Independent Advisory Group on Future Electricity Grid for Wales

Recommendations and report

January 2026

Foreword

Wales is entering a decisive period for its electricity networks. As we plan for a secure, affordable, and decarbonised energy future, we will inevitably make choices that bring both benefits and impacts for people and places. The Welsh Government convened this Independent Advisory Group to examine the evidence and surface practical principles that can guide those choices in a distinctly Welsh context, recognising devolved planning responsibilities and the wider GB-level system in which our networks operate.

From our first meeting in summer 2024, the Group brought together a deliberately diverse range of expertise and lived perspectives: network engineering and regulation, environment and biodiversity, the rural economy and land management, community interests, socio-economics and the Well-being of Future Generations framework. Members served in a personal capacity and gave their time voluntarily. I am deeply grateful for that commitment and for the constructive spirit that characterised our work.

A word on consensus. This was, by design, a large, varied group. We agreed on most points and, where we did, you will see clear recommendations intended to unlock better engagement, fuller evidence, and swifter, more confident decisions. But we also had areas of honest disagreement. In particular, members expressed a range of views on how planning policy could or should be enhanced and how best to frame viability when balancing costs with social, environmental and landscape impacts. Where common ground was not possible, we have been transparent about that in our report and focused our advice on the steps that will most usefully improve evidence, clarity and trust.

None of this diminishes the positive case for grid investment. Strengthening and extending the network is essential for energy security, resilience, economic opportunity and progress towards net zero. The risk of not acting, and of not acting in time, is substantial. But in Wales, how we act matters too. The choices we make should reflect not only engineering necessity and financial prudence, but also our legal duties, our consideration for the wellbeing of future generations, and our societal ambitions for the places we cherish.

Finally, my thanks. To Group members for their expertise, candour and patience; to the many organisations and individuals who shared evidence and experience with us; and to the Welsh Government officials who provided the secretariat and coordinated the collation of material for wider publication. This report is a testament to what can be achieved when different voices work together with respect and purpose - even, and perhaps especially, when they do not agree on everything.

I offer this foreword in the spirit in which the Group worked: open-minded, evidence-led and focused on practical steps that will help Wales deliver the grid we need in a way that the public can understand and support. Diolch yn fawr.

Professor Hywel Thomas
Chair of Independent Advisory Group on Future Electricity Grid for Wales

Report and recommendations of the Independent Advisory Group on Future Electricity Grid for Wales

1. Introduction

1.1 In 2023 Welsh Government published a study that provided the evidence base for future need for electricity, and therefore for new electricity networks. The Future Energy Grids for Wales[1] report was clear on the need to invest in our electricity networks. Work on local, regional and national energy planning is designed to provide much more clarity on exactly where and when these new networks will be needed.

1.2 New electricity networks will bring both benefits and impacts. There has been relatively little new network construction since devolution, but the scale and potential impact of rewiring the country for a future using our own renewable resources to meet increased demand means we need more detailed policy on how decarbonisation of energy supply and use is delivered. The Welsh Government committed to working with representatives of all sectors and regions of Wales to develop a set of principles to inform future grid development.

1.3 It is important to set the work of the Independent Advisory Group in the context of Welsh legislation and policy and Welsh Government responsibility, noting those areas reserved to UK Government, where Welsh Government works with UK Government to ensure the views of Wales are represented.

1.4 The overarching electricity network system, and the mechanisms that fund it, are reserved matters for UK Government. UK Government regulates the electricity system under the Electricity Act (1989), and regulation is implemented by the independent economic regulator, Ofgem. UK Government has established the new National Energy System Operator (NESO) to operate the Great British energy system and provide a pathway for the system to move to a resilient low carbon system.

1.5 Planning decisions relating to new network lines up to 132kV sit within the devolved responsibilities of the Welsh Government under the Town and Country Planning Act (1990). Decisions on higher voltage lines are reserved to UK Government.

1.6 Welsh Government has already stated its position that new grid must be efficiently and sensitively designed to minimise impact and maximise the value it delivers.[2] Planning Policy Wales is the principal policy for guiding new infrastructure proposals in Wales

[1] Future Energy Grids for Wales

[2] The Independent Advisory Group note that the topic of appropriate grid solutions for Wales is an area subject to political debate and the commissioning of the Independent Advisory Group itself is a part of evidence gathering in support of greater insight into the most appropriate policy positions.

and National Planning Policy[3] states the Welsh Government's preferred position is that new power lines should be underground where possible and where that is not possible or applicable, it expects public engagement to mitigate their impact.

1.7 Alongside the devolved planning responsibilities, Wales has a unique piece of legislation in The Well-Being of Future Generations Act (2015). Under this legislation Welsh Government Ministers and public bodies in Wales have a key role in enabling infrastructure, and also in ensuring that approved infrastructure maximises its contribution to seven well-being goals[4] as defined in the Act, realising wider social, cultural, economic and environmental benefits.

1.8 This policy context in Wales places importance on sustainability and resilience. It sets the principle that decision-making must consider the whole life costs, impacts and benefits. Under these principles, cost should not be the sole or primary consideration for development in Wales; overall contribution to improving well-being should be a fundamental consideration too. There is an expectation that developers and other organisations deliver projects in Wales understand this different legal and policy context.

1.9 Local stakeholders, including community groups and politicians, have raised concerns with Welsh Government through many channels that undergrounding is not being considered fully as an option by developers. They feel there are not adequate benefits and mitigations for communities and businesses that would be subject to the infrastructure being built near / on their land. The potential impact of overhead lines on the countryside is a very significant concern amongst those living, working, visiting and holidaying there, particularly in relation to visual impact and the related impacts on the environment, visual amenities, the rural economy and the wellbeing of residents.

1.10 The purpose of the Independent Advisory Group, set out in the Terms of Reference[5], was to build an understanding of the possible approaches to delivering electricity infrastructure, to create a public evidence base, and to produce a set of agreed principles for determining the most appropriate solutions for Wales.

1.11 In response to the public concerns being raised, the group's work included a focus on considering the capabilities and limitations of undergrounding of electricity grid, and the impacts from both underground cables and overhead lines.

1.12 Members of the Independent Advisory Group were invited to take part either due to their specific knowledge and expertise, such as academic and practical expertise in electricity networks; or they were nominated by key expert stakeholder organisations, for example, representative of the environmental sector, or of landowner or community interests. The group also included members who could provide expertise on the Wellbeing of Future Generations Act[6] (WFGA) and regional economic impact. Meetings were chaired by an independent chair, with secretariat provided by Welsh Government officials. All group members have given their time and expertise to the group on a voluntary basis. The group was convened with a membership[7] that could assess the

[3] National Planning Policy
[4] The Well-being of Future Generations | GOV.WALES
[5] Terms of Reference
[6] Well-being of future generations act: the essentials | GOV.WALES
[7] membership

questions communities and the public more broadly have about how new grid proposals are designed and delivered. Members have contributed as individuals and reflecting their specialist or sectoral knowledge, though not necessarily as a representative of their organisation.

1.13 The work of the group in making recommendations is an important step in identifying the considerations needed in the Welsh legal and policy context and will be considered with regard to the landscape of devolved and reserved responsibilities.

2. Overview of the Work Undertaken

2.1 The group formed in June 2024 and have met regularly to consider the high-level challenges and opportunities related to the future electricity grid in Wales. Experts have been invited to deliver presentations to the group from a wide range of viewpoints including the system regulator, environmental experts, community group representation, and network engineers. The group is appreciative of the contributions received and suggestions of further contacts and work that could be pursued. The group acknowledges that many more people and organisations would have welcomed the opportunity to present information to the work of the group, had time and resources allowed.

