ARUP

National Infrastructure Commission Wales

Net Zero Strategy Research: How can value for Wales be maximised through the strategic development of renewable electricity infrastructure by 2050?

Final report

Reference:

| 23 February 2023

Job number 292190-00

Ove Arup & Partners International Limited
4 Pierhead Street
Cardiff
CF10 4QP
United Kingdom
arup.com

Contents

Tables

Figures

Appendices

Executive summary

Introduction to the research

Welsh Government has declared a Climate Emergency and has set in legislation the goal of achieving net zero by 2050. For Welsh Government to achieve this goal, the planning and delivery of renewable electricity infrastructure in Wales will need to undergo a transition. The National Infrastructure Commission Wales (NICW) was established in 2018 and has a remit to advise and make recommendations to Welsh Ministers on Wales' long term economic and environmental infrastructure needs, up to eighty years into the future[1].

Arup was commissioned by NICW in September 2022 to undertake qualitative research into the value for Wales of the transition to renewable energy, and in particular from investment in renewable electricity infrastructure. The aim of the research was to provide a set of clear policy recommendations, including options that are workable within the levers that Welsh Government has available in the short to medium term, and bolder recommendations for the longer term.

The research comprised a literature review, socio-economic data analysis, stakeholder engagement, studies of the renewable energy systems in four key geographies, case studies of renewable electricity schemes, and the development of typologies of renewable electricity infrastructure. Policy and delivery options were then developed, drawing on the findings of the research and conversations with stakeholders, and tested and refined through stakeholder workshops and interviews, and through a detailed multicriteria analysis (MCA).

Key findings

A key finding of the research was that there is no single definition of value in the infrastructure sector. While new, wider understandings, beyond traditional metrics such as jobs and Gross Value Added (GVA), are emerging, there is not yet any established method for measuring and reporting social and environmental value from infrastructure investments. Social value is often locally defined and dependent on the local context. In Wales, understandings of value tend to be linked to the Well-being of Future Generations Act (2015), and to the socio-economic duty, enacted in 2021.

The research found that different renewable electricity typologies can generate different types of value, in different ways and at different scales, and that renewable electricity projects across all typologies are already delivering value for Wales. However, the renewables that will be required to meet net zero by 2050 are not being delivered at the speed or scale required, and there are therefore opportunities to increase the rate of delivery in a way that can maximise the value to be generated and retained within Wales. The research found two related issues that the recommendations should address. These are:

- Increasing the rate of delivery of renewable electricity developments at all scales; and
- Increasing the value that is generated and retained within Wales from those developments, nationally and locally.

Recommendations were developed based around a set of themes that emerged from the research. These are:

- Planning and land use;
- Enabling infrastructure;
- Financial support and resources;
- Education and skills; and
- Creation, retention and distribution of value.

[1] Welsh Government (2019), Commission unveils priorities for next year as it develops a future infrastructure plan for Wales: Commission unveils priorities for next year as it develops a future infrastructure plan for Wales | gov.wales

A set of scenarios was developed to explore the different pathways for value capture, based on different combinations of recommendations coming forward, under short (to 2025), medium (2025-2035) and long-term (2025-2050 and beyond) timescales.

Priority recommendations

The report identifies a set of 26 detailed recommendations, grouped around the themes identified above. These are set out in full in Section 6 of the report, and the scenarios are included in Section 5. Based on stakeholder feedback and the findings of the MCA, the following six recommendations have been identified as priorities that could have the most impact and make a real difference in terms of increasing the delivery of renewable electricity schemes and maximising value for Wales from its renewable electricity infrastructure.

The six priority recommendations are set out under the relevant scenario. While the scenarios look at the short, medium and longer term, this is based on our estimation of *when* the value can be delivered, and it is important that Welsh Government takes into account the timescales for delivery of renewable electricity infrastructure, and begins the work that would be needed to deliver on these ideas as soon as possible.

Scenario 1: what are the **quick wins** that can address immediate challenges and generate value in the short term (to 2025)?

