Green GEN Cymru
Phase Three
Grid Connection Strategy

Mid-Wales
February 2025

GREEN GEN CYMRU

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Contents

Figures

Executive Summary

Green GEN Cymru has undertaken a detailed appraisal of grid connection options to identify the most appropriate solution for connecting the proposed Mid Wales Energy Parks to the National Electricity Transmission System (NETS).

The Green GEN Cymru Phase Two Grid Connection Strategy[1] assessed and considered ten potential connection options, within three geographical regions. Following the grant of the IDNO licence the Grid Connection Strategy has been revisited and this Green GEN Cymru Phase Three Grid Connection Strategy published as part of the materials to support the statutory consultation, focusing on determining a suitable substation location and evaluating potential routes from the energy developments to the substation.

An initial review considered 10 connection options across three geographical zones: North Zone, East Zone, and South Zone. These options were assessed based on technical feasibility, environmental impact, cost-effectiveness, and alignment with National Grid's strategic plans. Environmental considerations were prioritised, particularly avoiding sensitive areas such as Bannau Brycheiniog National Park, Eryri National Park, and National Landscapes, in line with policy requirements.

Our appraisal process concluded that the most appropriate solution would be to construct a new 132kV distribution network connecting to the National Electricity Transmission System via a substation near to Lower Frankton, Shropshire.

The Mid Wales Energy Parks, located in Powys would be connected to a new substation via a 132kV route from a 132kV collector substation in Powys. Currently, the proposed route is comprised of approximately 4.8km of underground cable and approximately 45km of overhead line supported on steel lattice towers.

Our analysis has concluded that a route to a new substation at Lower Frankton in Shropshire offers the most appropriate solution and is therefore our preferred solution. This has weighed relevant factors, including potential impacts on the environment, technical and cost consideration.

[1] Green GEN Cymru Phase Two Grid Connection Strategy (August 2023) https://d141qvydpnmd03.cloudfront.net/Green+GEN+Phase+2+Grid+Connection+Strategy.pdf

Glossary

Term	Definition
Alternating Current (AC)	A type of electrical current, in which the direction of the flow of electrons switches back and forth at regular intervals. The vast majority of the electrical network in Great Britain consists of AC infrastructure.
Collector substation	An electrical site where generated electricity is combined to enable the more efficient transfer of electricity to the subsequent section of the network.
Connection substation	An electrical site where voltage is increased or decreased to enable connection to the subsequent section of the network.
Designated Areas	Specific sites within the UK that have special status as protected areas because of their natural and cultural importance.
Development Consent Order (DCO)	The consent issued by the UK Government under the Planning Act 2008 for a Nationally Significant Infrastructure (NSIPs) Project.
Development of National Significance (DNS)	Large infrastructure projects in Wales that require planning permission from the Welsh Ministers (the process is administered by Planning and Environment Decisions Wales (PEDW) on behalf of the Welsh Government.)
Direct Current (DC)	Electrical current which flows consistently in 1 direction. DC technology is often used to carry electricity over very long distances (hundreds of kilometres).
Distributed Generation	Electricity generation that is located close to the load that it serves, usually connection to the distribution network.
Distribution Network	In England and Wales this is the infrastructure that typically operate at 132kV and below, while in Scotland it is the infrastructure that operates below 132kV. Distribution networks carry electricity from the transmission system and Distributed generation to industrial, commercial, and domestic users.
Distribution Network Operator (DNO)	DNOs own, operate and maintain the distribution networks. There are 14 licensed DNOs in Great Britain (GB), and each is responsible for a regional distribution services area.
Future Wales: the national plan to 2040	The Welsh Government's national development plan for Wales. It provides the policy context against which DNS applications are determined and influences all levels of planning policy in Wales and will help to shape Strategic and Local Development Plans prepared by councils and national park authorities.

Term	Definition
Independent Distribution Network Operator (IDNO)	IDNOs are companies that can develop, own, operate and maintain local electricity distribution networks within a DNO network.
Mid Wales Energy Parks	The seven Energy Parks proposed to be located within Mid Wales.
National Electricity Transmission System (NETS)	Also known as the 'Grid' the 'National Grid' or the 'transmission system,' this is the system of high voltage (132kV or greater in Scotland; greater than 132kV in England and Wales) electric lines owned or operated by transmission licensees within Great Britain. See also "Transmission Network."
SP Energy Networks	The electricity DNO for Merseyside, Cheshire, North Wales, and North Shropshire.
National Grid Electricity System Operator (NGESO)	The licensee with the responsibility for the minute-to-minute operation of the GB system and Transmission Network, ensuring it is balanced and stable.
National Grid Electricity Transmission (NGET)	The electricity transmission licensee in England & Wales.
National Park	National Parks are large areas designated by law to protect their special landscape qualities and promote outdoor recreation. National Parks have their own authorities which control planning.
National Landscapes (Formerly known as Areas of Outstanding Natural Beauty)	A National Landscape or Northern Ireland, which has been designated for conservation due to its significant landscape value. Areas are designated in recognition of their national importance by the relevant public body: Natural Resources Wales, Natural England, and the Northern Ireland Environment Agency, respectively.
Overhead line (OHL)	An electric line installed above ground supported by lattice steel pylons or wooden poles
Planning and Environment Decisions Wales (PEDW)	PEDW manages casework (on behalf of the Welsh Ministers) relating to the development and use of land in the public interest, including applications for Developments of National Significance (DNS).
Span	The section of OHL towers or poles.
Special Area of Conservation (SAC)	Special Areas of Conservation (SACs) have been chosen to make a significant contribution to conserving habitats and wildlife species that live there, named in the EC Habitats Directive.

Term	Definition
Mid Wales Energy Generators	The 7 Energy Generators that have connection agreements with GREEN GEN Cymru proposed to be located within mid Wales.
Site of Special Scientific Interest (SSSI)	A statutory designation under the Wildlife and Countryside Act 1981, protecting nationally important wildlife sites, habitats and geological sites
South Wales Energy Parks	The six Energy Parks proposed to be located within South Wales.
Special Protection Area (SPA)	Special Protection Areas (SPAs) are areas that have been designated specifically to conserve wild birds that are listed as rare and vulnerable in the Birds Directive. They also include sites that migratory birds use as stop-off points on their journeys across the planet.
Tee-connection	Where a new circuit connects into an existing circuit, so that the combined electricity is able to be transferred along 1 circuit, as opposed to two separate circuits.
Transmission Entry Capacity (TEC)	This is the allowed capacity a larger generator can export onto the Transmission Network, as agreed in the connection agreement.
Transmission Network	See “National Electricity Transmission System (NETS)”
Underground cable (UGC)	Electricity cables that are buried below the ground.

1 Introduction

Green Gen Cymru

1.01. Green GEN Cymru is part of the Windward Energy Group. Windward Energy was founded in 2018 and operate a number of companies across the UK that are developing infrastructure that will play a part in the country's transition to net zero.

1.02. Green GEN Cymru is proudly based in Wales and will design, build, and operate a new 132kV distribution network needed to unlock Wales's energy potential and meet the future needs of its people communities and businesses. On the 5th July 2024, Green GEN Cymru was granted an Independent Distribution Network Operator (IDNO) licence from OFGEM so that it can build, operate and maintain a 132kV network. IDNOs are companies that develop, own, operate and maintain smaller, local electricity distribution networks (up to 132kv) within the regional Distribution Network Operator (DNO) network. In Mid Wales, the DNO is SP Energy Networks. As an IDNO, Green GEN Cymru have the benefit of the powers within the Electricity Act 1989[2].

1.03. Tackling the climate emergency, connecting new community and renewable energy projects, creating and expanding businesses and electrifying our heating and transport systems will all require more grid capacity. These are challenges that Wales faces and ones that Green GEN Cymru is trying to help address.

1.04. Our proposed network can provide a regional network solution for Wales with capacity for additional generators and new energy users to be able to apply for connections, reducing the need for more infrastructure in future. The Welsh Government, the Senedd and energy generators both private and community) have been looking for ways to unlock this potential for a number of years but have faced challenges due to a lack of electricity grid infrastructure.

1.05. Green GEN Cymru is taking action now, to help deliver clean green energy to our homes and businesses through developing a new energy network. This will help tackle both the energy crisis and the climate crisis.

[2] Electricity Act 1989 https://www.legislation.gov.uk/ukpga/1989/29/contents

1.06. Our proposals will assist in addressing key national priorities to contribute to decarbonisation, energy independence and climate-resilience and would become part of a more resilient network for the region – creating capacity to support local investment and providing for a future in which we all use more electricity. It has the potential to create new skills and jobs, nationally and locally, and it will support the adoption of low carbon technologies in our homes and businesses, such as electric heating and charging points for domestic and agricultural vehicles.

1.07. Our approach aligns with the Welsh Government's ambitions for renewables in Wales. We will follow best practice in working with local communities throughout the development of our proposals, ensuring that communities have a strong voice in the process and derive maximum benefit from environmental, employment, and social opportunities generated by our project.

1.08. We are keen to work in partnership with the Welsh Government, Local Authorities, public bodies and the private sector to see how others can use our infrastructure to the benefit of local communities in Wales.

Purpose of This Document

1.09. This document provides an overview of the background and needs case for new grid infrastructure, as well as the process followed to identify a preferred solution to be delivered by Green GEN Cymru for the connection of the Mid Wales Energy Parks being promoted by our customers, to the National Electricity Transmission System (NETS). Green GEN Cymru's preferred option will be taken forward for further development, including the identification of potential corridor and route options to connect the Mid Wales Energy Parks to the NETS.

1.10. This document focuses on the connection infrastructure between the energy developments and a single connection point on the NETS, it does not examine the energy developments themselves.

Strategic Option Development

1.11. Following the need for the Project being identified strategic options were identified to determine how best to achieve a connection between the proposed energy generation in Mid Wales and the NETS.

1.12. The Green GEN Cymru Phase Two Grid Connection Strategy[3] assessed and considered ten potential connection options, within three geographical regions. Following the grant of the IDNO licence the Grid Connection Strategy has been revisited and this Green GEN Cymru Phase Three Grid Connection Strategy published as part of the materials to support the statutory consultation.