2.2 The group has undertaken further research to gather existing evidence relevant to the work, and speakers, community groups and network companies have provided additional information and signposting to useful relevant resources. To use members' time to the best advantage, the Independent Advisory Group formed sub-groups to look into key areas including technical capability, costs and the impacts of electricity grid infrastructure.

2.3 The group has been looking at principles and were explicitly not considering particular current or future developments. At the time of drafting this report, proposed transmission and distribution grid project plans from network operators are in development (T3[8] and ED3[9]) and have not had regulatory approval through the Ofgem RIIO[10] framework as yet. There remains significant uncertainty around which proposals may be taken forward and the group have therefore kept any specific project consideration outside of the remit and scope for the group. There is also even greater uncertainty around the network infrastructure which might be identified as required in future planning periods subsequent to T3 and ED3. The group did receive responses that referenced current or past projects, which provided helpful insights that informed the group's work.

2.4 The group identified a large number and variety of topics they consider directly relevant to this area of the review. The group focused their research on the impacts of overhead and underground lines, the costs of different infrastructure, and the technical challenges for infrastructure.

2.5 Despite recognising the importance of several research areas, the group was unable to commission new work or comprehensively review all topics of interest within the time and resources available. As a result, some areas were only briefly explored, and further investigation is recommended to strengthen the evidence base and inform future public discourse.

2.6 This report provides a narrative of the key findings and recommendations from the Independent Advisory Group.

[8] Homepage | RIIO-T3

[9] Framework decision: electricity distribution price control (ED3) | Ofgem

[10] What is RIIO? - SP Energy Networks

2.7 The work of this group and its findings are of great interest in Wales and beyond, particularly in the current political debate on grid expansion. Information provided to the group not in the public domain or not written for publication requires the consent of the contributor to be included in the public evidence base. Officials are working with those who have submitted evidence to develop and publish information that further contributes to the evidence base. An overview of the subject areas considered by the group can be found at Annex 1.

3. Recommendations

3.1 While presented as individually considering different aspects of the electricity network development planning and implementation process, the following recommendations have been generated with the overarching aim of promoting greater understanding, collaboration and engagement between involved stakeholders, and improving the evidence base to support the identified need to accelerate the pace to achieve net zero, while at the same time ensuring that the full range of challenges considered in the decision-making process are clearly communicated to engaged stakeholders to enhance their understanding and ideally obtain their buy-in.

Recommendation 1

The Welsh Government should consider how the people and businesses of Wales are prepared for the upcoming changes to the grid needed fora clean 21st century energy system, and what role the Welsh Government takes in supporting this.

The group recommend that Welsh Government should have an informative and supportive engagement and communication plan, to lead, engage and inform people throughout the period of significant infrastructure change. This will sit alongside other communication and engagement strategies across Great Britain from bodies such as UK Government and the National Energy System Operator.

The group feel it is key to raise awareness of, and keep focus on, the need for and importance of these infrastructure changes in Wales. The benefits of making changes should be articulated clearly within dialogues, including benefits to energy security and the benefits of decarbonisation to mitigate the impacts of climate change for future generations.

Consideration to ensuring that appropriate assistance is in place for those who may find the prospect of grid infrastructure expansion particularly challenging or impactful is important in this work. Clear information about compensation, community benefits or other schemes for those affected by changes should be a part of an engagement and communication plan, though any compensation should not be a substitute for well-designed and well-considered schemes.

Recommendation 2

The Welsh Government should support public discussions by promoting or commissioning easy-to-understand factual information about electricity transmission and distribution[11] grid infrastructure, and ensuring it is available and promoted in ways that will maximise the reach to the public.

[11] Energy Networks Explained – the Energy Networks Association provides insight into what is meant by transmission and distribution networks, as referred to throughout this report.

This includes explaining the technical capacities of different components and of different design options, and the technical strengths and limitations of these components and options in a non-technical way.

Recommendation 3

The Welsh Government should support public engagement by promoting or commissioning a clear overview of the processes involved in major infrastructure projects, from the proposal and funding stages through development and consenting, including when planning consent is not required, to completion and operation. This will support public understanding of the timeframes that can be expected for each phase of development, the parties involved, and, crucially, the points at which stakeholders and the public can directly feed into proposals.

The oversight of the timeframes for the process could also be used to identify where efficiencies may be gained in the processes. This would support reducing grid infrastructure delivery timeframes to meet decarbonisation targets, aligning with recommendations from the Winser report[12].

Recommendation 4

Working with other GB-wide organisations, the Welsh Government should commission one or more reports or studies providing high-level cost and technical characteristics comparisons for transmission and distribution-level infrastructure.

While there are existing 400kV studies and reports, there is no comparable information for other voltages and the group recognises that there would be significant value in this on a GB-wide basis, particularly in consideration that much of the projected need for infrastructure development in Wales will be within the distribution network.

The group also recommend such a report or studies should include environmental and other impact considerations, as well as consideration of specific application techniques such as cable or mole ploughing or horizontal directional drilling, of how smaller scale projects can interact with the system effectively, and of non-network-build options as viable alternatives.

Recommendation 5

The Welsh Government should collaborate with network companies and innovation programmes to enable cable ploughing to be considered as one of the options for specific routes once they are proposed. This would build on existing knowledge of this technique seen by the Independent Advisory Group. It would also help to develop and share understanding of the costs, impacts, suitability, and limitations of this technique across different voltage levels and landscapes within Great Britain.

[12] Accelerating electricity transmission network deployment: Electricity Networks Commissioner's recommendations - GOV.UK

Recommendation 6a

The group recommends that Welsh Government reviews the Welsh policy approach in respect of grid infrastructure projects. This review should identify areas where policy can be enhanced to be both supportive and directive of promoting visible, cohesive, and effective decision-making in this area. Enhancements may be considered within, but not limited to, Planning Policy Wales and Energy policies, and should be supported by planning department practices.

Key themes and context for potential policy enhancements are included in Section 9 of the report

Recommendation 6b

As part of the policy review, the group proposes that Welsh Government considers the design and implementation of a structured framework and guidance to support the review of key aspects of infrastructure planning and consenting applications.

The following non-exhaustive points are suggested for consideration within such a framework:

- Ensuring transparency of economic costs and financial viability, particularly where undergrounding has not been proposed for new network projects.
- Requiring developers to demonstrate that proposals have been developed collaboratively and designed holistically, with due consideration of national strategic plans, energy plans for Wales, and nature recovery plans.
- Ensuring the full range of costs, impacts, and benefits have been transparently considered in the development process.
- Making life-time costs, impacts (environmental, including landscape, social, cultural, and economic), and benefits visible, substantiated, and available for consideration by stakeholders and decision makers.

Recommendation 7

The Welsh Government should work with stakeholders to help identify and address gaps in the evidence used to assess impacts from grid infrastructure – including, but not limited to, social and cultural, environmental and economic impacts.

As potential gaps are identified, research should be compiled or commissioned to expand the evidence base, with a view to ensuring planning decisions on infrastructure proposals are made having fully considered the wide spectrum of potential impacts across installation, operation and decommissioning of infrastructure, including cumulative impact across policy areas, as well as emerging requirements and techniques.