- Provide support to local authorities, including ministerial directive and updated guidance (or removal of current guidance), to develop local planning policy environments to support the delivery of more renewables.
- Provide additional targeted resource and training for planning teams and organisations involved in consenting, including local authorities and NRW.
- Consider revisions to business rates for renewable energy projects, including abolishing rates for all renewable developments below a certain size.

Scenario 2: how can we capture more value for Wales in the **medium term** (2025 to 2035)?

- Collaborate with Distribution Network Operators (DNOs), local authorities, developers and other partners to develop a plan for the delivery of additional infrastructure needs to support renewable energy development, drawing on evidence from Local Area Energy Plans (LAEPs) to target investment where it is needed.
- Build on the potential devolution of the Welsh Crown Estate and the creation of the Welsh Government renewable energy developer to distribute benefits across Wales.

Scenario 3: what are the big ideas to deliver change in the **longer term** (2035 to 2050 and beyond)?

- Explore the feasibility of further investment in, or a degree of state-ownership of, national grid infrastructure, including gas networks as well as electricity.

Next steps

This is one of three pieces of work commissioned by NICW as part of its Preparing Wales for a Renewable Energy 2050 project. Its aim is to provide NICW with recommendations to make to Welsh Ministers on what needs to change in the current regulatory and policy framework to achieve its overarching goals, and in particular to reach net zero by 2050. Following completion of the three pieces of research, NICW will issue a single report to Welsh Government in summer 2023.

The final NICW report will prioritise the recommendations to be taken forward to Welsh Government, and should set out the next steps to make progress against these recommendations. In some cases this will involve working with the UK Government and with Ofgem, and undertaking further research and feasibility studies to understand the steps that need to be taken to deliver the renewable energy required to meet net zero by 2050 in a way that is fair, just, and maximises value for the people of Wales.

1. Introduction

Arup was commissioned by the National Infrastructure Commission Wales (NICW) in September 2022 to undertake qualitative research into the value for Wales of the transition to renewable energy, and in particular from investment in renewables infrastructure. The research sought to answer the following central research question:

- How can value for Wales be maximised through the strategic development of renewable electricity infrastructure by 2050?

This is one of three pieces of work commissioned by NICW as part of its Preparing Wales for a Renewable Energy 2050 project. Its aim is to provide NICW with recommendations to make to Welsh Ministers on what needs to change in the current regulatory and policy framework to achieve its overarching goals, and in particular to reach net zero by 2050.

1.1 Context

Welsh Government has declared a Climate Emergency and has set in legislation the goal of achieving net zero by 2050. This is within the wider context of a similar UK Government target. For Welsh Government to achieve this goal, the planning and delivery of renewable energy infrastructure in Wales will need to undergo a transition. In 2018, NICW was established as a non-statutory body to advise and make recommendations to Welsh Ministers on Wales' long term economic and environmental infrastructure needs[2]. Since 2021, NICW has had a remit to look eighty years into the future, with this timescale reflecting the expected timeline of infrastructure developments[3].

Historically, Wales has been home to major high-carbon energy generation facilities that have been or are being phased out. Some of these have been important for the jobs and wider value that they have created for their local communities. There are also areas of Wales where carbon-intensive industries such as steel manufacturing remain important local employers. There is therefore the potential for some areas of Wales to be disproportionately impacted by the transition to net zero, as well as opportunities around reskilling existing workforces, developing new skills and technologies, and supporting access to employment and training in the renewables sector.

This transition needs to be carefully planned to avoid adverse impacts on communities and to deliver socio-economic and wider benefits in line with the requirements of the Well-being of Future Generations Act (2015) and the Socio-economic Duty. However, investing in renewable energy infrastructure provides a significant opportunity for Wales to address the climate emergency, deliver on the Well-being Goals, and tackle inequality, particularly in the context of rising energy prices and increasing fuel poverty[4].