1.13. Following the appraisal of options the Lower Frankton option is still considered, on balance, the best-performing option, whilst having regard for environmental considerations and the need to deliver an economic and efficient solution to connect energy generation in Mid Wales to the NETS.

Consenting Regime

DNS Regime

1.14. In Wales, the consenting of an overhead electric line that has a nominal voltage of 132kV or less and is associated with the construction or extension of a devolved Welsh generating station is a devolved matter under the Development of National Significance (DNS) consenting regime.

1.15. The purpose of the DNS consenting regime is to ensure timely decisions are made on those planning applications that are of the greatest significance to Wales, because of their potential benefits and impacts. DNS applications are submitted to Planning and Environment Decisions Wales (PEDW) who will appoint an Inspector to examine the application and determine the procedure to be followed. The appointed Inspector will consider evidence from the applicant, the Local Planning Authority(ies) (LPA) and other statutory consultees and interested parties and thereafter write a report to the Welsh Minister setting out recommendations for the Minister to consider in determining the application.

DCO Regime

1.16. The consenting overhead electric lines in England and / or Wales (which are not associated with a Welsh generating station) with a nominal voltage of 132kV or more and in excess of 2km in length is governed by the Development Consent Order (DCO) regime under

[3] Green GEN Phase 2 Grid Connection Strategy (August 2023) https://d141qvydpnmd03.cloudfront.net/Green+GEN+Phase+2+Grid+Connection+Strategy.pdf

the Planning Act 2008[4]. Projects of that description are classified as of nationally significant infrastructure projects (NSIPs).

1.17. Applications for DCOs are submitted to the Planning Inspectorate (PINS), which examines the application and provides a recommendation to the Secretary of State for the relevant government department. The examination process is evidence-based and involves consultation with local planning authorities, statutory consultees, and interested parties. Following the examination, the Secretary of State makes the final decision on whether to grant development consent. This process ensures that applications are thoroughly reviewed and that decisions are made in the context of national policy objectives and the need for strategic infrastructure development.

[4] Planning Act 2008 https://www.legislation.gov.uk/ukpga/2008/29/contents

2. Context

Background

2.01. In 2008, the Climate Change Act entered into force in UK law[5]. Section 1 of the 2008 Act, which was amended in 2019 when the UK Government declared a climate emergency, requires the Secretary of State to ensure that the net UK carbon account for 2050 is at least 100% lower than the 1990 baseline. This is often referred to as the net zero target. On 20 April 2021, the UK Government announced its commitment to reduce carbon emissions by 78% by 2035 compared to 1990 levels (including, for the first time, those from shipping and aviation). The new target was enshrined in law in June 2021. The 2008 Act also requires the Secretary of State to set at five-year intervals beginning in 2008, legally binding carbon budgets, which place a restriction on the total amount of greenhouse gases the UK can emit over those five-year periods. The underlying objective of these carbon budgets is to set a trajectory towards the achievement of the net zero target by 2050. The 6th carbon budget, which relates to the period 2033-2037, was made in 2021. The UK Government's October 2021 Net Zero Strategy sets out its policies and proposals for decarbonising all sectors of the UK economy in order to meet its net zero target by 2050[6].

2.02. The Environment (Wales) Act 2016[7] also requires the Welsh Government to reduce greenhouse gas emissions (GGEs) in Wales to net zero for the year 2050, with a system of interim emissions targets and carbon budgets. The Welsh Government has set ambitious renewable energy targets to transition towards sustainability. By 2030, Wales aims to generate the equivalent of 70% of its annual electricity demand from renewable sources[8].

2.03. Building on this, the government announced in January 2023 a target to meet 100% of its electricity needs from renewables by 2035. These

[5] Climate Change Act 2008 https://www.legislation.gov.uk/ukpga/2008/27/contents
[6] Department for Energy Security and Net Zero (DESNZ) (2021). Net Zero Strategy: https://www.gov.uk/government/publications/net-zero-strategy
[7] Environment (Wales) Act 2016 https://www.legislation.gov.uk/anaw/2016/3/contents
[8] Welsh Government (2021). Climate change targets and carbon budgets: https://www.gov.wales/climate-change-targets-and-carbon-budgets#:~:text=Monitoring%20progress-,Net%20zero%20pathway,of%205%2Dyear%20carbon%20budgets

goals are part of Wales' broader strategy to enhance energy resilience, reduce carbon emissions, and align with its net-zero aspirations.

2.04. In April 2019, the Welsh Government declared a climate emergency and set an ambitious target of net zero emissions no later than 2050. In March 2021, new legislation came into force in Wales, amending the 2050 emissions target[9] and the interim emissions targets[10]. As well as amending the 2050 emissions target to net zero, the 2030 target was increased from 45% to 63% below the 1990 baseline, and the 2040 target was increased from 67% to 89% below the 1990 baseline. The Welsh Government and Plaid Cymru have jointly invited an independent group to explore how the country can speed up its transition to net zero, and how amending its target to 2035 from 2050 could be made possible.

2.05. As part of its plan to tackle this emergency, the Welsh Government has brought forward policies to encourage innovative ways of creating energy that are sustainable, secure, and cost effective. This includes Future Wales and the 12th edition of Planning Policy Wales (PPW12)[11]. As part of these new policies, the Welsh Government has confirmed that ‘in determining planning applications for renewable and low carbon energy development, decision makers must give significant weight to the need to meet Wales’s international commitments and our target to generate 70% of consumed electricity by renewable means by 2030 in order to combat the climate emergency’ (Future Wales, Policy 17). Future Wales Policy 17 also confirms that: ‘The Welsh Government strongly supports the principle of developing renewable and low carbon energy from all technologies and at all scales to meet our future energy needs’ and that ‘New strategic grid infrastructure for the transmission and distribution of energy should be designed to minimise visual impact on nearby communities. The Welsh Government will work with stakeholders, including National Grid and Distribution Network Operators, to

[9] The Environment (Wales) Act 2016 (Amendment of 2050 Emissions Target) Regulations 2021 https://www.legislation.gov.uk/wsi/2021/333/contents/made

[10] The Climate Change (Interim Emissions Targets) (Wales) (Amendment) Regulations 2021 https://www.legislation.gov.uk/wsi/2021/338/contents/made

[11] Future Wales: the national plan 2040 (Last updated February 2021) https://www.gov.wales/future-wales-national-plan-2040 and Planning Policy Wales 12th Edition (February 2024) https://www.gov.wales/sites/default/files/publications/2024-07/planning-policy-wales-edition-12.pdf

transition to a multi-vector grid network and reduce the barriers to the implementation of new grid infrastructure'.

2.06. In October 2021, the Welsh Government published its second statutory decarbonisation plan (LCDP2) titled Net Zero Wales[12] which sets out policies and proposals across all Ministerial portfolios. These policies include an ambition to install 1GW of additional renewable energy capacity by 2025 and to increase the delivery of renewable energy developments on land through the planning system through the positive policy framework provided by Future Wales.

2.07. Onshore wind development will play a critical role in assisting the Welsh Government to meet its renewable targets. Central to this are the Pre-assessed Areas for Wind Energy identified in Future Wales, which comprise those areas where the Welsh Government has already modelled the likely impact on the landscape and has found them to be capable of accommodating development in an acceptable way, subject to the criteria in Future Wales Policy 18. Future Wales Policy 17 confirms that 'there is a presumption in favour of large-scale wind energy development in these areas. Outside of these areas, Future Wales Policies 17 and 18 provide a positive policy framework for the consenting and development of large-scale renewable energy projects and associated infrastructure.

2.08. It has long been acknowledged by the Welsh Government, energy generators and network operators that a key challenge with respect to delivering Wales's net zero obligations is the fact that the strongest renewable resources are generally in areas that have the lowest existing electricity network capacity, meaning that key strategic opportunities for renewable energy generation are currently sterilised. Without intervention, this lack of grid infrastructure across Wales is likely to have a detrimental impact on achieving the UK Government and Welsh Government's net zero targets. Future Wales notes "*The Welsh Government acknowledges the significant challenge that grid infrastructure and capacity will have on the potential for new on-shore and off-shore renewable energy development across Wales*" adding that the Welsh Government "*are committed to working with energy networks and developers to identify opportunities and barriers as well as working collaboratively to find solutions*". There is therefore a

[12] Welsh Government (2021) Net Zero: https://www.gov.wales/net-zero-wales

clearly identified national need for new renewable energy development and associated grid infrastructure in Wales.

2.09. The proposed energy developments, and associated connection infrastructure, provide a key opportunity to help to address the climate emergency in a timely manner by providing network connection capability for strategic renewable energy generation.

2.10. In addition to the energy developments that will be directly connected to the grid, our customers are proposing to develop new energy developments that are geographically remote from existing high voltage (HV) electricity infrastructure.

2.11. The proposed energy developments and the options considered for connecting these energy developments to the NETS, including the rationale for the preferred option, are the subject of this document.

2.12. Operation of electricity infrastructure at 132kV within England and Wales is classified as ‘Electricity distribution’. These assets are in the main owned and operated by Distribution Network Operators (DNOs). However, in order to increase competition in the electricity distribution market, Ofgem, as the GB energy regulator, now licences Independent Distribution Network Operators (IDNOs). IDNOs are able to develop, operate and maintain electricity distribution networks. IDNOs connect their networks onwards into the local distribution network or Transmission Network.

2.13. Green GEN Cymru was granted an IDNO Licence, in July 2024 which allows Green GEN Cymru to deliver efficient and reliable grid infrastructure in Great Britain, opening broader opportunities for connections in the future.

2.14. As with DNOs, an IDNO holds an electricity licence under Section 6(1)(c) of the Electricity Act 1989. DNO and IDNO Licences also share the same Standard Licence Conditions. This places specific requirements on an IDNO, including ‘the development, maintenance, and operation of an efficient, co- ordinated, and economical system for the distribution of electricity.’

2.15. Green GEN Cymru are required to adhere to the provisions of the Electricity Act 1989, including Schedule 9, which confirms that the licensee ‘shall have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical

features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects.'