The group's work to date has identified the following areas that could be prioritised for filling evidence gaps, noting that the lists of specific topics are non-exhaustive:

Environmental impact areas:

- Nature recovery
- Avian population threat to certain species and appropriate mitigations, including sourcing comprehensive bird electrocution data for Wales and the efficacy of current measures to deter wildlife collision with infrastructure.
- Cumulative impacts of renewable energy transition on the visual and character attributes of landscapes
- Soil and soil habitat impact, including the impact from heat generated by underground cables, the impact of access roads over peat, and evidence that cable ploughing has a reduced environmental impact over traditional undergrounding methods.
- Impact from chemical compounds used in electrical infrastructure, should these be accidentally released into the environment, for example oil-based operating fluids from underground cables, sulphur hexafluoride from switchgear equipment.
- The carbon footprint for each technology and method of delivery of infrastructure for conveying electricity

Social Impact areas:

- Health – physical and wellbeing
- Housing
- Community cohesion

Cultural impact areas:

- Building a greater understanding of potential for impacts on culture from infrastructure developments

Economic impact areas:

- Tourism and visitor revenue facing industries and tourists.
- Farming
- Insight and overview of compensations and benefits to be expected from project development

Policy impact and integration areas:

- Cumulative impact on farmers and landowners from the current and proposed policy landscape
- How infrastructure enables and impacts the wellbeing goals of the Wellbeing of Future Generations Act.
- The role of networks in respect of Welsh Government policy ambitions in other areas – for example Net Zero, Economic growth, Connected communities.

Key findings

4. Engagement and Communication

4.1 The anticipated scale and speed of changes needed to prepare the grid for future demand are unprecedented and broad public acceptance will be essential for successful delivery of infrastructure that meets future needs. The group judged that helping people understand and engage with the societal need for this change would require a concerted communication and engagement effort similar in scale and resource to that deployed during Covid.

4.2 Research is clear that good communication is fundamental to gaining understanding and acceptance of change, but in isolation will never be sufficient. Good listening and involvement of communities must also be a crucial part of the process so that the engagement is two-way. Any unquestioning acceptance of change is replaced in modern society with different degrees of conditional support for projects, alongside a genuine desire to know and understand more, and to be involved in making informed choices that can, wherever possible, also address key local concerns.

4.3 Designing new networks is difficult and complex. With little new electricity infrastructure development having been progressed onshore in the UK since privatisation took place in the 1990s, there is a limited amount of information available about how the process of network design is carried out and what the network companies consider in their design process when looking for final, proposed solutions, both at a general level and a project specific level.

4.4 Communities that would be directly impacted by existing proposals to develop the grid network in Wales have expressed a strong desire to understand the proposals to update and improve the grid network in Wales. They ask for information about what options have been considered and discounted, and expect answers to why proposals have chosen that specific location and route and what influenced the design choices on the type of connection and equipment.

4.5 People also want to have meaningful engagement at an early stage of development of schemes and to see clearly where their voices are being heard and acted on in relation to approaches to projects. The feeling that people have, that decisions are already made by the time they are consulted on, is proving counter-productive for accelerating projects and can result in delays through legal challenges. Involvement is one of the five ways of working under the Well-being of Future Generations Act. Transparent, supportive, and respectful listening and engagement that supports learning by all parties involved is key.

4.6 While there is a wealth of information resource in the public domain relating to electricity grid planning and infrastructure, the group has found that much of it is highly technical and might be difficult for the wider public to use.

4.7 Providing general educational information for a lay audience about the grid will be helpful both in the general public discussion on grid upgrades and in supporting project specific consultations, when they are opened. The group sees that government should have a clear leadership role in this, linking with work underway in this area as appropriate.

4.8 The group noted that information is also largely available on online platforms and consideration of having information that is convenient and accessible to all people in Wales is important. Some people may find leaflets and posters easier, while other people may find online information through websites, email and social media easier. Within Wales, the availability of bilingual resources will also be important.

Related recommendations: 1, 2 and 3

5. Impacts

5.1 Major infrastructure projects have many impacts on the environment, habitats and species, business, economy, property, tourism, culture, wellbeing, and landscape, and have implications for the options open to future generations. Networks in particular can have widespread impacts where they extend across long stretches of the country. These impacts can be positive and negative, short-term and long-term, requiring careful consideration and planning.

5.2 Strengthening, extending and expanding the network has many positive impacts, including security of supply and resilience; protection from energy price shocks; economic resilience and expansion; protecting existing jobs and creating new opportunities; business diversification through better connections; and providing landowners with rental for hosting infrastructure. The risks associated with not making these network changes and not reaching net zero are not generally contested. Drivers of change, such as the climate crisis and the decarbonisation of business and industry, are crucial for protecting economic investment and fostering economic growth. The need to ensure a sufficient and resilient supply to meet all demands is well evidenced through a growing number of reports, including, for example, Welsh Government's Future Energy Grids for Wales[13], and the National Energy System Operator's Beyond 2030 report[14].

5.3 However, concerns are being raised regarding the impacts of different technical approaches to infrastructure choices. New pylons with overhead lines in rural areas are seen by local communities as having significant negative impacts, while support for undergrounding, particularly cable ploughing, as an alternative in rural areas appears to be widespread. The group noted that electricity network circuits are generally undergrounded in towns and cities as standard, due to technical and safety requirements in built-up areas, and network expansion appears to be less contentious in these areas.

5.4 The Wellbeing of Future Generations (Wales) Act[15] is a critical piece of legislation, unique to Wales's political context. The Act is about improving the social, economic, environmental and cultural well-being of Wales. The Act gives a legally-binding common purpose – the seven well-being goals – for national government, local government, local health boards and other specified public bodies. It details the ways in which specified public bodies must work and work together to improve the well-being of Wales. The group felt that the Act is an important consideration in the planning and building of infrastructure in Wales now that will impact people for years to come. While grid companies are required to meet regulatory requirements, they are not bound to the principles of the Act as Welsh public bodies are. The group felt that using the principles alongside the requirements of the regulator within discussions around planning for the future needs of Wales would result in better decisions, as the scale of change and potential impact must balance the goals of prosperity, resilience, health, equality, cohesive communities, vibrant culture and global responsibility.

[13] Future energy grids for Wales: reports | GOV.WALES
[14] Beyond 2030 | National Energy System Operator
[15] Wellbeing of Future Generations Act

5.5 Correspondence received by the group from community groups raises concerns around how individuals living in or regularly visiting areas with current infrastructure proposals are coping in the face of these potential changes. Communities express anxiety and even depression about the proposals, feelings of helplessness, and raise the need for respectful engagement and for understanding of why proposals impacting them are being put forward.

5.6 Communities also express concern that while they are being asked to host infrastructure, they do not directly benefit from the infrastructure. They raise concerns over extraction of resources to the detriment of locals for the benefit of those elsewhere, often across borders. This narrative is a reflection of the experiences of other communities in Wales affected by coal mining and mine closure or affected by historic reservoir projects.

5.7 Communities are concerned that the value of compensation cannot address the impact and changes to daily lives of those affected. Compensation is not aligned with the negative effects to the value of land and houses, and the potential loss of earnings due to land loss for farming or impact on tourist trade.

5.8 Visual impact in rural areas is a concern, not only for residents but also for visitors and for tourism, which is a major source of revenue generation across rural Wales. The installation of all types of infrastructure, overhead and underground, has the potential to impose visual impact throughout rural areas during construction. Although no measurable data has been identified to date about the impact of new infrastructure on tourism and visitor revenue once installed, the presence of pylons will create an obviously changed visual environment for the future and tourism businesses believe the impact on them could be significant.

