveness band.

Habitat Condition

Condition is defined as the quality of a particular habitat. For example, a habitat is in poor condition if it fails to support the rare or notable species for which it is valued, or if it is degraded as a result of pollution, erosion, invasive species or other factors.

The Defra metric requires habitat condition to be assessed. The approach suggested by Defra is presented in Natural England's FEP manual (Natural England 2010). The simplified method does not require a condition assessment as the condition is assumed for the habitats present.

For the full method whilst completing the Phase 1 habitat survey, once the habitat has been identified, the SQE should look up the habitat in the FEP Manual. If the type of habitat differs from the types in the FEP Manual, match the habitat to its best equivalent habitat, recording the reasons. If the habitat or an equivalent is not present within the FEP, Table 3 – Default Condition Assessment should be used to assign a condition score. Gather information to assess the criteria as to whether the habitat passes or fails each one. For the purpose of a BREEAM family assessment count the total number of passes and fails and score the condition as detailed in Table 2.

Table 2 - Habitat Condition Bands and Scores

Condition Band	Condition Score	Criteria for Assigning Condition
Good	3	Any habitat which passes all the FEP criteria.
Moderate	2	Any habitat which fails one FEP criterion.
Poor	1	Any habitat which fails two or more FEP criteria.

In addition to the information set out in this guidance document, a methodology for condition assessment of the habitats is needed. This guidance recommends using the Farm Environment Plan (FEP) Manual (Natural England 2010) or, if the habitat or an equivalent is not present within the FEP, in Table 3 – Default Condition Assessment should be used to assign a condition score.

Table 3 – Default Condition Assessment

For use when the habitat present is not covered by the Farm Environment Plan (FEP) condition assessment methodology (Natural England 2010). If some of the criteria are not relevant for the habitat being assessed the SQE should use their expert judgement to select the appropriate criteria.

Criterion	Commonly Used Habitat Condition Assessment Criteria in the FEP
1	A diverse age range
2	A diverse species mix
3	Diverse structure variety/diverse form
4	Presence of protected species
5	None or a limited presence of invasive species
6	No or limited damage for example by machinery

Where an FEP condition assessment is not possible and the condition cannot be based on local relevant data (such as surveys on other similar habitats within the Development Footprint) the condition of the habitats should be assumed to be moderate, giving a condition score of 2, unless there is other evidence that the habitat is of good condition, such as the presence of species of principal importance. If a different methodology is used the SQE should set out why it has been used and provide evidence to demonstrate why that methodology is more appropriate.

Risk Factors Application to the Post Development Calculation

Risk factors take account of the likely scale of impact and the potential for success or failure of a habitat to be established over time. They are currently only applicable to area based habitat calculations. The Post Development Biodiversity Unit calculation should consider the risks and account for them, as they can influence the overall outcome. The risk factors do not cover all eventualities, but provide a numerical value for the main risks to delivering biodiversity gains.

The Defra metric sets out three risk factors:

1. distance from scheme (spatial risk);
2. time taken for created or enhanced habitats to reach target condition (temporal risk); and
3. how difficult it is to create or enhance any given habitat (delivery risk).

1. Spatial risk

Spatial risk is the risk associated with delivering compensation for the loss of a habitat at a distance from that loss (i.e. generally a greater distance can mean a greater risk) and in relation to areas of strategic priority for biodiversity. Therefore, the spatial risk factor is applied to the Post Development Biodiversity Unit calculation when the compensation for habitat loss is being delivered at distances prescribed in Table 4.

Numerical Spatial Risk Factors
The numerical risk factors for the spatial risk have been altered from the Defra metric. This is to better weight the impact of the spatial factor within the methodology so that it reflects the relative importance of proximity to the impact when creating a new area of habitat. The delivery risk and the time taken to create a habitat have a large impact on the success of the habitat creation than the proximity to the area of impact.

Table 4 – Spatial Risk Factors

Location of Habitat Creation or Enhancement	Risk Factor
Habitat being created or enhanced is within 500m of the area of loss or in the same ecological network identified in a local (county or equivalent) biodiversity, green infrastructure or offsetting strategy	1
Habitat type being created or enhanced contributes to and is in a location identified within a local (county or equivalent) biodiversity, green infrastructure or offsetting strategy	0.67
Habitat being created or enhanced is not making a contribution to local (county or equivalent) biodiversity, green infrastructure or offsetting strategy.	0.50

Adapted from the Defra metric, 2012

Spatial Factors - Calculation Considerations

1. Where the SQE is able to demonstrate that the habitats created or enhanced are outside of an area identified within a local (county or equivalent) biodiversity, green infrastructure or offsetting strategy but provide a meaningful contribution to achieving the objectives of the strategy (e.g. buffering the site) then the SQE can apply the 0.67 spatial risk factor and set out justification for doing so in the final report.

2. Spatial risk factors can be excluded if the loss of the Pre Development habitat has a low distinctiveness and is compensated for within 1km of the area lost, unless the SQE determines the Pre Development habitat was providing vital habitat for a species with a shorter homing range. In these instances the relevant spatial risk factor should apply. In this instance, a risk factor of 1 should be applied.