Planning Policy

Future Wales: The National Plan 2040 (February 2021)

2.16. Future Wales is the Welsh Government's National Development Framework and is the highest tier of the Development Plan in Wales. It states that 'as set out in legislation, applications for Developments of National Significance must be determined in accordance with Future Wales.'

2.17. As the most recent expression of national planning policy, Future Wales is considered to have primacy in the planning policy hierarchy. Its purpose is to ensure the planning system at all levels is consistent with, and supports the delivery of, Welsh Government strategic aims and policies (including those in Planning Policy Wales, the Wales Infrastructure Investment Plan and Regional Economic Frameworks). It was prepared with regard to various Welsh Government policies and legislation, including:

- Well-being of Future Generations (Wales) Act 2015[13];
- Environment (Wales) Act 2016;
- Prosperity for All: A Low Carbon Wales (March 2019)[14];
- Policy Statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations (February 2020)[15]; and
- Future Energy Grids for Wales (FEW) (June 2023)[16].

2.18. Future Wales provides the spatial direction for development in Wales and the policy framework for SDPs and LDPs at the regional and

[13] Well-being of Future Generations (Wales) Act 2015 https://www.legislation.gov.uk/anaw/2015/2/contents

[14] Prosperity for all: a low carbon Wales (June 2019) https://www.gov.wales/prosperity-all-low-carbon-wales

[15] Policy Statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations (February 2020) https://www.gov.wales/sites/default/files/publications/2020-02/policy-statement-local-ownership-of-energy-generation-in-wales.pdf

[16] Future Energy Grids for Wales (June 2023) https://www.gov.wales/sites/default/files/publications/2023-07/future-energy-grids-for-wales-technical-report.pdf

local level. These plans are required to conform to Future Wales and planning decisions at every level must be taken in accordance with the Development Plan.

2.19. Future Wales states:

'*Wales is abundant in opportunities to generate renewable energy and the Welsh Government is committed to maximising this potential. Generating renewable energy is a key part of our commitment to decarbonisation and tackling the climate emergency*.'

'*Wales can become a world leader in renewable energy technologies. Our wind and tidal resources, our potential for solar generation, our support for both large and community scaled projects and our commitment to ensuring the planning system provides a strong lead for renewable energy development, mean we are well placed to support the renewable sector, attract new investment, and reduce carbon emissions*.'

2.20. Section 2 of Future Wales sets out how it has been informed by climate change issues, including projections showing an increased chance of milder more wet winters and hotter, drier summers, rising sea levels and an increase in the frequency and severity of extreme weather events. It further states:

'*It is vital that we reduce our emissions to protect our own well-being and to demonstrate our global responsibility. Future Wales together with Planning Policy Wales will ensure the planning system focuses on delivering a decarbonised and resilient Wales through the places we create the energy we generate, the natural resources and materials we use and how we live and travel*.'

Planning Policy Wales (Edition 12, February 2024)

2.21. The Welsh Government published Planning Policy Wales Edition 12 (PPW) in February 2024. PPW provides the key principles for the planning system in Wales, in terms of what development plans and decisions must achieve and how development should deliver the best possible outcomes. According to Future Wales, this is a material consideration in the planning process.

2.22. The primary objective of PPW is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental, and cultural well–

being of Wales, as required by the Planning (Wales) Act 2015, the Well–being of Future Generations (Wales) Act 2015 and other key legislation.

2.23. Paragraph 3.61 of PPW States that:

> '*adequate and efficient infrastructure, including services such as education and health facilities along with transport, water supply, sewers, sustainable waste management, electricity, and gas (the utilities) and telecommunications, is crucial for economic, social, and environmental sustainability. It underpins economic competitiveness and opportunities for households and businesses to achieve socially and environmentally desirable ways of living and working*.'

2.24. Section 5.7 details the policy in relation to the electricity grid network, paragraphs 5.7.8 to 5.7.11 state that:

> *'An effective electricity grid network is required to fulfil the Welsh Government's renewable and low carbon ambitions. An integrated approach should be adopted towards planning for energy developments and additional electricity grid network infrastructure. In certain circumstances, additional electricity grid network infrastructure will be needed to support the Pre-Assessed Areas in Future Wales, but also new energy generating developments more generally.'*

> *'The Welsh Government's preferred position on new power lines is that, where possible, they should be laid underground. However, it is recognised that a balanced view must be taken against costs which could render otherwise acceptable projects unviable. Where undergrounding of lines is not possible or applicable, proactive engagement with energy companies and the public to mitigate the visual impact of any potential new transmission lines should take place.'*

> *'Planning authorities should plan positively for grid infrastructure. Development plans should facilitate the grid infrastructure required to support the renewable and low carbon energy potential for the area, particularly areas identified for such development. Planning authorities should support appropriate grid developments, whether or not the developments to be connected are located within their authority.'*

> *'Planning authorities and the energy industry, including National Grid and Distribution System Operators, should engage with each other to ensure development plans take grid infrastructure issues into account. This can also ensure investment plans for transmission and distribution align with the identified potential for renewable and low carbon energy as well as the future challenges of increasing electrification of transport and heat.'*

2.25. It is identified in PPW that a positive approach to grid infrastructure should be taken to support low carbon emissions. The proposals of Green GEN Cymru and Bute Energy would make a significant contribution to these ambitions by both unlocking and delivering the renewable energy potential in areas that are not currently serviced by sufficient grid infrastructure.

2.26. It is acknowledged that it is the preferred position of Welsh Government that new power lines should be placed underground where possible unless this could render otherwise acceptable projects unviable. This position has been considered within this report under the 'Considered Technologies' section.

National Policy Statements

2.27. Section 104 of the Planning Act 2008 states that the SoS must have regard to any relevant National Policy Statements (NPS). The relevant NPSs for the Vyrnwy Frankton project are the:

- Overarching NPS for Energy (EN-1)[17]; and
- NPS for Electricity Networks Infrastructure (EN-5)[18]

Overarching National Policy Statement for Energy (EN-1)

2.28. NPS EN-1 sets out the need for new nationally significant infrastructure to achieve energy security and reduce greenhouse gas emissions.

2.29. Paragraph 2.1.3 of NPS EN-1 recognises that:

'To produce the energy required for the UK and ensure it can be transported to where it is needed, a significant amount of infrastructure is needed at both local and national scale. High quality infrastructure is crucial for economic growth, boosting productivity and competitiveness'.

2.30. Paragraph 3.3.62 of NPS EN-1 states that:

[17] Overarching National Policy Statement for Energy (EN-1) (Last updated January 2024) https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1

[18] National Policy Statement for electricity networks infrastructure (EN-5) (Last updated January 2024) https://www.gov.uk/government/publications/national-policy-statement-for-electricity-networks-infrastructure-en-5

'Government has concluded that there is a critical national priority (CNP) for the provision of nationally significant low carbon infrastructure'.

2.31. Recognising the national security, economic, commercial, and net zero benefits of CNP Infrastructure, paragraph 3.3.63 of NPS EN-1 makes clear that:

'Government strongly supports the delivery of CNP Infrastructure and it should be progressed as quickly as possible.'

2.32. Paragraph 3.3.65 also confirms that:

'There is an urgent need for new electricity network infrastructure to be brought forward at pace to meet our energy objectives.'

National Policy Statement for Electricity Networks Infrastructure (EN-5)

2.33. NPS EN-5 covers above ground electricity lines, with voltages that are expected to be 132kV or above. NPS EN-5 sets out the factors that should be taken into account during site/route selection and the potential impacts that are specific to electricity networks infrastructure.

2.34. Paragraph 2.2.10 of NPS EN-5 states that:

'*As well as having duties under Section 9 of the Electricity Act 1989, (in relation to developing and maintaining an economical and efficient network), applicants must take into account Schedule 9 to the Electricity Act 1989, which places a duty on all transmission and distribution licence holders, in formulating proposals for new electricity networks infrastructure, to "have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and …do what [they] reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects*.'

2.35. Paragraph 2.9.7 of NPS EN-5 recognises that:

'*While the government does not believe that the development of overhead lines is incompatible in principle with applicants' statutory duty under Schedule 9 to the Electricity Act 1989, to have regard to visual and landscape amenity and to reasonably mitigate possible impacts thereon, in practice new overhead lines can give rise to adverse landscape and visual impacts*.'

2.36. Paragraph 2.9.16 of NPS EN-5 recognise the importance of the guidelines provided in the Holford Rules:

'*intended as a common-sense approach to overhead line design, were reviewed and updated by the industry in the 1990s and they should be embodied in the applicants' proposals for new overhead lines*'.

2.37. Paragraph 2.9.20 of NPS EN-5 covers undergrounding:

'*Although it is the government's position that overhead lines should be the strong starting presumption for electricity networks developments in general, this presumption is reversed when proposed developments will cross part of a nationally designated landscape (i.e. National Park, The Broads, or Area of Outstanding Natural Beauty*'.

2.38. Paragraph 2.12.7 of NPS EN-5 again refers to the CNP:

'*As highlighted in EN-1 government has concluded that there is a CNP for the provision of nationally significant low carbon infrastructure. This includes for electricity grid infrastructure, all power lines in scope of EN-5 including network reinforcement and upgrade works, and associated infrastructure such as substations. This is not limited to those associated specifically with a particular generation technology, as all new grid projects will contribute towards greater efficiency in constructing, operating, and connecting low carbon infrastructure to the National Electricity Transmission System*'.

3. Overview of Grid Connection

Background

3.01. Whether it is energy generators or energy users, Green GEN Cymru as an IDNO have an obligation to establish the feasibility of potential connection agreements with customers. The primary objective of Green GEN Cymru's grid connection strategy is to determine the optimal infrastructure for establishing a connection between the proposed Mid Wales Energy Parks to the NETS. The Mid Wales Energy Parks consist of seven energy developments (Llyn Lort, Banc Du, Rhiwlas, Waun Hesgog, Esgair Galed, Llyn Lort II and Maesnant).