5.9 The farming sector in rural Wales is also significantly affected by infrastructure projects. Representations from the National Farmers Union, the Farmers Union of Wales, the Countryside Alliance, and from landowners, all state strong opposition to new pylons, preferring underground networks. Landowners believe trenchless technologies like cable ploughing reduce land use, corridor width, and long-term business impacts. Key concerns for these stakeholders include future land use, appropriate and full compensations, impacts on business diversification, and impact on property values after installation of overhead or underground lines. These issues add to the already complex policy environment for farmers.

5.10 Community representations express the belief that progress towards net zero can be achieved without the negative impacts they associate with overhead lines. They support appropriate grid development delivered in ways that minimise harm, speed up consent and delivery, and maintain public backing. Submissions urge Government and industry not to see progress and adverse impacts as an either/or choice, but to find solutions that enable both rapid progress and reduced negative effects, avoiding unnecessary conflict and delays.

5.11 The group considered that it was important to continue to thoroughly consider the environmental impacts of new grid, which can be far reaching. The group also recognised the importance of local knowledge in identifying specific species or habitats that need particular protections in the planning process. This is done as a mandatory part of the planning process, in line with the Environment Act[1617]. However, it is not always evident to interested parties how potential environmental impacts influenced design decisions, either through avoiding areas completely, or by implementing mitigation measures by minimising impact, or restoring areas impacted during construction, or compensating for impacted areas, in line with planning policy frameworks.

5.12 The group identified widely held views that underground cables facilitated by, for example, cable ploughing are better for the environment. However, evidence indicated that for wildlife and habitats, the location of the project is critical to determining whether an overhead line or underground line is appropriate, if appropriate at all.

5.13 For example, the temperature of cables in soil could negatively impact vulnerable and rare plant and fungi species, where such species are located. Conversely, overhead lines can negatively impact bird life as certain groups of birds, particularly raptors and wetland birds, are at risk of collision and electrocution from pylons. This issue poses a significant conservation challenge across Europe to certain species such as storks, cranes, geese, swans and many raptor species, particularly in locations that are important to the conservation of these species.

5.14 Both approaches to infrastructure installation and its ongoing management require removal of trees along the route to remove risks, from tree branches and fallen trees on overhead lines or from tree roots impacting underground cables, and need long term management and maintenance of trees in proximity to infrastructure.

5.15 There are techniques available to mitigate impacts on biodiversity and even create corridors for flora, insects and small mammals, for instance through Integrated Vegetation Management. However, in some locations it may be better environmentally to deploy underground cables, while in others, it may be better to deploy overhead lines. Impacts need to be considered on a project specific basis and careful routing must consider all these factors.

5.16 Consideration of project impacts is part of the planning permission process, but the group found it challenging to quantify these impacts compared to monetary costs. The recent IET report[18], 'A comparison of electricity transmission technologies: Costs and characteristics' by Mott MacDonald, separates costs and non-cost characteristics as distinct project threads. From a project management perspective, costs must be met, while impacts should be mitigated. Although mitigation incurs monetary costs, it does not assign a direct value to impacts, such as loss of habitat or reduced visual amenities.

[16] Environment Act 2021

[17] Environment (Wales) Act 2016: factsheets | GOV.WALES

[18] https://www.theiet.org/impact-society/sustainability-and-climate-change/iet-electricity-transmission-technologies-report

With the limited time available to the advisory group, it has not considered in detail how Planning and Environment Decisions Wales (PEDW) and planning departments balance these factors in decision-making, but feel greater transparency would be beneficial. The group recommends Welsh Government explores in more depth how to better provide evidence of and present the costs of impacts when decisions are made.

Related recommendations: 1,4,6 and 7

6. Strategic planning and decision making

6.1 The pathways for making strategic decisions are complex and vary depending upon the size and scope of each individual project, including a blend of devolved (Welsh Government responsibility) and reserved powers (UK Government responsibility).

- Welsh Government planning powers include consents for electricity grid at 132kV and below. This makes up the majority of electricity grid infrastructure in the country. Guidance on making these decisions is set out in Planning Policy Wales.
- Electricity system decisions relating to higher voltage circuit consents are reserved to UK Government. Guidance on these is set out in UK National Policy Statements. In these areas, Welsh Government works with UK Government to ensure the views of Wales are represented.
- Matters relating to strategic spatial planning for the energy systems of Great Britain are the responsibility of the National Energy System Operator. The regulatory system through which our networks are run and paid for sits with Ofgem. Welsh Government works with these organisations to ensure the views of Wales are represented.

6.2 With the scale of the upgrades needed to our electricity system, planning the network strategically is a vital component of this work. Having a robust, resilient and optimised system will be key. Welsh Government has already established the position that we should be planning for the minimum necessary new grid to achieve net zero, to contribute to the least cost system. All parties with an interest in the grid should plan grid development with consideration for long term system need and resilience, beyond the current round of strategic investment. This would ensure works undertaken now are not superseded later or require additional lines to be installed as potential capacity needs were not considered early enough.

6.3 The group observed that a large amount of work has begun on strategic planning at GB level, which will support identification of connection needs.

- Future energy grid planning started with the Holistic Network Design (HND)[19], and is building through the Centralised Strategic Network Plan (CSNP), of which Beyond2030 and Clean Power 2030[20] are parts.
- Welsh Government sits on the Strategic Spatial Energy Plan (SSEP) committee, where work is taking place to identify those areas across Great Britain which are best suited as locations for different types of energy generation and storage.
- Welsh Government has supported local authorities in Wales to develop Local Area Energy Plans (LAEPs) to collate information about future energy demand and need. These will feed into the transitional Regional Energy Strategic Plan (tRESP) and later the full Regional Energy Strategic Plan (RESP) for Wales.

6.4 Officials engage regularly with colleagues in UK Government, Ofgem and the National Energy System Operator in these areas of work, to ensure Welsh interests are not overlooked in the central processes. The collective spatial plans for generation and

[19] A Holistic Network Design for Offshore Wind | National Energy System Operator
[20] Clean Power 2030 | National Energy System Operator

storage, energy demands, and the related connecting grid will provide an overview of the strategic needs of the full transitioning energy system to meet Net Zero targets.

6.5 Before designing technical grid infrastructure solutions, network designers must establish the need for a connection, considering all the different purposes driving the connection need. Once the need for a connection is established, designers must identify the most appropriate route and point of connection to the existing network. The group considers it important that the principles of strategic planning apply directly to the implementation of individual grid project plans across Wales. It considers that the strategic need and location of proposed grid infrastructure is a core consideration in planning decisions and developers should continue to be required to fit with wider strategic grid plans, with projects clearly demonstrating how they fit with strategic plans, evidenced through the planning process.

6.6 Infrastructure project planning is a lengthy process, with many optioneering steps taken before a final solution goes out to consultation. The early considerations in project development are carried out by experts in network companies, or the system operator for new strategic plans. This is crucial to ensure that the technical solutions proposed are feasible and align with industry standards. Increasing the public awareness and understanding of the complexity of network design and planning processes, looking to engage with the public during the project process and providing clear guidance on the most effective opportunities to input to a scheme, will help in the conversation around the infrastructure needed to grow, strengthen and decarbonise our grid system.

Related recommendations: 3 and 6

7. Technical capabilities

7.1 Welsh Government Planning Policy states that, wherever possible, undergrounding of new infrastructure should be the default approach. Accordingly, the group spent a large proportion of their time considering the technical implications of installing underground cable circuits as opposed to overhead lines.

7.2 A key part of the advisory group's work has been to build an understanding of the technical capacities and limitations of the electricity grid. This included considering the feasibility of using underground lines at various voltages, the methods by which undergrounding can be achieved, and the information available to the public regarding the technical implications of both underground cable and overhead line circuits.