2. Delivery risk

Delivery Risk is the risk associated with the difficulties linked to the creation or enhancement of any specific habitat. Appendix 1 of Defra's Technical Paper (2012 a) provides an indicative guide to broad categories of risk for different habitats. The information in Appendix C and Table 5 below provides risk factors that should be used for this methodology. For habitat types not listed in Appendix C or Defra's guidance, SQE opinion based on evidence relevant to the habitat type should be used to determine the appropriate level of delivery risk (and this should be fully described and justified in the report). This should be informed by delivery risk levels assigned to similar habitat types by Defra. Table 6 shows factors assigned to each level of delivery risk.

Table 5 – Defra's Delivery Risk Factors

Difficulty of Recreation / Enhancement	Risk Factor
Very High	0.10
High	0.33
Medium	0.66
Low	1

Adapted from the Defra metric, 2012

3. Temporal risk

In delivering compensation for habitat loss, the timing of the impact may not coincide with the new habitat reaching the required quality or level of maturity, which could result in loss of biodiversity for a period of time. Additionally there may be a time gap between the habitat loss and the start of the creation or enhancement of a new habitat. Where possible, the development should decrease or prevent this additional time gap. Where this is not possible and is justified, this additional time gap needs to be accounted for. These two time lags together are called the temporal risk. For example, a development clears an area of woodland. Five years later it implements its offset, which will take 25 years to reach target condition. So the time to target condition is 30 years (i.e. from the time of habitat clearance) and the associated risk factor is 0.36.

The risk factors are defined by Defra as outlined in Table 6.

Table 6 – Defra's Temporal Risk Factors

Years to Target Condition	Risk Factor
5	0.84
10	0.71
15	0.59
20	0.50
25	0.42
30	0.36
>30	0.33

Adapted from the Defra metric, 2012

There is no set guidance for each habitat type on the time it takes to reach a specific condition. However, the information in Appendix C should be used along with evidence, where this exists, and expert opinion relevant to the habitat type to estimate number of years to target condition and be fully justified within the final report.

5.4. Key Aspects of the Methodology

The same change in ecological value calculation methodology is applicable for the full and simplified approach. This involves the following:

1. Calculation of Linear and Area Biodiversity Units for the habitats pre and post development. The following factors facilitate this:

a. Linear Habitats

i. The length of the habitat

ii. The condition of the habitat

iii. Whether habitat is lost, created and/or enhanced

Output = Linear Biodiversity Units (separate outputs for watercourse and foliage based habitats)

Two Types of Linear Biodiversity Unit Output

Due to differing methodology needed for Linear Habitats and the variation in the ecology benefits they can bring, there are two types of Biodiversity Unit outputs which are kept separate within the calculation of value Pre and Post Development. These cover:

- **Watercourse based habitats and,**
- **foliage related habitats (i.e. everything other than watercourses covered by the linear habitat definition – see Appendix A)**

b. Area Based Habitats

i. The area of the habitat

ii. Habitat distinctiveness

iii. The condition of the habitat

iv. Whether habitat is lost, created and/or enhanced

v. For the Post-Development calculations the following risks should also be taken into consideration

a. Spatial

b. Temporal

c. Delivery

Output = Area Biodiversity Units

2. For the above habitat types compare the pre and post development Biodiversity Units in order to calculate change and therefore the change in ecological value.

3. Calculate the overall change in Biodiversity Units as a percentage for each of the following:

a. watercourse based linear habitat types

b. foliage based linear habitat types

c. area based habitat types

4. Determine the reward (credit/points) applicable for the development

This is undertaken by the Assessor.

The lowest percentage score should be used to identify the number of credits available. In addition, requirements relating to designated sites and/or irreplaceable habitats and the Mitigation Hierarchy must also be taken into consideration before confirmation can be given that reward is available. See Section 6. Determining the Change in Ecological Value and Assigning Reward (credits/points) for more information.

1 Defra guidance states time to target condition by single years (e.g. 5 years, 10 years, 15 years etc.). For clarification, this has been adapted in the table to show the range of years to which each multiplier should be assigned.

Keeping Linear Habitats and Area Habitats and Associated Biodiversity Units Separate

Linear Habitats and Area Habitats are treated separately for the purposes of Biodiversity Unit calculations as above The contribution Linear Habitats make to the biodiversity in the landscape is far greater per unit of area than even the most biodiversity rich localised habitats because of their multiple role in the provision of nest sites, corridors, feeding sites, shelter belts etc. (Defra 2012 a). As a result these habitats are treated separately from Area Based Habitats that are accounted for on a hectare basis.

Linear Habitats - Keeping Foliage Habitats and Watercourse Calculations Separate

When calculating Linear Biodiversity Units, the foliage based habitats (i.e. everything other than watercourses covered by the linear habitat definition – see Appendix A.) and watercourses calculations should be completed independently. This is partly because they provide habitat spaces which are not comparable with each other e.g. a hedge does not provide the same habitat benefits as a brook. Another reason for keeping these outputs separate is because there is no set method for assessing the condition of watercourses.

Creation and Enhancement

Habitat creation consists of the removal or the loss of any present habitat(s) in the action of creating the new one or creating habitat where none was previously present. For example, removing scrub habitats in order to create a wetland habitat or removing hardstanding to create grassland.

Habitat enhancement consists of improving the condition of an existing habitat and thereby increasing the ecological value of a habitat type through measures that improve its biodiversity capacity and/or by removing factors that detract from its value, such as by increasing the diversity of species that can be supported by a habitat. For example, managing improved grassland so that it becomes semi-improved grassland.