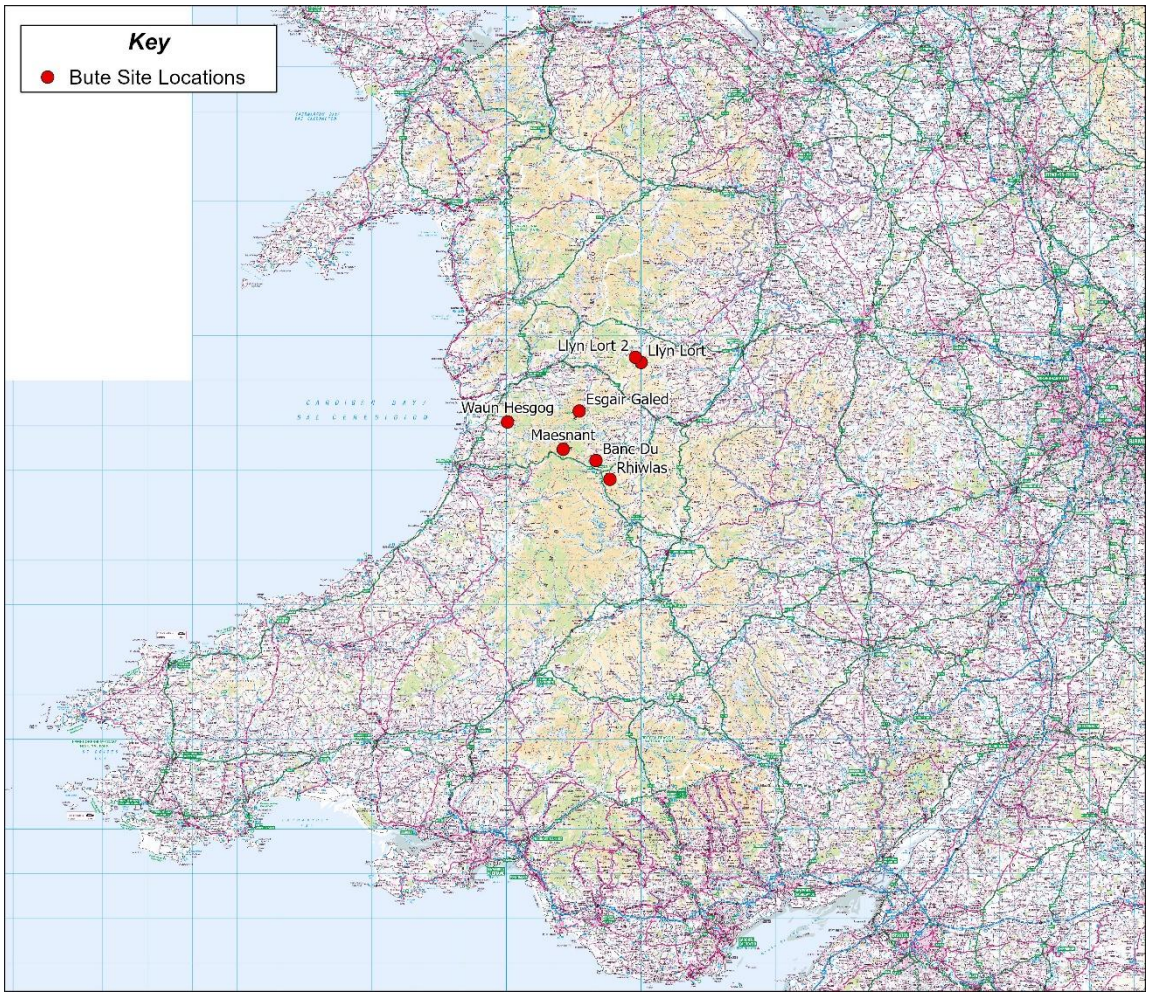

Figure 1 - Location of Bute Energy's proposed Mid Wales Energy Parks

3.02. The Mid Wales Energy Parks have a total contracted generation capacity (known as Transmission Entry Capacity - TEC) of 935MW. The proposed locations of these energy developments are shown in Figure 1, with the individual capacities for each of the parks then described in Table 1.

Energy Park	TEC (MW)
Llyn Lort	158
Banc Du	46
Rhiwlas	106
Waun Hesgog	250
Esgair Galed	125
Llyn Lort II	100
Maesnant	150

Table 1 - Individual capacities of the Mid Wales Energy Parks

3.03. Figure 2 shows that the Bute Energy proposed Energy Parks in Mid Wales are geographically distant from the existing Transmission Network.

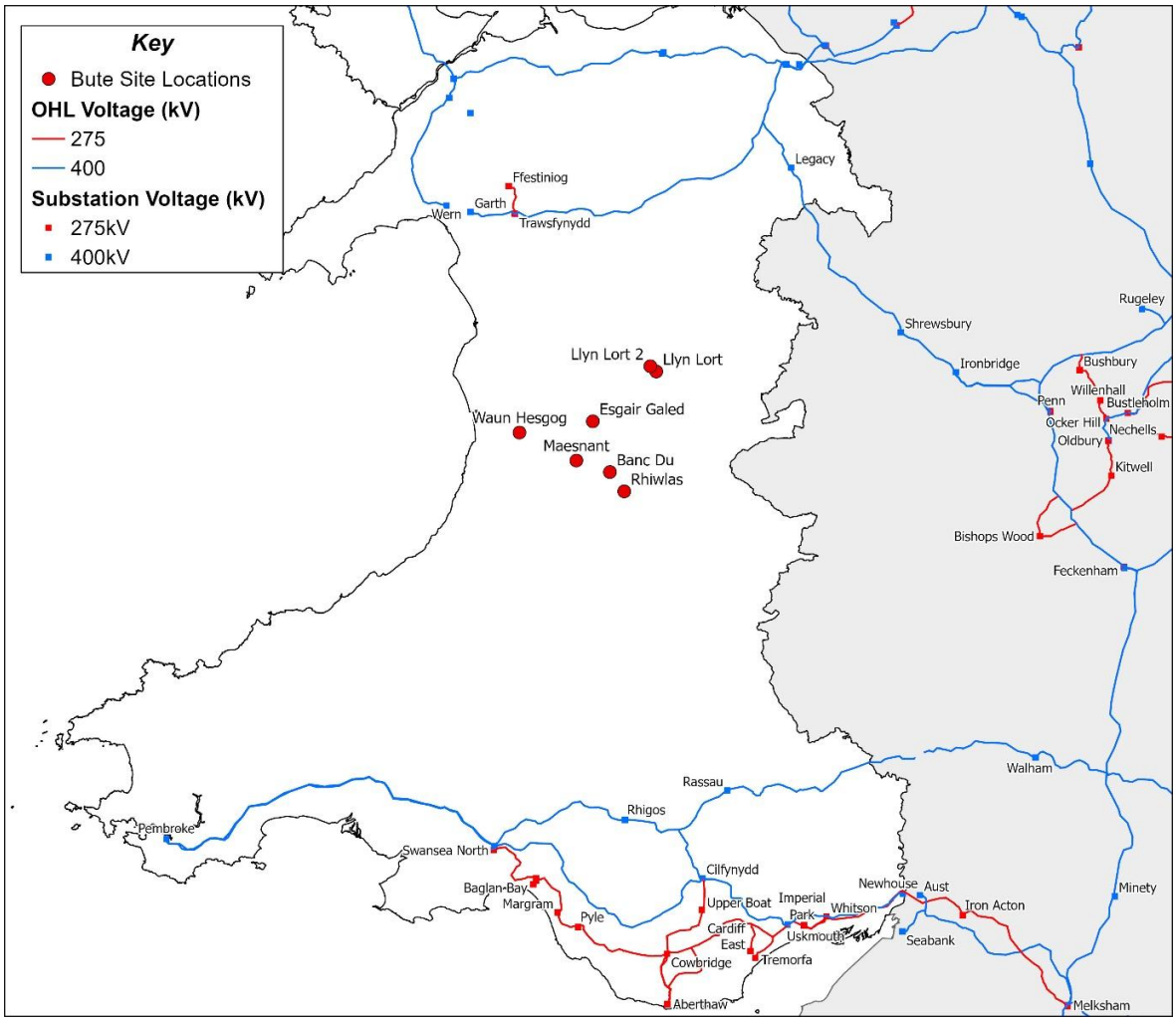

Figure 2 - Bute Energy's proposed Mid Wales Energy Parks and existing Transmission Network infrastructure

Electricity Transmission System

3.04. The UK's 400kV electricity transmission system forms the backbone of the electricity supply system, operated by the National Energy System Operator (NESO) it provides a transport highway for bulk energy transfer. It connects power stations, large-scale renewable energy projects, and regional distribution networks across England, Wales, and Scotland, ensuring that electricity can be transmitted over long distances to where it is most needed. This network also facilitates the import and export of electricity via High Voltage Direct Current (HVDC) interconnectors to neighbouring countries, enhancing energy security.

3.05. The 400kV transmission lines are the highest alternating current voltage level in the UK, designed to handle large volumes of electricity efficiently and reduce transmission losses over long distances. The higher voltage enables the network to support significant electricity demands, especially in densely populated areas. As the UK increases its reliance on renewable energy, the 400kV grid is essential for transferring power from renewable generators to population centres.

Connection Agreements

3.06. Connection agreements are contracts between energy producers (or consumers) and Transmission or Distribution Owners and Operators. These agreements outline the technical and financial responsibilities of both parties, ensuring that any new connections do not compromise grid stability or safety. The agreements also specify timelines for when the connection must be completed and operational. These timelines are critical for coordinating large infrastructure projects, particularly for renewable energy projects that need to come online to meet government targets.

3.07. As Green Gen Cymru is now an IDNO it has an obligation to listen to all offers from potential energy generators and users under its statutory obligations under its licence terms.

Considered Technologies

3.08. Prior to undertaking an assessment of the identified feasible options for the connections, we firstly considered the technologies that would be available to Green GEN Cymru to deliver the connections. This

section explains the technology options considered to connect the Mid Wales Energy Parks to the Transmission Network and how these technologies may be used to deliver the solution.