7.3 People who are impacted by proposed developments expect developers to provide clear and detailed information about the infrastructure. They confirm they want to know:

- why a project is being proposed,
- why in a particular area,
- why a particular technology,
- what alternatives have been considered,
- how will it affect local communities and businesses,
- what can they expect from it,
- what impacts will they see, and
- what benefits or what compensation should they get.

The answers to all these questions do not lie with one party. Technical, planning and environmental impacts are reviewed separately from compensation to impacted parties. Impacted communities express frustration at not having clear sight of all points and not being actively listened to effectively.

7.4 Both case studies and academic research show that having clear and constructive conversations from an early stage and through the planning process, showing how plans have adapted as a result of input, leads to better outcomes on acceptability and delivery.

7.5 The advisory group have had helpful presentations that increased the non-technical members' understanding of the technical options available and the decision-making and design processes used to identify a preferred network design. The group also found that there is very little information in the public domain that starts to address some of these technical options in a way that is accessible for a lay audience.

7.6 The group asked network companies in Wales for information they already publish that may help inform the debate. The companies provided signposting to a range of their resources that provide public information and these will form part of the public evidence base proposed in the terms of reference.

7.7 The group identified that information relating to distribution lines of 132kV and below is particularly relevant to the work, as planning decisions for these lines are devolved in Wales. The group identified that this information was not readily available in the public

domain, compared to data on 400kV transmission lines. The group requested comparative data from the Distribution Network Operators in Wales about the technical capabilities of lines and cables at different sizes, focusing on 132kV and 33kV.

7.8 The two major Distribution Network Operators in Wales, Scottish Power Energy Networks (SPEN) and National Grid Electricity Distribution (NGED), provided similar comparative data to each other. The data provided was based on typical (most populous and in use) conductor and asset types on the networks that the two Distribution Network Operators operate.

7.9 Some key observations from the information presented by the Distribution Network Operators to the group include:

- Long routes require system reinforcement along them, to manage the technical capability of alternating current (AC) lines. For 132kV overhead lines, this is around every 30 to 50 km. For 132kV underground lines it is every 25-30km. System reinforcement would be through building a sub-station (or similar) compound. These reinforcements could be impactful in terms of footprint and expense, particularly at the higher 132kV voltage.
- The (average) projected lifespan of overhead lines is around 60 years, with steel towers lasting up to 80 years but fittings needing replacement around 40 years. (The separate components of towers, lines and fittings can be changed out separately, as appropriate.) The (average) projected lifespan of underground cable lines is 100 years. (Separate sections of cable and joint bay components can be changed out separately, as appropriate.)
- It is possible to use wooden poles to support overhead lines up to 132kV. However, at 132kV they can only carry a single circuit, which reduces their use for higher capacities, where steel towers carry double circuits.
- One of the companies felt that underground cables can carry more power (have a greater maximum continuous distribution capacity) than overhead lines, whereas another felt that there was less of a difference and that overhead lines carried the greater capacity.
- All companies flagged the challenges around access to underground network for maintenance. Overhead lines can be monitored easily by sight, allowing for some pre-emptive resilience work and quick identification of damage. Underground cable maintenance is usually triggered by a system failure. Repair on the overhead network can be carried out more quickly because excavations are not needed.

7.10 The group saw some very helpful data in this information and recommended that more is done to get comparisons of this type into the public domain. The group recognise and appreciate that this data was supplied with a very short turnaround and acknowledge that companies will wish to spend more time on the presentation of the data prior to any potential publication. The timescales have also precluded Independent Advisory Group members from raising any additional questions about the information received.

7.11 The Distribution Network Operators, in their submissions, made the distinction that cable ploughing is one method of laying underground cables or cable ducting, an installation technique, and that the performance of an underground system compared to overhead lines is a separate point.

7.12 Cable-plough installation is highly supported by communities, who express the belief that this can reduce the cost differential, and increase the speed, of undergrounding compared to overhead lines.

7.13 A detailed submission about cable-ploughing from a UK-based company with a track record of delivery has provided insight for the group into this undergrounding technique. Cable-ploughing is not extensively used in the UK, especially on higher voltage networks. However, the group also had some communications from companies who are using the technique in Europe, further building an understanding of how it is carried out.

7.14 The group considered some physical properties of higher voltage cables may mean the technique's application is better suited to lower voltage network, for instance, due to the thickness of higher voltage cables limiting their ability to bend as needed for ploughing. Company submissions confirm that high voltage cables are not currently directly cable-ploughed anywhere, but the insulating ducting for them can be installed using this technique, requiring the cable to be fed or pulled through after the ducts, pipes or chutes are installed.

7.15 The group note that soil and ground conditions are an important factor in the viability of using the technique. Cable-ploughing is only possible where ground conditions allow for ploughing. Arable lowlands are likely to form the best environment for ploughing at the depths required. Ground conditions across many areas of Wales have significant amounts of hard rock which is likely to limit the use of the technique in those areas.

7.16 The cable ploughing information supplied supports the community view that the technique, as an approach to undergrounding, has advantages in reducing ground impact during installation and in increasing speed of installation compared to the traditional open-trench undergrounding methods. These advantages are stated as being able to reduce monetary costs of undergrounding.

7.17 However, the advisory group note that the technique has only been used in the UK in selective areas, meaning that there is not a robust evidence base to articulate its suitable application for electricity grid installation in the UK, or to corroborate the anticipated benefits of lessened impact and increased speed of installation in UK ground conditions. The group, within the limited time frame of its operation and data gathering, has not been able to seek or commission additional UK-based evidence but identify cable-plough installation as a key area to seek to generate more evidence, particularly over longer distances. As this area of exploration strongly aligns with Planning Policy Wales's position of seeking to underground electricity circuits as the preferred approach to installation, Welsh Government is well placed to be instrumental in helping to bridge this knowledge and data gap.

7.18 Preferred technical strategy and design solutions for any long-distance project is understood to be considered for each kilometre of the route and may therefore involve a mix of approaches over the full length of a network connection. Potentially this could include a mix of underground cables and overhead lines, although noting that mixing the infrastructure approach requires careful planning processes to ensure resilience and efficiency, and large sub-station-type compounds are needed for transitioning between overhead lines and underground cables. The area or areas that a grid connection

passes through also impacts the technology and route planning therefore considers both technical and geographical factors.

Related recommendations: 2,3,4 and 5

8. Costs

8.1 We anticipate having to implement many more new electricity network circuits in the future to achieve the UK's net zero target and the cost of not having timely upgrades to our networks could be substantial. Delays can limit business expansion, increase costs for consumers through large constraint payments and negatively impact the economy. It also takes a long time to design, get consent for and build new electricity networks. At present this can take up to 14 years for transmission lines, although the reforms outlined in the Winser Review[21] suggest this can be reduced to 7 years. Therefore, it is important to make the case for upgrades promptly and deliver them quickly and efficiently.

8.2 There is very limited information in the public domain relating to actual costs of infrastructure projects, possibly due to concerns over commercial confidentiality for privately developed projects, and due to the limited number of new projects implemented in the UK in recent years. There are, however, sources available that consider the cost differences between undergrounding and overhead solutions for 400kV transmission lines as ratios.

8.3 The 2025 IET report 'A comparison of electricity transmission technologies: Costs and characteristics' which was produced by Mott MacDonald, presents a review and comparison of technologies that could be used in the next decade to extend and enhance the capacity of the electrical transmission network of Great Britain. This report finds that the lifespan costs for undergrounding transmission network using open-trench methodology are between 4.2 and 4.7 times greater than overhead lines over medium distances (15km). The installation costs, when separated out in the transmission circuit data, are 6.3 to 9.5 times greater.