Post Development Biodiversity Units are calculated to reflect whether the change is as a result of the habitat being enhanced or the existing habitat is being lost and a new one created.

It is important to clearly identify which areas of habitat are being created and which are enhanced.

Decisions on which habitats are created or enhanced should be based on Area and Linear Biodiversity Units of individual habitats in combination with qualitative ecological information, and not simply the total number of Units.

For compensation to be taken into consideration in the assessment calculations, it should be the same habitat type as that which has been or will be lost and of the same or higher ecological value. If a habitat of higher ecological value is created or enhanced, it should be an appropriate habitat type that is still capable of supporting the species affected by the habitat loss resulting from the development. For example it is appropriate to replace semi-improved grassland with unimproved grassland.

If the development has no negative impact on biodiversity, the area of habitat created should be compared to the area of the Development Footprint to calculate the percentage of the Development Footprint that is covered by habitats. A length of linear habitat should also be provided, as appropriate to the site and of an appropriate length justified by the SQE.

Good Practice Principles Applied to BREEAM Ecological Assessments

CIEEM, CIRIA and IEMA (2016) have produced good practice principles and guidance for delivering biodiversity net gain in developments. These principles provide a framework that helps improve the UK's biodiversity by contributing towards strategic priorities to conserve and enhance nature while progressing with sustainable development. They also provide a way for industry to show that projects followed good practice.

https://www.cieem.net/data/files/Publications/Biodiversity_Net_Gain_Principles.pdf

Linear and Area Based Biodiversity Units and their Calculation

Linear and Area Biodiversity Units must be calculated for the habitats both Pre Development and Post Development and these compared in order to calculate a change in ecological value for each habitat present within the Development Footprint/Zone of Influence as follows:

1. The Pre Development units are calculated based on the habitats present on the site prior to development including any site clearance, temporary use of land and preparatory works. These are calculated to provide a baseline of the ecological value of the site.
2. The Post Development units are calculated based on the temporary use of land during the development and the post development landscape plans or equivalent.
3. The Pre and Post Development units are then compared with one another to reflect whether any change is likely to occur as a result of the habitat being enhanced, the existing habitat being lost or a new one created.

Area Based Biodiversity Units and Linear Biodiversity Units are both arbitrary units which are not comparable with each other.

Linear Habitat Calculations and Outputs

Where both are present there are two separate calculations and outputs for Linear Biodiversity Unit:

- **Watercourse based habitats**
- **Foliage related habitats (i.e. everything other than watercourses covered by the linear habitat definition – see Appendix A)**

5.5. Linear Habitats – Calculation Formulae and Associated Notes

Linear Habitats are habitats that form linear ecological features such as lines of trees, hedgerows, ditches and water courses and in some cases, green walls (climbers). To account for the value of the Linear Habitats, Linear Biodiversity Units are calculated. These units are a measure of ecological value of the Linear Habitats in the Development Footprint. Linear Biodiversity Units are derived from a calculation using numerical values assigned for only the condition and length of a habitat. When calculating these units watercourses are kept separate from other types of linear habitat. See Section 5.4: Key Aspects of the Methodology for more information.

The calculation methodology below is broadly the same for both the full and simplified approaches. The key difference is that a condition assessment is not required for the simplified approach where the condition level is assumed. See general calculation notes.

Calculation Formulae and Associated Notes

Pre Development (Pre-D)

Calculating the Pre Development Linear Biodiversity Units involves:

a) Determining the Linear Biodiversity Unit(s)

i) Length of Linear Habitat type (m) x Condition =	Pre-D Linear Biodiversity Units (per habitat type) A

Note: the above must be completed for each linear habitat in the Development Footprint.

b) Determining the total sum of Linear Biodiversity Units

i) Sum all Pre-D Linear Biodiversity Units =	Total Pre-D Linear Biodiversity Units B

Linear Habitats – Distinctiveness

'The contribution of hedgerows, water courses and other Linear Habitats to biodiversity in the landscape is far greater per unit of area than many of the most biodiversity rich habitats because of their multiple roles in the provision of nest sites, corridors, feeding sites, shelter belts etc.

For this reason, BREEAM assumes that all Linear Habitats will be of high distinctiveness both Pre and Post Development. To simplify the calculation distinctiveness is, therefore, not included as part of the Linear Biodiversity Unit calculation. This follows the approach set out by Defra. In situations where an ecologist takes the view that a linear feature is of significantly lower biodiversity value than this suggests, the Condition Factor can be used to make allowance for this in the calculation.

Natural England are currently reviewing their approach to linear features. It is BRE's intention to take the outcomes of this into account in future revisions of this calculation once a new approach has been agreed.'