3.09. There are a number of different technologies that could be utilised for the new connections required to transport the electricity from the Energy Parks to a Connection Substation on the NETS. These are:

- Gas Insulated Lines (GIL)
- Direct Current (DC) solutions
- Alternating Current (AC) underground cables and overhead lines (OHLs)

3.10. The electricity network in Great Britain predominantly operates using an AC system (although DC connections are used in instances where power is transported over extremely long distances), the majority of which is made up of AC overhead line (OHL) circuits. For each of the proposed solutions discussed within this report, due to the required capacity, the majority of the route would need to consist of two circuits, each likely to contain two conductors per phase.

Gas Insulated Lines

3.11. GILs provide a means of burying high-voltage cables. GIL technology consists of a tubular aluminium conductor to carry the current, enclosed in a rigid metallic tube that is filled with an insulating gas. Due to this enclosure, GIL offers high safety and reliability, as well as low electrical losses. However, there are environmental concerns with GIL as the gas currently used in the insulating gas mixture, Sulphur Hexafluoride (SF6), is a potent ‘greenhouse gas’, and SF6-free solutions have not been developed to a sufficient level of maturity at this stage. In addition, the use of GIL technologies has been limited within the UK, with the majority of instances being within substations and of short lengths.

3.12. In addition, for a wholly GIL solution there could be increased impacts on local biodiversity when compared with alternative technologies attributable to excavating trenches and installing GIL technology. While excavations would naturally recover over time, additional significant excavation works could be required for on-going line maintenance.

3.13. Based on these factors, the use of GIL technology has been discounted at this stage and this has not been subject to further consideration as part of the appraisal of options undertaken.

Direct Current (DC) solutions

3.14. DC circuits are generally used when high volumes of power are required to be transported over very long distances, such as for the 420 km Western HVDC Link between Hunterston in Western Scotland and Flintshire Bridge in North Wales. DC circuits use converter stations to convert the power from AC to DC at one end of the circuit and then from DC back to AC at the other end. These converter stations use highly complex high voltage power electronics to achieve this conversion process; the cost involved would be in the region of £50m - 100m per converter station. It is anticipated that the potential cost of converter stations could make this option unviable compared to the cost of an AC solution.

3.15. In some cases, the reduced energy losses incurred in the DC circuits and better technical performance (compared to an AC equivalent) can compensate for the high costs of the converter stations, especially where power needs to transported over very long distances.

3.16. In addition to high costs, converter stations are large structures and could increase the visual and environmental impacts compared to AC alternatives where they are sited. Having regard to the distance between the proposed Mid Wales Energy Parks and the Transmission Network (detailed in the options section below), as well as the power capacity requirements being contemplated, DC solutions are not considered to represent a suitable technology for the proposed connection. It is also important to note that HVDC OHL is an unproven/unused technology in the UK and only HVDC UGC has been used to date.

3.17. Significant benefits from reduced energy losses would not materialise over the distances associated with the proposed connection. Therefore, the higher costs associated with DC solutions would not be justified. For these reasons, the use of DC technology has been discounted at this stage and this has not been subject to further consideration as part of the appraisal of options undertaken.

Alternating Current (AC) Underground Cables and Overhead Lines

3.18. The UK Transmission and Distribution systems typically use AC technology to transfer power around the nation from points of generation to homes and businesses. AC is an electric current which periodically reverses direction and changes its magnitude continuously with time. AC is the form in which electric power is delivered to businesses and residences, and it is the form of electrical energy that consumers typically use in homes and businesses.

3.19. OHLs are electricity lines that are supported above ground through the use of towers or poles. Underground cables (UGCs) offer an alternative to OHLs by installing the conductors underground but at a considerably higher cost. Therefore, in order to ensure that the proposals are economic and efficient in accordance with the Electricity Act duties of the IDNO holder, underground cable technology is generally only used in instances when an OHL could be technically unsuitable (e.g. in heavily built-up areas) or where the use of OHL is considered to give rise to significant environmental impacts. UGCs have different technical requirements and environmental considerations than those for an OHL. For example, UGCs have less visual impact, once installed, than OHLs but could have a potentially greater impact on ecological habitats and species and on archaeological remains, given the increased level of ground disturbance required during construction and maintenance. It is fully recognised that there are specific circumstances in which the use of UGCs could be appropriate and this will be assessed on a project-by-project basis.

3.20. The estimated additional cost of placing a 132kV HV electrical connection underground could be approximately six to ten times the cost of an over-head connection. Since publication of an earlier iteration of this report, we are currently reviewing the latest available cost information, and carrying out further assessment of likely costings based on best available industry practice. GGC will publish a report on the cable costings in 2025.The respective costings of each of OHL and UGC technologies will likely change and, potentially, both may increase throughout the lifetime of these proposals. We will regularly review the best available and up to date cost information as the projects develop further.

3.21. Green GEN Cymru has considered a wholly underground solution for the connections, and deemed this unsuitable as the additional cost would severely impact the viability of the proposals, take more years to build, increase ecological impacts during construction and not comply with our obligations to be economic and efficient. If, in certain circumstances, it is determined that a section of UGC is required instead of OHL, the approach would be to define the length of UGC necessary to overcome the constraint to OHL routeing, consistent with a balance between technical and economic viability, deliverability and environmental considerations. Accordingly, the starting point of development is that AC OHL technology would be proposed.

3.22. In addition to traditional UGC trench installation, a recent technology has emerged that utilises the process of cable ploughing. This approach enables the simultaneous installation of UGC, ducting, backfill, marker tiles, and warning tape without the need for extensive trenches. This can minimise disruption along cable sections by reducing ground disturbance and heavy equipment use. Cable ploughing can offer benefits, however the ground conditions and geology of the area needs to be suitable to be able to accommodate the process. Currently it is unclear what the cost savings would be against traditional UGC techniques but it's unlikely to be comparative to an OHL.

3.23. The ploughing method could enhance program efficiency but could introduce risks of weather-related downtime and unknown site-specific constraints (e.g. ground conditions), particularly in rocky or wet areas.

3.24. At this stage, Green GEN Cymru would assume the undergrounding of a 132kV overhead line within a designated landscape such as a National Park or National Landscape and this has been taken into account in the consideration of the connection options below. Consideration of undergrounding in other areas will be determined on a specific project basis and will be considered in subsequent stages of project development.

Supporting structures

3.25. There are a number of different structures available to support OHL conductors (wires) that can operate at 132kV. Single circuit structures are able to support the three wires in each circuit and these are typically of single or double wood pole design and are circa 14m in

height. A range of conductors can be installed on single circuit wood pole structures, however in order to maintain a spacing of approximately 100m between the supporting structures, the realistic limit of power that can be transferred on wood poles at 132kV is approximately 200MVA.

3.26. There are also double circuit structures that are capable of supporting two circuits consisting of 6 or 12 wires. Double circuit structures operating at 132kV typically consist of steel lattice design (such as an L4 or L7) and are able to support larger conductors and are therefore able to distribute more power than the equivalent single circuits.

3.27. The standard height for an L7 tower is 27m, with the possibility of increments in height using 3m extensions and, on rare occasions, lowering the height as needed. This variability is determined by the topography, ensuring clearance from the terrain or other obstacles by altering the span length between towers which on average is 250m. The use of extensions is essential to maintain span lengths and minimise the need for additional towers. Steel lattice towers at 132kV offer the ability to support conductors with realistic limit of power distribution of 800MVA per circuit (or 1600MVA per OHL route).

3.28. Larger standard steel lattice structures (such as an L8 design) are able to carry 132kV conductors, however these are much higher in height. L8 towers are normally used for 275kV and 400kV transmission connections.

3.29. Although lattice towers would be taller than using wood pole alternatives, standard wooden poles can only carry three wires meaning that three – four parallel sets of wooden poles could be required to hold the same number of wires that can be contained on one L7 tower. A substantial lateral separation distance between parallel wooden poles would need to be maintained for safety, which could materialise into a swathe width of approximately 75m. In most cases, wood poles can be spaced 80- 150m apart longitudinally. In contrast, L7 steel lattice towers are typically spaced 200- 250m apart. This, alongside the lateral spacing requirements, could lead to greater impacts on the environment and greater restrictions on future land use.

3.30. Each structure type is intended for use in specific scenarios or conditions. Green GEN Cymru has sought to choose supporting structures that could enable the OHLs to distribute the required power

generation from each of the Mid Wales Energy Parks in the most appropriate manner, balancing our obligations to develop an economic, efficient, and coordinated network.

3.31. Due to the combined generating capacity of the Energy Parks, the majority of the main OHL routes would need to consist of double circuits towers each containing 6 or 12 wires. It is assumed that steel lattice towers could be employed for the majority of the main OHL routes. However, the use of wood poles for carrying conductors will be considered where appropriate.

3.32. The use of steel lattice structures balances the need to transmit high levels of electricity while reducing the landscape and visual impacts in the locations they are installed through routeing and potential mitigation measures. Alternative steel or composite structures (such as T-pylon) have not been considered as they have not been designed for 132kV technology and / or will require significant time and investment to comply with electricity safety standards.

3.33. Nevertheless, where the conductor capacity is expected to be lower, for example when distributing the generated electricity from the smaller capacity Mid Wales Energy Parks, we expect to use a single 132kV circuit on either single or double wood pole structure.

Voltage level

3.34. We propose to distribute the electricity from the Energy Parks to the selected transmission connection point at a voltage of 132kV. If the Connection Circuits were to be proposed at a higher voltage level (>132kV), the infrastructure would be classified as transmission. This would mean that responsibility for designing and delivering the assets would lie with National Grid Electricity Transmission (NGET) as this scale of infrastructure is not deliverable by Green GEN Cymru under the IDNO Licence.

3.35. As the operating voltage of OHLs increases, the infrastructure becomes larger due to the increased electrical clearance needed between each circuit, from the ground, other structures, and from people to ensure safety. Figure 3 compares the heights of a typical 132kV tower (L7 model – left) and a typical tower for 275kV and

400kV voltages (L8 model – right), both towers in this case are designed to carry two circuits (each consisting of three phases).