8.4 Despite these ratios or comparative costs for the high voltage transmission network being available and frequently quoted, it is clear to the group that the purpose for and most appropriate use of such comparators is in high-level discussion, for instance, during early-stage analyses. The ratios are unlikely to be directly applicable when considering the financial costing for a specific project and, as stated in the IET Mott MacDonald report itself, should not be used for that purpose.

8.5 Each project is unique, with associated costs dependent on selected design choices, applied on a per-kilometre basis. This means final project costs can contain a wide variety of cost-influencing factors along the length of a transmission or distribution circuit. Project costings take account of and are based upon fully informed design, which is the product of careful and expert consideration, and reflects careful routeing considerations, project-specific technical and environment requirements, and project enabling factors such as supply chain. With no one project like another, ratios are not used as a tool for making specific project infrastructure decisions. The consistent message to the group in relation to how much these projects cost has been "it depends", referring to the range of factors affecting design and installation.

[21] Accelerating electricity transmission network deployment: Electricity Networks Commissioner's recommendations - GOV.UK

8.6 The group noted that there are no existing costing study ratios available for distribution networks, such as those in Wales of 132kV and below, similar to the IET report on transmission networks referenced above. Planning decisions for 132kV and lower voltage distribution lines in Wales are devolved. High-level comparative data relating to these circuits would be of particular interest to this group and of particular help to the discussion in Wales (noting that the observations covered in points 8.4 and 8.5 above on project-related costs are also applicable at these voltage levels).

8.7 The group requested some lifetime costs comparison information for network circuits of 132kV and lower from the distribution network operators in Wales, Scottish Power Energy Networks (SPEN) and National Grid Electricity Distribution (NGED). The request for this data was to align with previous archetypes topology data done at 400kV by DNV for the National Energy System Operator, as published in the Network Topology Assessment Report[22], providing a direct comparator. Only the network companies in Wales were asked for this data, and within a limited time window, but the group conclude that there is value in a wider study of distribution level network costs and drivers. This is a piece of work members agree as a priority to take forward (recommendation 4) and would have worked towards commissioning something further reaching, had the timeframe and remit for the group allowed for this substantial piece of work.

8.8 The two major Distribution Network Operators in Wales, Scottish Power Energy Networks (SPEN) and National Grid Electricity Distribution (NGED), provided similar comparative data to each other. The lifetime archetype cost data provided by the Distribution Network Operators was produced using Ofgem's RIIO-ED2 Final Determination asset replacement unit costs for the asset categories involved, based on typical (most populous and in use) conductor and asset types on the networks that the two Distribution Network Operators operate. Some key cost comparison points presented to the group in this data are:

- At 132kV, the full lifecycle costs of underground cable circuits installed by open-trenching are 2.2 – 2.8 times greater than overhead line circuits with towers.
- The cost differentials increase at lower voltages because the comparison is with cheaper, wooden pole mounted overhead lines, rather than pylons. For example, at 33kV, it is 4.5 - 9 times more expensive for underground cable circuits installed by open-trenching than overhead wooden pole circuits.
- Wooden pole networks are a much cheaper option than those with steel towers. At 132kV they are 20 - 30% of the cost of a similar line with pylons – BUT they only hold a single not double circuit and so carry less power too. This could mean more infrastructure if wooden poles are considered technically appropriate for 132kV.

8.9 Network companies and private developers clearly indicate that financial project costs are a fundamental component of their decision-making for the design of any infrastructure project. When considering infrastructure cost, the group have noted that the conversation tends to focus on installation costs. The discussion around the fastest and cheapest options for installation appears prominently within the options

[22] Network Topology Assessment Report

put forward by developers, while other factors, such as the less-easily quantifiable impacts, are less visible, particularly from the perspective of those impacted by the projects.

8.10 Network Operators i.e. Transmission Owners, Distribution Network Operators and Independent Distribution Network Operators are the long-term owners and operators of the network assets. In the case of the electricity transmission and distribution networks, the monopoly network companies are responsible (through licence conditions) for investing in their networks in the long-term interest of consumers. All network operators balance their initial investment costs with the lifetime costs and risks for a project, and they ultimately recover their allowable costs through current and future consumer bills.

8.11 As the independent energy regulator for Great Britain, Ofgem's principal objective is to protect the interests of existing and future consumers. It also has a duty to support government to achieve net zero targets. Ofgem's work is focused on ensuring that the monopoly transmission and distribution networks facilitate the delivery of net zero targets in a timely manner at efficient cost to consumers. Ofgem does not design new network projects, plan how they should be built, or decide which routes they should take[23]. This is the responsibility of the developing network company and the relevant planning authorities.

8.12 Ofgem review network companies' infrastructure upgrade projects and proposals through its RIIO Price Controls[24]. These price controls set the efficient costs and appropriate return that monopoly network companies can then recover from consumer bills over the relevant price control period. For non-monopoly network companies, the independent network operators, Ofgem has a role in approving their charging methodologies, and uses Relative Price Control to align their pricing and the cost to consumers with the other major network operators.[25] [26]

8.13 Network companies are expected to justify the costs of their proposed network upgrades to Ofgem. This can include clarifying where additional costs are driven by the legal requirements of the planning process, evidence that consumers are willing to pay for additional works, or where additional costs can secure quicker delivery to reduce constraint costs on the network. Where additional costs appear unjustified or inefficient, Ofgem will not fund this element of cost and this presents an investment risk for a project. How network upgrades balance cost efficiency on

[23] Further insight into the role of Ofgem as the energy regulator for Great Britain can be found on the regulator's webpages - About us | Ofgem

[24] Network price controls 2021-2028 (RIIO-2) | Ofgem (Note that the framework for the next round of price controls for distribution network (ED3) will differ from this in that it will link with alignment to the new regional energy strategic plans (RESPs) which are currently under development. More detail of the supporting policy framework for RESPs can be found here: Regional Energy Strategic Plan policy framework decision | Ofgem)

[25] Further details on Ofgem's role with regards to the upgrade of the higher voltage electricity transmission can be found here: Electricity transmission infrastructure: what's changed | Ofgem

[26] The independent advisory group has benefited from a presentation providing insight into the funding of our transmission networks from the regulator, which this report is not attempting to capture in its full complexity. This report provides a very brief overview of how the price controls and decisions of Ofgem, in its role as regulator for the industry, can be viewed as a risk factor to companies expanding our grid networks.

behalf of consumers with appropriate mitigation for their projects' long-term impact on the local community is a risk that sits with the relevant network companies.

8.14 It is fundamentally important for network operators to manage and minimise current and future risk in infrastructure projects of this scale. Installation and engineering costs are closely linked to practical risk factors, including matters such as supply chain and workforce. Infrastructure choices affect the level of risk for a project, including the potential for cost increases.

8.15 Ground conditions are a very significant risk factor within grid-related projects as variable ground conditions can produce the biggest increases of costs in contracts. Increases can occur with the discovery of conditions which may not all have been captured in early ground investigation work, for instance, working through an unexpected rock bed, or discovering archaeological remains. Overhead line circuits are likely to have fewer ground-impact points along a length of circuit than equivalent underground circuits i.e. intermittent pylon base footprints as opposed to a continuous run of cable circuit with joint bays. This means the risk level due to ground condition issues during construction is higher for underground circuits.