Post Development (Post-D)

Post Development Linear Biodiversity Units are calculated as follows:

a) Identify Linear Habitat Lost

i) Length of each Linear Habitat Type LOST (m) x Condition =	Post-D Linear Biodiversity Units Lost Due To Development (per habitat type) C

Note: the above must be completed for each linear habitat in the Development Footprint.

ii) Sum all Post-D Linear Biodiversity Units LOST (m) of previous calculated per habitat type =	Total Post-D Linear Biodiversity Units Lost Due To Development D

b) Identify Linear Habitat Created and/or Enhanced

i) Length of Linear Habitat Type Created and or Enhanced (m) =	Post-D Linear Biodiversity Units Created and/or Enhanced Due To Development (per habitat type) E

Note: the above must be completed for each linear habitat in the Development Footprint.

ii) Sum all Post-D Linear Biodiversity Units Created and/or Enhanced =	Total Post-D Linear Biodiversity Units Created and/or Enhanced Due to Development F

c) Total Post -D Linear Biodiversity Unit(s)

i) (Total Pre-D Linear Biodiversity Units – Total Linear Biodiversity Units LOST Due to the Development) + Total Length of Linear Habitat to be Created and/or Enhanced (m) =	Total Post-D Linear Biodiversity Units for the development (B - D) + F = G

d) Percentage Change in Linear Biodiversity Units

i) (Total Post-D Linear Biodiversity Units ÷ Total Pre-D Linear Biodiversity Units) x 100 =	Percentage change in Linear Biodiversity Units rounded to the nearest whole percentage point (G ÷ B) x 100

Table 7 – Linear Habitats: Calculation Notes

General	Pre Development (Pre-D)	Post Development (Post-D)
Linear Biodiversity Units gained Length of linear habitat created is equal to linear units gained. **Identifying the length of habitat** The habitat length and habitat type should be identified from existing data (e.g. aerial photography) or a site walk-over. **Hedgerows and watercourses: distinctiveness level** All hedgerows and watercourses are assumed to be of high distinctiveness because most hedgerows and rivers will meet the Habitat of Principal Importance (HPI) criteria. For this reason, distinctiveness is not included as part of the Linear Unit calculation. This follows the approach set out by Defra. **Simplified Approach** **Applicability of the condition assessment** In order to decrease the time taken to run the simplified assessment, a condition assessment is not required. Instead a condition score will be assumed for all habitats. To provide an average condition score it is assumed that the condition of all habitats is moderate unless there is evidence that habitats are in good condition, then good condition will be assigned. Also see Table 2 for Habitat Condition Bands and Scores	**Watercourses** There is no set method for assessing the condition of water courses. If a suitable method is not available it should be assumed that all water courses on the site are in moderate condition unless it is canalised in which case assume it is of poor condition **Simplified Approach** **Applicability of the Pre-D calculation - no impact on biodiversity** If the development has no impact on biodiversity at all, calculation of Pre Development units can be skipped and the Post Development units calculated as set out.	**Watercourses** It is often not possible to create watercourses but it is possible to improve their condition. In this case the length of water course that undergoes meaningful improvement, such as reinstating meanders or marginal vegetation. **Risk factor applicability** The risk factors (delivery, special, temporal) are not included in the calculation for Linear Habitats. This is because the risks associated with creating the linear features are considered to be taken into account within the condition multiplier used to calculate the Pre Development Linear Units.

5.6. Area Based Habitats – Calculation Formulae and Associated Notes

An area based habitat is any habitat that is assessed using an area based measure. This effectively means that it covers all habitats other than features assessed as Linear Habitats (see Appendix A: Definitions).

The calculation methodology below is the same for both the full and simplified approach. The key difference is that a condition assessment is not required for the simplified approach. The condition level is assumed.

Calculation Formulae and Associated Notes

A) Pre development (Pre-D)

Calculating the Pre Development Area Based Biodiversity Units involves:

a) Determining the area based biodiversity unit(s)

i) Distinctiveness x Condition x Area (ha or m^2) =	Pre-D Area Biodiversity Units (per habitat type) A

Note: the above must be completed for each area based habitat in the Development Footprint.

b) Determining the total sum of linear Biodiversity Units

i) Sum all Pre-D Area Biodiversity Units previous calculated per habitat type =	Total Pre-D Area Biodiversity Units B

B) Post development (Post-D)

Post development Area Biodiversity Units are calculated as follows:

a) Identify Area Based Habitat Lost

i) Distinctiveness x Condition x Area LOST (ha or m^2) =	Post-D Area Biodiversity Units Lost Due To Development (per habitat type) C

Note: the above must be completed for each linear habitat in the Development Footprint.

ii) Sum all Post-D Area Biodiversity Units LOST (ha or m^2) =	Total Post-D Area Biodiversity Units Lost Due To Development D

b) Identify Area Based Habitat Gained (Created And/Or Enhanced)

i) Creation

Post-D Distinctiveness x Post-D Target Condition x Post-D Area (ha) x Delivery Risk x Temporal Risk x Spatial Risk =	Post-D Area Biodiversity Units Created Due To Development (per habitat type) E

ii) Enhancement

(Post-D Distinctiveness x Post-D Target Condition x Post-D Area (ha) - Pre-D Biodiversity Units for the area of the habitat that is enhanced) x Delivery Risk x Temporal Risk x Spatial Risk =	Post-D Area Biodiversity Units Enhanced Due To Development (per habitat type) F

Pre-D Biodiversity Units are determined from calculating distinctiveness, condition and area for the habitat.