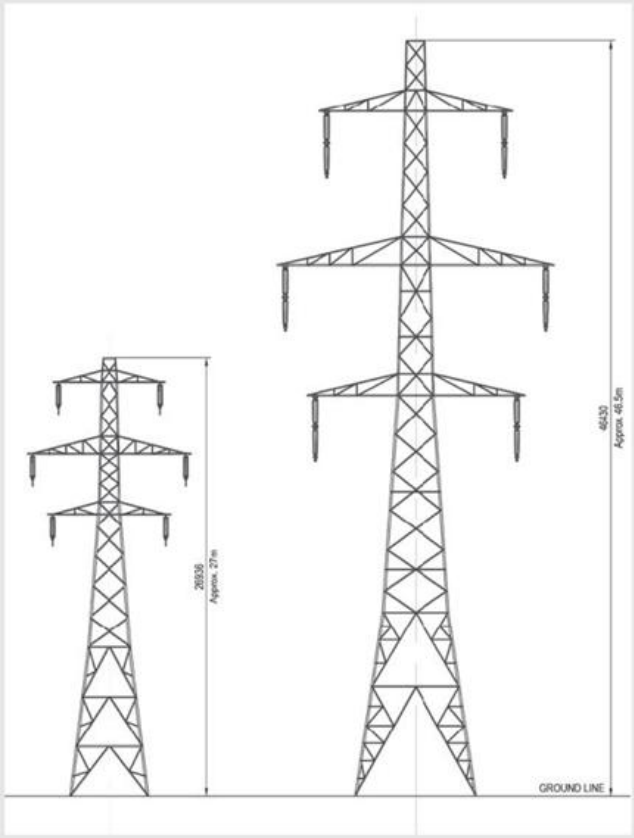

Figure 3 - L7 and L8 tower comparison[1]

3.36. The larger (height and width) L8 tower shown in Figure 3 mean that it is capable of supporting conductors capable of operating at 400kV. Operating at 400kV enables much higher power transfer than 132kV and spacings between structures increase to typically 350m, meaning fewer are needed over the same distance.

3.37. The larger towers used for 400kV conductors require a larger footprint, as well as additional steel when compared to the L7 tower, used for 132kV conductors. The additional height and width of the L8 structures has a greater landscape and visual impact.

3.38. As circuits operating at 132kV would be sufficient to enable the full capacity of the Mid Wales Energy Parks to be transported to a Connection Substation with the existing NGET network, the development of a transmission-level (400kV) network from the Mid Wales Energy Parks is not considered appropriate, having regard to the additional environmental impacts as it is not considered that the increase in additional capacity that a 400kV connection would provide is necessary at this time.

3.39. This, coupled with the fact that the 400kV towers and conductors would likely exacerbate environmental effects (particularly landscape and visual) and are not necessarily the most economical solution, means that 132kV towers strike the right balance in terms of deliverability, economics, likely environmental impacts, efficiency and would provide sufficient flexibility to deliver green energy to Wales in the short and longer term.

Traditional Underground Cable Method

3.40. The traditional method for installing underground high-voltage electrical cables begins with the excavation of trenches along a planned route. These trenches are typically dug using excavators or other suitable heavy machinery, with depths generally ranging from 1 to 2 meters, depending on site-specific factors and engineering requirements. Careful planning ensures that the route adheres to safety standards and minimizes disruption to surrounding infrastructure.

3.41. Once the trenches are prepared, the cables—commonly insulated with cross-linked polyethylene (XLPE)—are laid. This insulation provides excellent durability and electrical performance under high voltage. The cables may be placed directly within the trench or housed in protective ducts. In either scenario, a bedding of sand is used to cushion the cables, offering additional protection and ensuring stability within the trench.

3.42. To prevent accidental damage to the cables, especially during future excavation or construction, protective barriers are installed. These may include concrete slabs, marker tiles, or warning tapes placed directly above the cables. These markers provide a visual and physical barrier to protect against mechanical damage. After these safeguards are in place, the trench is refilled with the excavated soil or other suitable backfill material, which is then compacted to ensure stability and reduce the risk of settlement over time.

3.43. Following the installation of the cables, thorough testing is conducted to verify their performance and structural integrity. Specialised joints are employed to connect the cable sections, ensuring smooth transitions and reliable operation. These joints also link the cables to terminations at substations, ensuring seamless integration into the larger electrical network.

Cable Plough Method

3.44. A cable plough is a specialised piece of equipment designed to lay cables underground reducing surface disruption. It can be used for power cables, fibre optics and communication lines in rural or remote areas.

3.45. The plough is typically attached to a tracked winch system and as the plough advances it creates a slit from a steel blade in the ground. The cable is fed through a delivery chute at the rear and placed directly into the trench.

3.46. Once the cable is laid, the surrounding soil naturally falls back into the trench, burying the cable, additional mechanisms on the plough or a separate excavator may be employed to compact the soil over the cable. This ensures the installation remains stable and protected from external forces.

3.47. The cable plough is most used for cable installation of 11, 33, and 66kv in circumstances that imported backfill is not required and in circumstances where backfill is fed through the shoot behind the plough.

3.48. Use of the cable plough is limited where airtight compaction of imported backfill such as cement based sand (CBS) is critical to ensure adequate cooling of the cable system.

Costings

3.49. To inform our assessment of each of the options, we undertook an indicative cost assessment of the proposed solutions. This cost assessment considered key assumptions that have been outlined in The Green GEN Cymru Phase Two Grid Connection Strategy.

3.50. Since the publication of an earlier iteration of this report, we have been carrying out the respective costing assessments of OHL and UGC technologies and, potentially, both may increase throughout the lifetime of the project. We will regularly review the best available and up to date cost information as the projects develop further.

4. Grid Connection Options

Approach

4.01. Our appraisal process identified and compared the feasible options to provide the connections from the energy parks to the NETS. These options have then been developed and investigated to a level that enabled a comparative assessment to be undertaken. The appraisal included the following elements: consideration of different technologies, cost estimation, and desk-top investigation of options to identify key technical and environmental constraints.

4.02. A preferred connection option was selected on the basis of the comparative appraisal, which balances engineering constraints, economic viability, community impacts and the environment.

4.03. This document explains the assessment and decision-making process which has led to the selection of the preferred option to connect the Energy Parks to the Transmission Network.

4.04. The initial stage of the optioneering was to identity feasible grid connection points (i.e. locations for Connection Substations), as well as the connection circuits required in each case. These grid connection points, including circuits were then compared. The identified options fell within three geographical zones, a North Zone, East Zone, and South Zone.

4.05. To support the evaluation, an assessment framework was put in place. This allowed us to compare the long list of identified feasible options in a consistent and fair manner.

4.06. Under Section 9(2) of the Electricity Act 1989, Green GEN Cymru, as an IDNO, are required to 'develop and maintain as efficient, co-ordinated and economical system of electricity'. Schedule 9 of the Electricity Act 1989 will impose a statutory duty on Green GEN Cymru to take account of the following factors in formulating proposals for the installation of overhead lines:

'*(a) the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings, and objects of architectural, historic, or archaeological interest; and,*

(b) to do what it reasonably can to mitigate any effects which the proposals would have on the natural beauty of the countryside or any such flora, fauna, features, sites, buildings or objects.'

4.07. These duties and considerations were imperative in the development of the assessment framework that was utilised to undertake analysis of feasible options. We identified connection options which are, at a strategic level, economically and technically viable and, on balance, cause the least disturbance to the environment and the people who live, work, or enjoy recreation within it. This is of particular relevance for this proposed connection, where there are numerous nationally designated areas, for example the Eryri National Park, within the vicinity of the proposed energy developments.

4.08. Our assessment was focused on the following key factors. It should be noted that there is no specific hierarchy or weighting applied to these factors:

- Environmental: we identified the environmental factors that differentiate options. At this stage of appraisal, this has principally been on the potential for the OHL to impact on:
  - Landscape areas that benefit from the highest level of protection (National Parks and National Landscapes);
  - Internationally designated ecological sites (e.g. SACs, SPAs and Ramsar sites); and
  - Cultural heritage features that benefit from the highest level of protection (e.g. World Heritage Sites).
- Technical: at this stage of our process, our technical appraisal focused on the technology available to deliver each option (outlined above), as well as further technical considerations for each solution, such as the expected electrical losses. For example, the greater the length of the electrical circuit, the greater the electrical losses would be. The 'Considered Technology' section provides further details on our technical appraisal.
- Cost: for each option considered, using an anticipated scope of works relevant for each option, we prepared an indicative capital cost estimate. This enabled us to undertake a high level cost comparison of each option, with a view to balancing the most economic and efficient option with other factors as required under the Standard License Conditions.
- Deliverability: for each option, we considered key factors in relation to the timely delivery of the proposed connection, such as the associated planning and consenting requirements, noting how

these factors may impact on the expected completion date, and alignment with the commissioning of the proposed energy parks.

5. Project Overview

Proposed Generation

5.01. New energy generation projects, such as the proposed Mid Wales Energy Parks, can connect to either the Transmission Network (the higher voltage network owned and operated by National Grid Electricity Transmission, NGET, in England and Wales) or the local lower voltage Distribution Network. In North Wales, Merseyside, Cheshire and North Shropshire the local lower voltage Distribution Network is owned and operated by Scottish Power Energy Networks. In South Wales this is owned and operated by National Grid, through its National Grid Electricity Distribution, NGED, business. Connecting to one of these networks is necessary to allow our power to be transported to the National Grid, and ultimately through to homes and Businesses.