8.16 However, challenges around public acceptance of new circuits can also add risk factors to a project, particularly through the potential for delaying planning decisions or even needing to resolve legal challenges. These risks are seen more frequently in relation to the long-term visual impact of projects and the risk level is therefore higher for overhead circuits.

8.17 The group noted that the available evidence indicates that installation of underground cables will be significantly more expensive when compared to overhead lines, and that the cost differential generally increases with consideration of increased voltage levels. Public interest groups with concerns about overhead lines have submitted evidence to the group expressing a broad belief that cable ploughing could be used to install undergrounded lines at little additional cost to an overhead solution. The group found no clear, independent evidence to substantiate this belief, during the timeframe available. The group identify this as an area where there is a need to develop practical evidence to confirm the advised cost and utility benefits of cable ploughing.

8.18 The group sees value in considering more than the installation costs in business cases. This infrastructure has a lifespan of 40+ years and the full-life costs to the public, who ultimately pay for it through electricity bills, are relevant to the discussion. Full-life costs go beyond installation to maintenance, repair, and decommissioning. While initial installation will be the most significant expenditure point, value to the customer includes the consideration of long-term benefits and savings. There are also social and environmental costs of a project (impacts), which are more challenging to put a monetary value to, and where the 'costs' are likely to lie elsewhere than with the developer.

8.19 Viability of a project is a key consideration for developers, network operators and for the regulator. Grid project viability is determined following technical, environmental and social assessments when estimating the costs of implementing a preferred circuit design, particularly in the current public conversation of overhead

versus underground network. Non-viability of a project on the grounds of cost can be cited when a proposed project in Wales considers it challenging to comply with the Welsh policy preference for undergrounding circuits.

8.20 The group recognise that viability of a project is a more complex matter than just the financial investment, seeing a place for a connection between viability and impacts, and viability and technical solutions, in addition to costs. The group recommend that greater transparency of how viability decisions are reached in the planning consents process would be beneficial, particularly by demonstrating how projects have taken account of impacts and technical solutions and how those are weighted against financial costs.

8.21 The group note that greater transparency and integration of impacts in viability considerations may not ultimately change the shape of the network proposed but did feel that transparent decisions may be subject to less challenge and support the consenting process for projects.

8.22 The monetary cost to bill payers is a consideration in this complex picture – more expensive installations are likely to lead to higher bills, which will impact all customers.

8.23 The group considers that the Wellbeing of Future Generations Act adds a unique dimension to any approach to new networks in Wales and planning now with consideration for future impact on the environment, local economy and society should form a part of consenting decisions in this long-term investment in our infrastructure.

Related recommendations: 4 and 6

9. Planning and Consenting process

9.1 The primary objective of Planning Policy Wales is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural wellbeing of Wales. Planning Policy Wales is the principal policy for guiding new grid infrastructure proposals in Wales[27]. Text specific to the electricity grid network and energy storage is reproduced immediately below:

Electricity Grid Network and Energy Storage

5.7.8 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.

5.7.9 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.

5.7.10 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.

5.7.11 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.

5.7.12 Energy storage has an important part to play in managing the transition to a low carbon economy. The growth in energy generation from renewable sources requires the management of the resultant intermittency in supply, and energy storage can help balance supply and demand. Proposals for new storage facilities should be supported wherever possible.

[27] The latest published version of Planning Policy Wales available at the time of writing is Edition 12, dated February 2024. Consideration of the electricity grid is focused in Section 5 – Productive and Enterprising Places.

9.2 The group note that other areas of Planning Policy Wales pick up more widely applicable requirements such as consideration of environmental impact and how it is mitigated, and the document should be read as a whole. There are also areas of Welsh Government energy policy relevant to the policy-related discussion, but the group has focussed on consenting policy and process to date.

9.3 The group note that current grid-related policy:

- is supportive of grid expansion and the changes that are needed to decarbonise.
- states that it is preferred that grid circuits should be undergrounded where possible; and
- that policy confirms the expectation that planning for grid infrastructure should not be taken forward in isolation but should be part of consultative processes to ensure alignment of investment and infrastructure plans.

9.4 These policy points support the effective planning of major grid infrastructure to a degree but how these, and other relevant considerations of impact, are considered in planning decisions on a practical level is less visible from these policy requirements.

9.5 Taking the consideration of a ‘balanced view against costs’ (Planning Policy Wales - 5.7.9) for underground network, communities feel it is not clear how this is independently reviewed on a case-by-case basis, evidencing developers’ viewpoints on project viability. Group members broadly agree that the balance of costs is not clearly visible as applications come through planning decisions, and that decision makers may also benefit from having more transparent detail in this area.

9.6 Similarly, group members felt it is not clear how impacts from construction and full life-time impacts are balanced within consenting processes for grid infrastructure projects against the financial costs of a project design and build, and with consideration of the seven wellbeing goals of the Wellbeing of Future Generations Act (Wales).

9.7 The group observed that there are clearly significant challenges in being able to measure and quantify full life-time impacts. There is also no system for sharing any measurable data on quantified impacts of a network project. To have standardised or benchmarking data sets or expectations for measuring impacts in the full context of project cost or viability could be of significant benefit to both developers and planners in the consenting processes, as well as providing transparency to all stakeholders of how these are weighted.

9.8 The expectation that networks should be developed collaboratively and designed holistically to maximise connection potential and minimise impact on people and landscapes is important with the scale of change needed to the grid over the coming years. Communities emphasise the importance to them of being able to see how carefully planned route proposals are considered in the holistic context and with consideration to minimising holistic impacts. How this holistic spatial and technical planning in the full network context is currently being considered within individual project proposals and planning decisions is, again, less visible.

9.9 The group note that the future availability of holistic network and energy plans, which are currently being created by the National Energy System Operator (referenced in full at 6.3 of this report), should provide a clearer, published strategy for developers to align with. The transparency of that alignment should be a consideration for future policy or planning process.

9.10 Planning decisions for grid infrastructure in Wales are assigned to a number of different authorities in practice including local authorities, Welsh Government and UK Government. The group identify a potential risk that planning decisions for grid infrastructure, when taken disparately across different consenting bodies, may not align as effectively as they could, particularly at key network points and for strategic substation planning. However, the future availability of clear, published strategic and holistic plans can help mitigate this risk too, and evidencing alignment of individual proposals to holistic plans can support these decision makers.

9.11 The group observed that Permitted Development Rights (PDRs) can apply to some cable circuits. If PDRs apply, those projects will not need full planning consents or the related consultations and would be less visible in the complete picture of developments for grid infrastructure. Further preliminary investigation of these rights, however, revealed that they are unlikely to apply to major grid infrastructure projects as PDRs in Wales are restricted to lines under 20kV[28]. The construction of significant grid network circuits will fall under the Electricity Act (1989) and/or will be deemed to need Environmental Impact Assessments, both of which lead to a requirement for review under full planning processes to the relevant consenting body[29].

9.12 An apparent lack of visibility of accessible and digestible information about infrastructure projects can be particularly problematic where there may be a contentious application, for instance. The lack of clarity and detailed evidence is a significant contributing factor to communities feeling that any impact on them and their local areas and businesses are not being taken into account at all, and that impactful plans are not being discussed with them, so that their views are being heard. This combines with a potential lack of clear insight on benefits and compensations for communities impacted by infrastructure, the purpose of which are to ensure individuals are not bearing financial losses alone, for the greater good.[30]

9.13 The group discussed the merits of a number of approaches that might be taken for improving visibility and transparency of planning considerations in practice, and how this might sit within the current context of needing to facilitate and improve timeframes for grid expansion in the current climate emergency.