Note: the above must be completed for each area based habitat in the Development Footprint.

c) Total Post Development Area Biodiversity Units

i) Pre-D Area Biodiversity Units – Area Biodiversity Units LOST Due to Development + Post-D Area Biodiversity Units (Creation) + Post-D Biodiversity Units (Enhancement) =	Total Post-D Area Biodiversity Units G = (B - D) + (E + F)

d) Percentage Change Area Biodiversity Units

(Total Post-D Area Based Biodiversity Units ÷ Total Pre-D Area Based Biodiversity Units) x 100 =	Percentage change in Area Based Biodiversity Units rounded to the nearest whole percentage (G ÷ B) x 100

Table 8 – Area Based Habitats Calculation Notes

General	Pre Development (Pre-D)	Post Development (Post-D)
Hard standing and buildings Hard standing and buildings should be included in this calculation although the condition and distinctiveness of the habitats will be given a zero score. **Simplified Approach** **Applicability of the condition assessment** In order to decrease the time taken to run the simplified assessment, a condition assessment is not required. Instead a condition score will be assumed for all habitats. To provide an average condition score it is assumed that the condition of all habitats is moderate unless there is evidence that habitats are in good condition, then good condition will be assigned. Also see Table 2 for Habitat Condition Bands and Scores	**Simplified approach** **Applicability of the Pre-D calculation** If the development has no impact on biodiversity at all, calculation of Pre Development Area Biodiversity Units can be skipped and the Post Development units calculated	**Risk factor applicability** Risk factors covering the spatial, temporal and delivery risk associated with creating or enhancing a habitat are included in the calculation. **Enhanced Habitat versus Lost Habitat** Areas of enhanced habitat are not considered lost and should not be included in the Area Biodiversity Units Lost.

6. Determining the Change in Ecological Value and Assigning Reward (Credits/Points)

Applying the calculation methodology enables a project to determine the level of reward of BREEAM, CEEQUAL and HQM credits or points which the Assessor can award.

All three outputs of the calculation must be considered:

- Linear Biodiversity Units: Foliage related habitats,
- Linear Biodiversity Units: Watercourses habitats,
- Area Based Biodiversity Units: Area based habitat.

The output with the lowest percentage score (rounded to the nearest whole percentage point) should be used to identify the reward level available for the development as follows:

- 75% and 94% - Minimising loss,
- 95% and 104% - No net loss for the habitats assessed,
- 105% and 109% - Net gain for the habitats assessed,
- 110% or above - Significant net gain.

There are also additional requirements associated with each level of the reward levels which are detailed in Table 9:

The number of credits or points assigned to each reward level will vary depending on the BREEAM family scheme under which the project is being assessed. For this reason the number of credits or points associated with each reward level have not been listed in this document. See the relevant scheme technical manual for the number of credits available for each level of this scale.

Table 9: Reward Scale

Reward Scale*	Additional Requirements
Minimising Loss	A suitably qualified ecologist must confirm that it is not practically feasible to achieve the No Net Loss requirements AND There are no residual impacts on protected sites or irreplaceable habitats.
No Net Loss	If there is no impact on area or linear habitats at all, then the total area of habitat created should cover at least 2.5% of the Development Footprint and a length of linear habitat should be created. AND There are no residual impacts on protected sites or irreplaceable habitats.
Net Gain	If there is no impact on area or linear habitats at all, then the total area of habitat created should cover at least 5% of the Development Footprint and a length of linear habitat should be created. AND There are no residual impacts on protected sites or irreplaceable habitats.
Significant Net Gain	There are no residual impacts on protected sites or irreplaceable habitats

*** The number of credits/points assigned to each reward level may vary depending on the scheme. See the relevant scheme technical manual for the number of credits available.**

Designated sites, and/or irreplaceable habitats and the Mitigation Hierarchy

Biodiversity in designated sites and irreplaceable habitats is legally protected and its protection is covered by statutory requirements and procedures. The BREEAM family of certification schemes recognise steps taken that go beyond these regulatory requirements and as such BREEAM, CEEQUAL and HQM credits/points for this methodology can only be gained in relation to biodiversity that does not form part of a designated site or irreplaceable habitat or form part of the mitigation or compensation identified for these sites.

Whilst impacts on designated sites and irreplaceable habitats must be dealt with separately, credits/points cannot be gained unless it is demonstrated that all requirements of the environmental legislation and national policy are met by the project. The Assessor will need to seek confirmation that the mitigation hierarchy has been followed and that the appropriate avoidance, mitigation and/or compensation measures have been agreed with the relevant statutory bodies. Whilst habitat losses and gains relating to legally protected species should be included in the BREEAM assessment of change in ecological value, evidence that the appropriate avoidance, mitigation and/or compensation measures have been agreed with the relevant statutory bodies will also need to be provided.

The Mitigation Hierarchy

1. **Avoidance - Measures taken to avoid creating impacts from the start. For example, changing the location of the development or development activities within the site to avoid habitats present on site.**
2. **Minimisation - Measures taken to reduce the duration, intensity, extent and/or likelihood of impacts that cannot be avoided, to a level that is no longer considered significant for the species or habitat feature.**
3. **Onsite compensation - Measures taken onsite, to provide a biodiversity contribution that is proportionate to the long term loss for residual impacts that cannot be completely avoided or minimised.**
4. **Offsite compensation / offset - Measures taken offsite to provide a biodiversity contribution that is proportionate to the long term loss for any residual, adverse impacts onsite after full implementation of the previous three measures.**

For further information please see the Business and Biodiversity Offsetting Programme at http://bbop.forest-trends.org/pages/mitigation_hierarchy