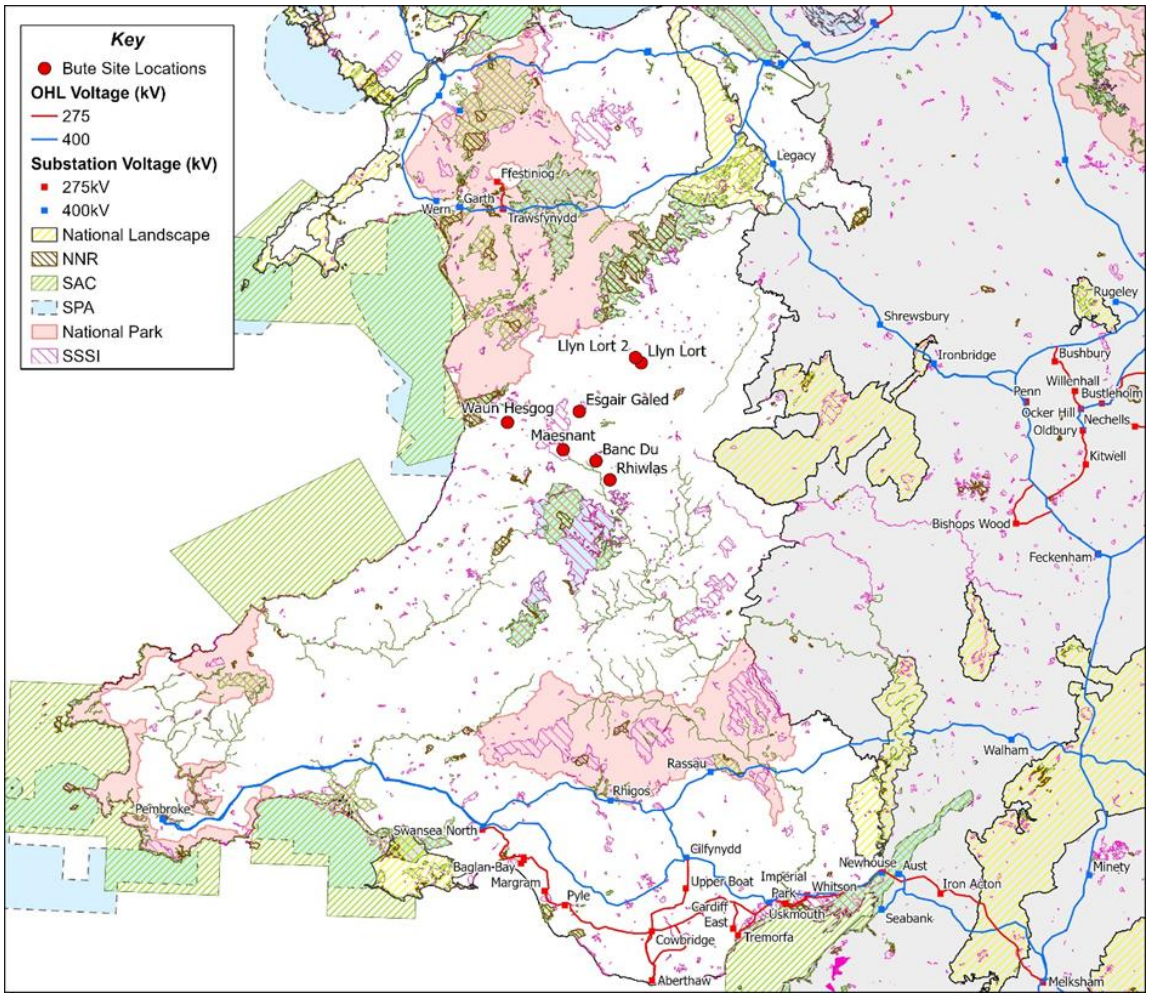

Figure 4 - Bute Energy's proposed Mid Wales Energy Parks, existing Transmission Network infrastructure and nationally designated areas.

5.02. Figure 4 shows that the proposed Energy Parks in Mid Wales are geographically distant from the existing Transmission Network.

5.03. The above demonstrates that the closest NGET transmission circuit routes are:

- to the north - the 400kV circuit that runs from Trawsfynydd substation in the west to Ironbridge substation in the east. On this northern transmission circuit, the closest existing NGET substations to the Mid Wales Energy Parks are Trawsfynydd, Shrewsbury and Ironbridge. In addition to these existing substations consideration has also been given to a proposed new National Grid substation near Gwyddelwern which will connect the proposed Bute Energy Park at Moel Chwa.
- to the east – the 275kV circuit that connects to Bishops Wood 275kV substation.

5.04. to the south - the 400kV circuit that runs from Pembroke substation in the west to Walham substation in the east. On this southern transmission circuit, the closest existing NGET substations to the Mid Wales Energy Parks are Rhigos and Rassau. In addition to these existing substations consideration has also been given to the proposed new National Grid substation near Carmarthen which will connect the South Wales Energy Parks.

5.05. Following the identification of these areas, it was considered that there were 10 reasonable alternative options for a feasible connection from the Mid Wales Energy Parks, contained within three geographic ‘zones’. In each zone a potential ‘new substation’ location was identified based on either shortest route length and / or ability to avoid nationally designated sites. These were and is shown in Figure 5 below:

North Zone

- Trawsfynydd – Existing Substation
- Shrewsbury – Existing Substation
- Ironbridge – Existing Substation
- Lower Frankton – New Substation
- Chirk – New Substation
- Gwyddelwern – New substation proposed by National Grid.

East Zone

- Bishops Wood – Existing Substation

South Zone

- Carmarthen – New Substation
- Rhigos – Existing substation
- Rassau – Existing substation

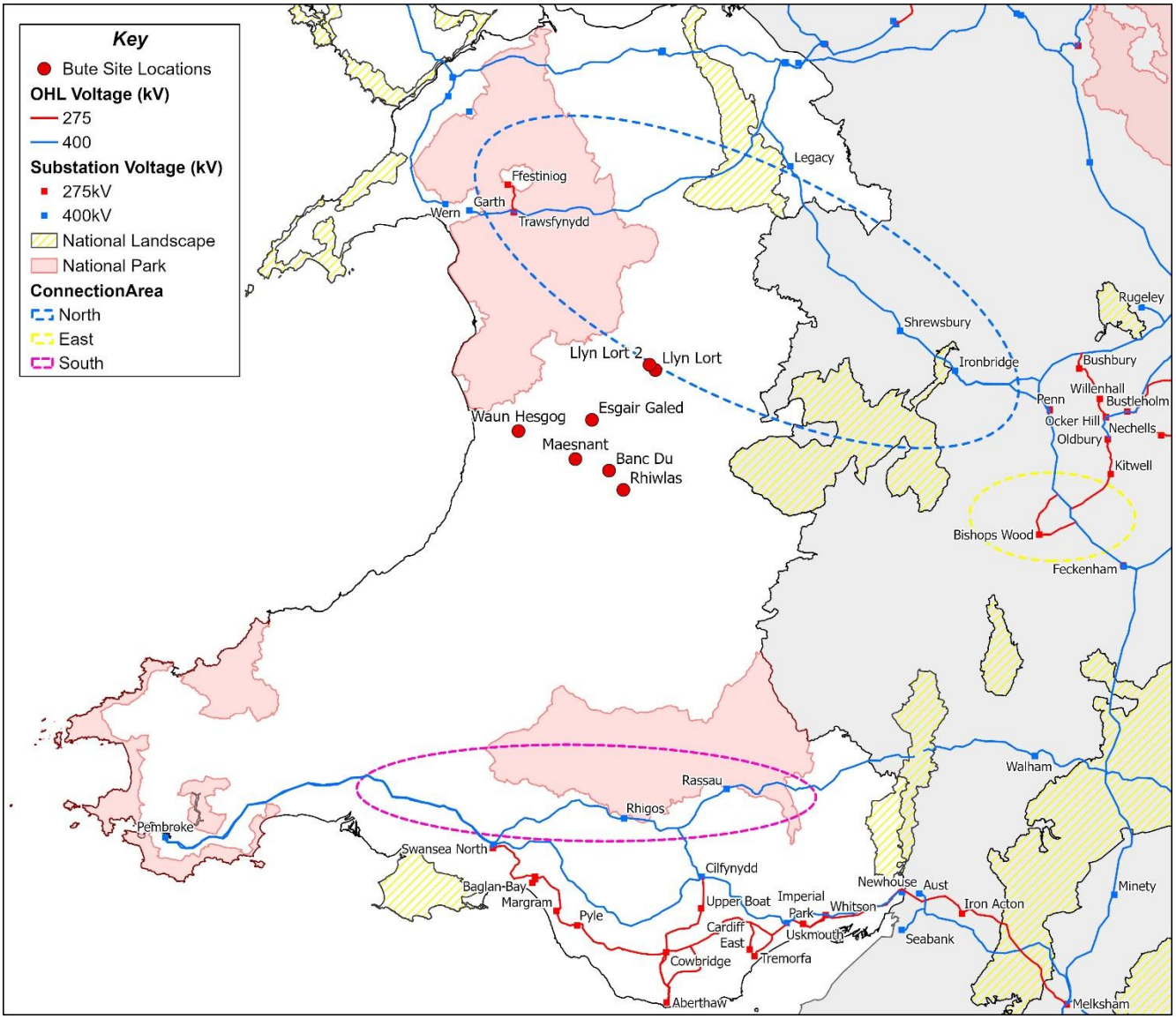

Figure 5 - The considered connection zones and nationally designated constraints

5.06. Employing the assessment criteria explained earlier within this document, we considered the implications of connecting the Energy Parks via single routes into each of the 10 connection options. We considered connecting into the existing NGET substations within each zone, and where appropriate, into potential new substations.

6. Assessment of Connections Options

Collector Substation

6.01. This part of the Grid Connection Strategy identifies options for a single collector substation for the Mid Wales Energy Parks, before providing a summary of the connection options to the wider Transmission Network. A review of those connection options is then provided with the identification of a preferred option.

6.02. Green GEN Cymru has considered the connection of the proposed Mid Wales Energy Parks from a central point in the Mid Wales Energy Parks cluster. In doing so, consideration has been given to the identification of an area for a collector substation.

6.03. A collector substation is required to 'collect' the generation from the Mid Wales Energy Parks and connect the combined generation to the strategic grid route to Lower Frankton. It would also provide opportunities for other generation to access the strategic grid route.

6.04. Two broad option areas for the Collector Substation were considered:

6.05. Broad Option 1 - in the general vicinity of the Mid Wales Energy Parks (excluding the area for the proposed Bute Llyn Lort Energy Park) and

6.06. Broad Option 2 - to the west of Newtown, Powys (in the vicinity of the junction of the A470 and the A489).

Environmental Designations and Policy Compliance

6.07. There are no SPAs, SACs or Ramsar sites which would potentially be affected, and the options are similar distances from the closest SSSIs.