9.14 The group discussed a number of potential areas for proposing enhancements to the information provided in planning applications, which could be considered for inclusion in Planning Policy Wales, or the planning process.

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[28] The Town and Country Planning (General Permitted Development) Order 1995

[29] The Town and Country Planning (General Permitted Development) Order 1995

[30] The Independent Advisory Group have noted that there is work underway within UK Government and Ofgem to review benefits and compensations available to impacted communities, for example, guidance on community funds for transmission infrastructure, which is relevant but was not available at the time the group was reviewing new evidence for this report.

Key themes included:

- explicit encouragement of reducing adverse environmental, biodiversity, ecological and land impacts
- greater encouragement of mitigating or avoiding impairment to landscape and visual amenity,
- how there might be a mechanism for developers to demonstrate that all options have been properly considered for a scheme, to include a focus on undergrounding,
- what feasibility assessment, including costings, could be provided and reviewed independently where undergrounding for a project is deemed unviable by the proposer,
- what resources and skills would be needed to effectively roll out process or system enhancements, and
- how best to define and protect the preferred position of Welsh Government that new electricity circuits should be placed underground.

9.15 Ultimately the group found this a topic on which members had very differing views and could not find common ground on how and what changes should be made or could be proposed by the group. Some members felt comfortable making recommendations that were directive for altering or adding aspects to existing planning policy. Other members felt there were layers of technical and policy complexity that the group did not have full sight of in the work done to date, and did not wish to make direct recommendations at this point. The group note that the discussions to date have not involved experts from within planning or planning policy departments.

9.16 Group members did feel that there could be potential for a new framework to bring together relevant information for grid planning applications. Using a structured and visible framework approach could both support the work across planning departments in Wales and also provide holistic information at project level for impacted communities. The group felt that it would be probable that much of the information which would be useful in a framework should already exist in relevant parts of project development plans, and this existing information could be brought together into the framework, to ensure the framework adds structure and transparency without adding complexity and time to planning applications. An example of this could be, for instance, by including information around route optioneering and costings in a framework, this would clearly show where mitigations have been considered and actioned against impacts during the project optioneering process.

9.17 The above points indicate a need for more work in this area, to explore the potential for using policy to strengthen and to improve visibility of decision-making in respect of grid infrastructure projects. The experience of the group also captures the challenges of reaching consensus in this area, and where policy leads into political decision-making to define an ultimate direction of travel.

Related recommendations: 6a and 6b

Annex 1 - Overview of information sources

Presenters

- National Grid Visual Impact team
- Institution of Engineering and Technology
- Academic expert, Lancaster Environment Centre, impacts on bird life from overhead lines
- Countryside Alliance
- Plantlife Cymru – environmental impacts of undergrounding
- Ofgem
- Net Zero Industry Wales
- Energy Advisor on financial costs to consumers
- Cable Ploughing contractor

Direct submissions

- Community group submissions
- MS, MP and Councillor submissions
- Industry representative submissions inc. farming, tourism and networks
- Network company technical submissions
- Evidence statements in relation to cable ploughing
- Responses in relation to cultural impacts of grid
- Survey responses from Countryside Alliance
- Literature search on mental health impacts from electricity lines
- Literature search on impacts on tourism from electricity lines
- Literature search on comparative costs of installing electricity grid

Information available in the public domain

Undergrounding information from Renewable UK	A closer look at undergrounding electricity lines
NIC electricity distribution networks report	Electricity-Distribution-Networks-report-21-Feb-2025.pdf
National Grid public information and technical and design guidance	https://www.nationalgrid.com/document/346096/download
SPEN public information	What We Do - SP Energy Networks Policies, Procedures and Specifications: Documentation - SP Energy Networks
SSEN webinar on transmission lines	Overground, underground, or subsea - how decisions are made on where electricity transmission lines go - SSEN Transmission

ENA pylons information	Explainer – Building new pylons in the UK – Energy Networks Association (ENA)
ENTSO-E undergrounding comparison (European Network of Transmission System Operators for Electricity)	Joint paper: Feasibility and technical aspects
Electricity Transmission Costing Study – IET Parson Brinckerhoff	Electricity Transmission Costing Study
Winser report overview	Electricity Networks Commissioner letter to Secretary of State for Energy Security and Net Zero
DNV Network Topology Assessment	Network Topology Assessment Report - DNV
RUK reports on planning policy and undergrounding	Planning-Project-Report-2024-Final.pdf
ENA report on Electro Magnetic Field (EMF) health effects	250807ena-emfs-the-facts.pdf
Voluntary code of practice relating to public exposer to EMF	DECC report
Scot Gov good practice guides for onshore renewable energy projects and community benefits	Scottish Government Good Practice Principles for Community Benefits from Onshore Renewable Energy Developments
RAENG report on technology pathways and innovation	raeng-technology-pathways-report-v3.pdf
DESNZ community benefits for electricity transmission network infrastructure	Community benefits for electricity transmission network infrastructure - GOV.UK
3Ci web publications including guidance on community engagement	https://www.3ci.org.uk/report/the-path-to-net-zero-three-steps-for-effective-community-engagement/
Mixed resources relating to public engagement and impacts on communities and community acceptance of renewable energy / infrastructure	Impact assessment of case studies - Assessing the impacts of public engagement in energy infrastructure projects - IEECP community benefit guide Vattenfall.pdf Investigating public disengagement from planning for major infrastructure projects: A high voltage powerline case study Net zero public engagement and participation: a research note Churchill Fellowship - Nils Hay
Beauly-Denny line report on property values	Beauly-Denny line report on property values

Energy and Nature report on integrated vegetation management	IVM_Workshop_Summary_Report_fin.pdf
Scottish Natural Heritage, Edison Electric, Council of Europe and others – papers and reports on the impact of power lines on birds	Guidance - Assessment and mitigation of impacts of power lines and guyed meteorological masts on birds | NatureScot
Academic papers, Biasotto and Kindel, Environmental Impact Assessment review	Academic papers, Biasotto and Kindel, Environmental Impact Assessment review
Landmap	LANDMAP Overview Natural Resources Wales / LANDMAP - the Welsh landscape baseline LandMap Geological Landscape | DataMapWales Landmap Landscape Habitats | DataMapWales Landmap Landscape Habitats | DataMapWales Landmap Historic Landscape | DataMapWales LandMap Geological Landscape | DataMapWales
Natural Resources Wales tools and guidance	Natural Resources Wales / Advice for developers on planning electricity grid infrastructure
Flood risk maps	Flood Map for Planning Flood Zones 2 and 3 | DataMapWales
Regional Energy Strategies	North Wales Energy Strategy South West Wales Energy Strategy Cardiff Capital Region Energy Strategy Mid Wales energy strategy
Local Area Energy Plan examples	Powys Local Area Energy Plan Ceredigion Local Area Energy Plan
DESNZ response on community benefits for infrastructure	Community Benefits for Electricity Transmission Network Infrastructure: government response
Ofgem framework for centralised strategic network plan	Consultation on the draft Centralised Strategic Network Plan Guidance
Welsh Local Government Association guides – land use and carbon sequestration and storage	WLGA Land Use and Carbon Sequestration Guidance and Tool - WLGA

Wildlife protection network innovation allowance project report	Wildlife protection network innovation allowance project report
Reports on the electrification of industry	https://www.makeuk.org/docs/electrify-industry-report/download?attachment
DESNZ responses on enabling industrial electrification MakeUK electrify Industry report	Enabling Industrial Electrification: summary of responses
Aldersgate group report on Electrifying industry and distribution networks	Aldersgate group report on Electrifying industry and distribution networks