Appendix A: Definitions

Term	Definition
Area based habitat	Any habitat that is assessed based on its area rather than its length. All habitats other than those listed in the Linear habitat definition fall into this category.
Area based biodiversity unit	A nominal figure that is derived from a calculation using numerical values assigned for the distinctiveness, condition and area of a habitat and associated risk factors. Biodiversity Units are not a full representation of ecological value, but are used to provide a quantification of a loss of biodiversity, no net loss or a net gain in biodiversity as a result of development.
Delivery risk	Delivery risk is the risk associated with the difficulty to create or enhance any specific habitat. Appendix 1 of Defra's Technical Paper (2012 a) provides an indicative guide to broad categories of risk for different habitats. For habitat types not listed in Defra's guidance or Appendix C - Habitat Classification and Reference Index, the applied delivery risk factor should be one for similar habitat types defined by Defra and be fully justified by the SQE.
Development footprint	The development footprint consists of the site, considered to be the land enclosed by the boundary of the BREEAM assessment, and includes any land used for buildings, hardstanding, landscaping, site access or where construction work is carried out (or land being disturbed in any other way). It also includes any areas used for temporary site storage and buildings. If it is not known exactly where buildings, hardstanding, site access, temporary storage and buildings will be located, it must be assumed that the development footprint is the entire development site. For the purpose of the Change in Ecological Value calculation this area will also include any land outside the development boundary where: - there is an indirect impact on biodiversity, including but not limited to the zone of Influence, and - land being used to compensate for impacts, either on the site or outside it as a biodiversity offset.
Green roof - Extensive green roofs	Extensive green roofs generally provide greater biodiversity interest than intensive roofs, but are considered to be less appropriate in providing amenity and recreation benefits. In most cases they are planted with, or colonised by, mosses, succulents, wild flowers and grasses that are able to survive on the shallow low-nutrient substrates that form their growing medium. (Greater London Authority, 2008)
Green roof - Intensive green roofs	Intensive green roofs are principally designed to provide amenity and are normally accessible for recreational use. They may be referred to as roof gardens or terraces. Generally intensive green roofs comprise a lush growth of vegetation and are based on a relatively nutrient rich and deep substrate. They allow for the establishment of large plants and conventional lawns. (Greater London Authority, 2008).
Habitat condition	Condition is defined as the quality of a particular habitat. For example, a habitat is in poor condition if it fails to support the rare or notable species for which it is valued, or if it is degraded as a result of pollution, erosion, invasive species or other factors. The methodology (mirroring Defra's metric) requires habitat condition to be assessed using the system presented in Natural England's Farm Environment Plan (FEP) manual.
Habitat creation	The removal or the loss of the present habitat in the action of creating the new one or creating habitat where none was previously present (including bare earth). This includes, for example, removing scrub in order to create a wetland habitat or removing hardstanding to create new grassland habitat.
Habitat distinctiveness	Habitat distinctiveness is a measure of biodiversity that has regard for the number and variety of species found there (richness and diversity), how rare the species are, and how many species the habitat supports that are not common elsewhere. Habitat distinctiveness is scored against a three category scale (high, medium and low). Broadly, all Habitats of Principal Importance (HPI) will be assigned high distinctiveness, other habitats which are not HPI quality will be assigned medium distinctiveness and any habitats which have been intensively managed such as improved grassland or arable pasture will be assigned low distinctiveness.
Habitat enhancement	The improvement of the condition of an existing habitat, thereby increasing the biodiversity value of a habitat type. Enhancement is achieved through measures that improve habitat biodiversity capacity and/or remove factors that detract from its value. This includes increasing the diversity of species that can be supported by a habitat, for example by managing improved grassland so that it becomes semi improved grassland, which would seek to increase species diversity.