6.08. Broad Option 2 is located in fewer LANDMAP aspect areas of 'high' overall evaluation, although it is within some aspect areas of 'outstanding' overall evaluation. There is however no overall preference in relation to LANDMAP. In terms of landscape character, the upland area (Broad Option 1) is relatively less sensitive though more exposed. The lowland location (Broad Option 2) is more sensitive due to smaller scale landscape, though more focused siting could benefit from more localised containment by vegetation. Broad Option1 is preferred as it is relatively less sensitive to this

development and there are siting options which could benefit from containment by local topography and woodland screening. Broad Option 1 is also located in relatively more remote upland near fewer settlements.

6.09. For cultural heritage Broad Option 2 has a greater likelihood of effects related to setting change to Scheduled Monuments and Conservation Areas and is within a Registered Historic Landscape (the Caersws Basin). Broad Option 1 is therefore preferred.

Summary of Connection Options

6.10. The following section begins with a table that summarises 10 potential options for electricity grid connection. These options are categorised into three geographical zones: the North Zone, the East Zone, and the South Zone. For each option, a brief description is provided to outline its key characteristics and initial considerations.

6.11. Subsequently, a summary is presented, evaluating each zone and its respective options against key factors. These factors include the presence of environmental designations, estimated costs, the required length of the grid connection, and the overall viability of the proposed connection point. This two-part approach aims to provide a comprehensive overview of the potential grid connection options and their suitability within the broader context of the project requirements.

6.12. For ease of reference, the report has complied a table below showing all 10 options with a description and the total distance from the connection point:

Option	Description	Total Distance
1 Trawsfynydd	Existing substation with undergrounding needed (c.50km) and a substation extension	c. 53km
2 Shrewsbury	Existing substation with an OHL routeing diversion needed (c.10km) and substation extension	c. 57 km
3 Ironbridge	Existing substation with an OHL routeing diversion needed (c.60km) and substation extension	c. 79km km
4 Lower Frankton	New substation with an OHL routeing diversion needed (c.5km)	c. 52 km
5 Chirk	OHL routeing needed and new substation needed	c. 55 km

6 Gwyddelwern	Undergrounding needed (c.2km) and substation extension	c. 52 km
7 Bishops Wood	OHL routeing including diversion (c.50 km) needed and substation extension	c. 138 km
8 Carmarthen	New substation with an OHL routeing diversion needed (c.5km)	c. 99 km
9 Rhigos	Existing substation with an OHL routeing diversion needed (c.95km) and substation extension	c. 123 km
10 Rassau	Existing substation with an OHL routeing diversion needed (c.95km) and substation extension	c. 181 km

Route Length and Disruption

6.13. The length of the route plays a critical role in determining the overall feasibility and cost-effectiveness of the connection. Longer routes not only incur higher costs but also involve greater interaction with landowners, and the potential for more extensive environmental disruption. Given the proposed location of the Mid Wales Energy Parks, any connection to the North or South zones would require significantly longer routes, resulting in higher electrical losses, more land usage, and increased disturbance to communities and the environment.

6.14. The connection to Lower Frankton represents the shortest and most direct route for the Energy Parks, reducing electrical losses and minimising the overall environmental and logistical impact. A shorter route also means reduced disruption to local communities, and lower costs related to infrastructure and construction. Given the lower length of the route, it is clear that the Lower Frankton connection stands out as the most efficient and cost-effective solution, both in terms of direct expenses and long-term operational benefits.

IDNO Licensing Requirements

6.15. As an Independent Distribution Network Operator (IDNO), the Mid Wales Energy Parks are subject to specific regulatory conditions that must be met in order to ensure the safe and efficient operation of the distribution network. One of the key obligations for an IDNO is to ensure that the energy supply is connected to the national grid in a way that is both efficient, in line with industry standards and is the most cost effective to the consumer and public.

6.16. The choice of Lower Frankton as the connection point aligns with the conditions of the IDNO licence, which requires that energy connections meet certain technical and operational standards. The connection to Lower Frankton offers a straightforward, reliable, and compliant solution that satisfies these regulatory requirements. Given that National Grid has already planned infrastructure in the area, this connection point provides a compliant and streamlined process for the Energy Parks to connect to the grid, ensuring full regulatory adherence.

Connection Option review

Summary of options within the North Zone

6.17. The options within the North Zone offer a variety of connections at mostly similar point-to-point route lengths. The shortest direct point-to-point total length would be a connection from the Mid Wales to Lower Frankton or Gwyddelwern, whilst the longest distance would be a connection to Ironbridge substation.

6.18. A new connection from the Energy Parks to Ironbridge substation would be considerably longer in distance than other available options. Longer routes would lead to additional interaction with environmental receptors, cost, increased disruption and higher electrical losses.

6.19. A connection to Ironbridge substation would also need to pass through, or divert around, the Shropshire Hills National Landscape. These interactions could lead to increased environmental impacts and the associated material planning and consenting risks, as well as additional costs associated with mitigation measures that are likely to be required.

6.20. In view of these factors, a possible new connection between the Mid Wales Energy Parks and Ironbridge should be discounted.

6.21. Whist a direct route to Trawsfyndd would offer a shorter and more direct connection route than other options, a connection would have to pass through the Eryri National Park as it is unavoidable. If this option was to be progressed, we would expect that a significant portion of the route would be undergrounded. In addition to the significant financial costs associated with undergrounding, this would also lead to substantial disruption within the Eryri National Park, impacting on local communities, visitors to the National Park, as well as the environment and its scenic beauty.

6.22. For these reasons and given the availability of other options with lesser impacts on the National Park, this option should be discounted.

6.23. Although a connection route to Shrewsbury would not have to pass through the Shropshire Hills National Landscape it would be in proximity and could potentially impact on its setting. This interaction could lead to effects on the special qualities of the National Landscape and the associated material planning and consenting risks, as well as additional costs associated with mitigation measures that are likely to be required. Routeing would however have to consider the effects on the proximity to Shrewsbury itself. As the existing substation is unlikely to be able to accommodate the required equipment a new substation would be required at additional cost. Given the availability of other options at similar cost this option has been discounted.

6.24. A connection to a new substation at Lower Frankton would be within or in proximity to any designated landscapes and therefore would not affect the settings. It is one of the shorter options and although not the least cost the potential for significant environmental effects is less than for other options. 48

6.25. A direct connection to a new Chirk substation could avoid passing through the Clwydian Range and Dee Valley National Landscape however it would be in very close proximity and could impact on its setting and special qualities. A direct connection would also have potential effects on the Pontcysyllte Aqueduct and Canal World Heritage Site and Scheduled Monument. These interactions and the associated material planning and consenting risks mean this option has been discounted.

6.26. In 2024, The Welsh Government and Natural Resources Wales identified a Candidate Area for a new National Park in North-East Wales. Currently approximately 6km of the Project located within this Candidate Area of the new National Park. Green Gen Cymru are closely monitoring the review of the New National Park and will consider changes required to the grid connection strategy. A direct route to the new Gwyddelwern substation would interact with the Berwyn SPA, SSSI and National Nature Reserve and the Berwyn and South Clywd Mountains SAC and would pass close to the western boundary of the Clwydian Range and Dee Valley National Landscape. Although this option is the least cost the material planning and

consenting risks associated with passing through the SACs mean that we have discounted this option.

Summary of options within the East Zone

6.27. A route to the existing Bishops Wood 275kV substation would be longer than options in the North Zone. In addition, a connection to Bishops Wood would need to pass through, or diverted around, the south of the Shropshire Hills National Landscape. These interactions could lead to increased environmental impacts and the associated material planning and consenting risks, as well as additional costs associated with the mitigation measures that are likely to be required. In view of these factors, a possible new connection between the Mid Wales Energy Parks and Bishops Wood should be discounted.

Summary of options within the South Zone

6.28. All of the connection options within the South Zone would require more than 80 km of connection circuits. There is therefore a significant distance between the proposed Mid Wales Energy Parks and all South Zone options in comparison with a number of the connection points in the northern zone.

6.29. Two of the three options within the South Zone could have significant interactions with the Bannau Brycheiniog National Park. A direct connection would also have to pass through SPAs and SACs, which are unavoidable. These interactions would likely lead to increased environmental impacts and the associated material planning and consenting risks, as well as additional costs associated with avoidance and compensatory measures that would be required.

6.30. The longer anticipated routes to connection options in the South Zone would lead to additional cost, interaction with more land and environmental receptors, increased disruption and higher electrical losses.

6.31. It is therefore considered that options within the South Zone should be discounted from further consideration.

Summary and Preferred Option

6.32. After considering each of the factors associated with the options, in particular noting the greater length of the circuits on the East and South Zones (leading to greater electrical losses, higher costs and potentially increased environmental effects), and the environmental

considerations for options in the North Zone, Option 4 (Lower Frankton – New substation) has been selected as the preferred grid connection option for the Mid Wales Energy Parks. That preferred grid connection option would commence from the Broad Option 1 Collector Substation location.

6.33. Although not the least cost option, following our appraisal of the options, this was considered, on balance, to present the best performing option, having regard to environmental considerations and the need to deliver an economic and efficient solution to connect Bute Energy's Mid Wales Energy Parks to the Transmission Network. This option would ensure compliance with the licence obligations that Green GEN Cymru would be subject to as a prospective IDNO Licence holder. Option 4 will be taken forward for further consideration through further, more detailed routeing studies.

7. Next Steps

7.01. Following the selection of Option 4 (Lower Frankton – new substation), and the area of Broad Option 1 for the collector substation, the Project has significantly developed through considerations from scoping and subsequent public and stakeholder consultation. Please visit the Project's website, www.greengenvyrnwyfrankton.com for updates on the development of the Project.

7.02. Throughout the continued development of the project, Green GEN Cymru will continue to back-check the analysis and assumptions within this report and will review items that could affect the analysis. This includes, technology developments, cost updates and changes based on consultation with key stakeholders such as local residents, the UK and Welsh Governments, statutory bodies and National Grid. We welcome comments in relation to the content, review and analysis included within this document. These will be taken into account as part of the ongoing development of the project.