Habitats and species of principal importance (HPIs)	Habitats of Principal Importance (or priority habitats) and species of principal importance (or priority species) are those identified as being of principal importance for biodiversity in accordance with the Natural Environment and Rural Communities Act (2006). These habitat types are also often referred to as 'priority habitats' and for the purposes of this methodology, will always be habitats with a 'high distinctiveness' attribute. Arable field margins specifically managed for wildlife also qualify as a Habitat of Principal Importance.
Legally protected species, designated sites and irreplaceable habitats	Legally protected species are the European Protected Species listed in Annex IV of the European Habitats Directive and those protected under The Wildlife & Countryside Act (1981). Designated sites are SSSIs (Sites of Special Scientific Interest), ASSIs (Areas of Special Scientific Interest (Northern Ireland), SACs (Special Areas of Conservation), SPAs (Special Protection Areas) and Ramsar Sites. Irreplaceable habitats includes ancient woodland defined in DCLG 2012 and Forestry Commission and Natural England, 2018. The draft NPPF (2018) provides the following definition: those which could be described as irreplaceable due to the technical difficulty or significant timescale required for replacement. It includes ancient woodland, blanket bog, limestone pavement and some types of sand dune, saltmarsh, reedbed and heathland.
Linear habitat	Hedgerows, lines of trees (where not part of a continuous hedge), watercourses, ecologically important ditches. Green walls consisting of climbing plants where the wall is simply acting as a support for the plants should be treated as Linear Habitats.
Linear biodiversity unit	A nominal figure that is derived from a calculation using numerical values assigned for condition and length of a linear habitat. Distinctiveness of Linear Habitats is not calculated as most linear features will be Habitats of Principal Importance (HPI).
Local biodiversity priorities	Local (county or equivalent) biodiversity, green infrastructure or offsetting strategies. For example, local Biodiversity Action Plans (BAPs) or Biodiversity Opportunity Areas (BOAs).
Low impact developments	For the purposes of BREEAM these are defined as those that meet both of the two following criteria: - Area: the total area of all habitats (excluding Linear Habitats) within the Development Footprint is less than 0.05 ha (500m^2). - Distinctiveness: the Area Based Habitats (i.e. those habitats that are not always linear in nature such as hedgerows) are medium or low categories of distinctiveness. Note: The simplified approach can be used when Linear Habitats are present, regardless of their distinctiveness. The full calculation approach must be used for all other projects.
Risk factors	Risk factors are used in the Post Development Biodiversity Unit calculation to account for main risks in delivering biodiversity gains. These do not cover all eventualities but provide a numerical value for the most likely risks. These are spatial risk, temporal risk and delivery risk. Risk factors are assigned to each risk in the BREEAM Ecological Metric to be applied to the Post Development Biodiversity Unit calculation. It should be noted risk factors only apply to Area Based Habitats as risks associated with creating linear features are taken into account within the condition multiplier.
Spatial risk	Spatial risk is the risk associated with delivering compensation for the loss of a habitat at a distance from that loss. In general the greater distance from the original habitat can mean a greater risk, especially in relation to areas of strategic priority for biodiversity.
Temporal risk	Temporal risk is the time required for the new habitat to reach the required quality or level of maturity. This is a combination of: 1. The time the habitat takes to enhance or create; and 2. The time gap between the habitat loss and the start of the creation or enhancement of a new habitat.
Web based maps	Web based maps should be from a robust source (government, NGO, etc.) and be up-to-date. For example MAGIC (http://magic.defra.gov.uk/)
Zone of influence	Areas of land or water bodies impacted by the site undergoing assessment. These areas can be adjacent to the site or can be areas that are dependent on the site but not physically linked including areas downstream from a site. Areas within the zone of influence can be negatively affected by changes on an assessment site but they also provide further opportunity to maximise enhancement activities.

Appendix B: Habitat Classification and Survey Methodology

Habitats should be classified into Phase 1 habitat categories following the methodology set out by JNCC (2010) in the Handbook for Phase 1 habitat survey - a technique for environmental audit.

Phase 1 habitat types do not always identify all Habitats of Principal Importance. Additional field notes should be taken to identify these habitats, using the JNCC (2011) definitions if needed. Please see the section below on Habitats of Principal Importance for further information.

The condition of the habitats should be assessed using the methodology set out in the Farm Environment Plan (FEP) Manual (Natural England 2010). If the habitat is not covered within the FEP Manual, the table in section 5.3 should be used to assign habitat condition.

If another methodology is used to assess the condition of the habitats the use of the chosen methodology should be justified within the ecological assessment report.

Urban Habitats

To supplement the Phase 1 habitats, additional habitats have been defined within this technical note to better address urban areas. These are listed in Appendix C and further information on the typologies of green roofs and walls can be found in Living Roofs and Walls (Greater London Authority 2008).

It is acknowledged that Phase 1 surveys will not always be possible, for example, due to lack of access to parcels of land. Where this is the case, and other means of classifying habitats are used, the inability to access the land should be justified and the alternative means of identification of habitats, such as the use of existing data from Local Record Centres or aerial photography, should be stated and justified.

Phase 1 surveys may not be required where all the habitats present within the development parcel are of low distinctiveness (irrespective of the area). In this case a site walk over should be undertaken following the guidelines set out by CIEEM for Preliminary Ecological Appraisal (CIEEM, 2018).

Where a Phase 1 survey or walk over are not possible the habitats should be identified based on the best available information (e.g. aerial photography).

Where a FEP condition assessment is not possible and the condition cannot be based on local relevant data (such as surveys on other areas within the Development Footprint) the condition of the habitats should be assumed to be of moderate condition unless there is other evidence that the habitat is likely to be of high condition, such as recent records of the presence of species of principal importance.

All habitats within the Development Footprint should be recorded including the areas not affected or those that are temporarily affected, indirectly affected and any existing habitats present at offsite compensation sites. This includes areas of hard standing and buildings that will be assigned zero values for their distinctiveness and condition – remembering that Biodiversity Unit scores are reported for each feature. Where indirect effects are identified, these should be included in the calculation, with justifications provided for the Pre and Post Development Biodiversity Unit and Linear Unit scores assigned.

Habitats of Principal Importance (or Priority Habitats)

Certain habitat types have been identified as being of principal importance for biodiversity in accordance with the Natural Environment and Rural Communities Act 2006. These habitat types are also often referred to as ‘priority habitats’ and for the purposes of this metric, will always be assumed to be habitats with a ‘high distinctiveness’ attribute.

Additional survey information will be needed alongside the Phase 1 habitat classification for some habitat types, to clearly demonstrate that the appropriate distinctiveness score has been applied. Details of which habitats this applies to are provided in Appendix C.

For example, A1.1.2 Woodland: Broadleaved - plantation could be a native species plantation or a traditional orchard. The native species plantation is assigned a medium distinctiveness score while the traditional orchard is a Habitat of Principal Importance and so is assigned a high distinctiveness score.

Habitats of Principal Importance can also be identified using the data held on MAGIC (http://magic.defra.gov.uk/) and/or in the UK Biodiversity Action Plan Priority Habitat Descriptions (JNCC 2011 - http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf).

Arable Field Margins

Arable field margins specifically managed for wildlife are a habitat of principal importance. Where field survey or interpretation of aerial photographs identifies the presence of margins that may qualify, then a standard width of 10m should be used to provide an estimate of the number of Biodiversity Units that are contributed by such features (i.e. they are not treated as linear features in the Biodiversity Unit calculation).

Individual Trees and Lines of Trees

Individual trees and lines of trees that are not part of a continuous hedgerow should be treated in the same way as an area based habitat. For these trees, the Root Protection Area, identified through established methodologies (such as the British Standard BS 5837:2012 trees in relation to design, demolition and construction), should be used as an estimated area.

Linear Features

Hedgerows, watercourses, ecological important ditches and some green walls etc. (see the definition of Linear Habitats in Appendix A) should be considered as linear features and each will form a separate aspect of the Biodiversity Unit calculation.

These habitats should be mapped as a line rather than a polygon if using GIS. Linear Habitats will generate their own number of Biodiversity Units (termed Linear Units) Pre Development which equate to metres required in the Post-Development assessment.

Due to the unique nature of these habitats it will normally only be acceptable to offset unavoidable losses of this habitat through the provision of the same habitat type (i.e. loss of hedgerow should only be offset by creation of more hedgerows of a similar type).

Losses and gains will generate Linear Units based on the length of hedgerow or watercourses etc lost or gained. Linear Units are not described within the Defra metric but are used in BREEAM to provide clarity on the impacts of a development. The Linear Units gained from hedgerows and watercourses should be kept separate from one another and from the units generated from Area Based Habitats.

Watercourses and green walls are not well covered within the Farm Environment Plan Manual and as such the use of alternative methodologies is acceptable where they are appropriate. If another methodology is used to assess the condition of watercourses the use of the chosen methodology should be justified by the SQE within their reporting.

Green Roofs and Green Walls

To take account of green roofs and walls these habitats need to be identified by the SQE.

1. Green roofs should be separated into two categories; extensive and intensive. Either type of roof should be treated as an area based habitat.

The definitions of intensive and extensive green roofs are set out in Appendix A.

2. The SQE should also separate green walls into two categories, those that are plug planted and those that consist of climbing plants.

- Plug planted green walls should be treated as Area Based Habitats being aligned to the closest equivalent habitat type.
- Green walls consisting of climbing plants where the wall is simply acting as a support for the plants should be treated as Linear Habitats.

Appendix C: Habitat Type Classification and Reference Index

For some habitat types within the Phase 1 classification, multiple distinctiveness bands can apply, depending on the quality of the habitat. Appendix C details these habitat types and provides guidance on how to assign the appropriate distinctiveness band.

This information is held in a stand-alone Excel file with the same title as this section. The Excel file is available on the BREEAM website, in the Resources section, www.breeam.com/discover/resources.

Appendix D: References

External Documents that are referenced

All references to external documents are correct at the time of writing. The current version of these documents, at the time of assessment, should be used. The SQE should ensure that the current or alternative versions (where appropriate) are reviewed as applicable. This list is not a complete set of references.

If other documents/methodologies are used in place of those listed, then the SQE should make reference to these alternatives providing adequate evidence/reason as to why these are used in preference. Specifically, this could apply to the JNCC Handbook on Phase 1 habitat survey and the use of the Farm Environment Plan condition assessment methodology.

BSI (2012). BS 5837:2012 – Trees in relation to design, demolition and construction.

CIEEM, CIRIA & IEMA. (2016). Biodiversity Net Gain: Good practice principles for development. https://www.iema.net/assets/newbuild/documents/IEMA%20Biodiversity%20Net%20Gain.pdf

CIEEM (2017) Guidelines for Preliminary Ecological Appraisal (GPEA) https://www.cieem.net/guidance-on-preliminary-ecological-appraisal-gpea-

Department for Communities and Local Government (2012) National Planning Policy Framework https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

Natural Environment and Rural Community Act (2006) http://www.legislation.gov.uk/ukpga/2006/16/contents

Department for Environment, Food and Rural Affairs (Defra) (2011) Biodiversity 2020: A strategy for England's wildlife and ecosystem services. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69446/pb13583-biodiversity-strategy-2020-111111.pdf

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Department for Environment, Food and Rural Affairs (2012b) Biodiversity Offsetting Pilots: Guidance for offset providers. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69530/pb13742-bio-guide-offset-providers.pdf

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Forestry Commission and Natural England (2018) Ancient woodland and veteran trees: protecting them from development https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences

Greater London Authority (2008) Living Roofs and Walls – Technical Report: Supporting London Plan Policy https://www.london.gov.uk/sites/default/files/living-roofs.pdf

JNCC (2011) UK Biodiversity Action Plan – Priority Habitat Descriptions. http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc- Rev2011.pdf

JNCC (2010) Handbook for Phase 1 Habitat Survey: a Technique for Environmental Audit.

Natural England (2010) Higher Level Stewardship Farm Environment Plan (FEP) Manual Technical Guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features. Third Edition. Natural England. Peterborough. http://webarchive.nationalarchives.gov.uk/20150303063952/http://publications.naturalengland.org.uk/publication/32037

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