1.2 Related work in this area

There are multiple stakeholders who have a role to play in improving the value that could be retained in Wales from investment in renewable energy, and a number of initiatives that are being taken forward by Welsh Government and others in this area. For example, there have been ongoing discussions around the creation of an energy company for Wales, and recent developments include the announcement in October 2022 of a new publicly-owned renewable energy developer for Wales which will generate funds through the

[2] Welsh Government (2019), Commission unveils priorities for next year as it develops a future infrastructure plan for Wales: Commission unveils priorities for next year as it develops a future infrastructure plan for Wales | gov.wales

[3] National Infrastructure Commission Wales (NICW) (2022), Annual Report 2021/22. Available online at: National Infrastructure Commission Wales: Annual Report 2021/22 | gov.wales

[4] Welsh Government modelling suggests that up to 45% of households in Wales could be in fuel poverty following the energy price cap increase in April 2022, up from 14% in 2021.

development of onshore wind projects on Welsh Government woodland estate to be retained and reinvested in Wales[5].

Welsh Government's Renewable Energy Deep Dive exercise, conducted in 2021, set out recommendations around scaling up renewable energy in Wales, and identified opportunities to maximise economic and social value in Wales. Recommendations in this area included working with UK Government to bring new investment to ports in Wales, developing a net zero skills action plan to support greater industry collaboration and maximise supply chain opportunities, and working with industry to scope a programme of work to maximise the installation of renewables, flexibility and storage on business and industrial sites[6]. An update on progress against the recommendations in the Deep Dive was published in September 2022 and the Net Zero Skills Action Plan is due for publication in February 2023[7].

Other recommendations of the Deep Dive were around strategy, grid, consenting, finance, innovation, and scaling up community and local energy. A key recommendation was the creation of a national energy plan by 2024 which would map out future energy demand and supply for all parts of Wales. In response to this, regional energy strategies have been completed for each region of Wales (North Wales, Mid Wales, South West Wales and the Cardiff Capital Region), and Local Area Energy Plans (LAEPs) are being rolled out following the delivery of pilot projects in Newport and Conwy.

The Welsh Parliament's Climate Change, Environment and Infrastructure Committee has gathered evidence and published a report in response to the Deep Dive which sets out further recommendations around unlocking the potential for renewables development in Wales, including measures to deliver greater benefits for communities from the transition[8]. Recommendations in this area are around using public land and the public estate for renewables, incentivising share ownership, and looking at how communities can better access Community Benefit Funds from commercial renewable developments.

It is recognised that there are various models of renewables development that can provide additional value to local communities, from relatively small-scale community-led projects to major commercial developers providing Community Benefit Funds, and new models such as Ripple Energy which allows members of the public to buy shares in new wind developments [9]. This report explores the potential for these, and other, different models to generate and retain different types of value at different scales across Wales, and identifies a set of recommendations that could be taken forward by Welsh Government to maximise the value for Wales from investment in renewable electricity infrastructure.

1.3 Scope and methodology

1.3.1 Research questions

In addition to the central research question, the research has been guided by the following set of questions:

- What do we mean by 'value'? Is that the same across Wales? Who would benefit from different types of value? Are there disbenefits too?
- Can all types of renewable electricity infrastructure deliver value in the same way and at the same scale?
- How can synergies and connections be derived through different scales of value creation?
- Are there different business or governance models that will deliver value in different ways?

[5] Welsh Government, 25th October 2022, Wales announces publicly-owned renewable energy developer: Wales announces publicly-owned renewable energy developer | gov.wales

[6] Welsh Government (2021), Renewable Energy Deep Dive: Recommendation. Available online at: Renewable energy deep dive: recommendations | gov.wales

[7] Welsh Government (2022), Renewable Energy Deep Dive Biannual Recommendations Update 1. Available online at: Renewable Energy Deep Dive Biannual Recommendations Update 1 | gov.wales

[8] Senedd, Climate Change, Environment and Infrastructure Committee (2022), Renewable Energy in Wales. Available online at: Renewable energy in Wales | senedd.wales

[9] Ripple Energy, Why join Ripple? Join Ripple | Ripple Energy

- What are the levers, policy interventions and delivery mechanisms that could maximise value across the whole system and all of Wales?

1.3.2 Project boundaries

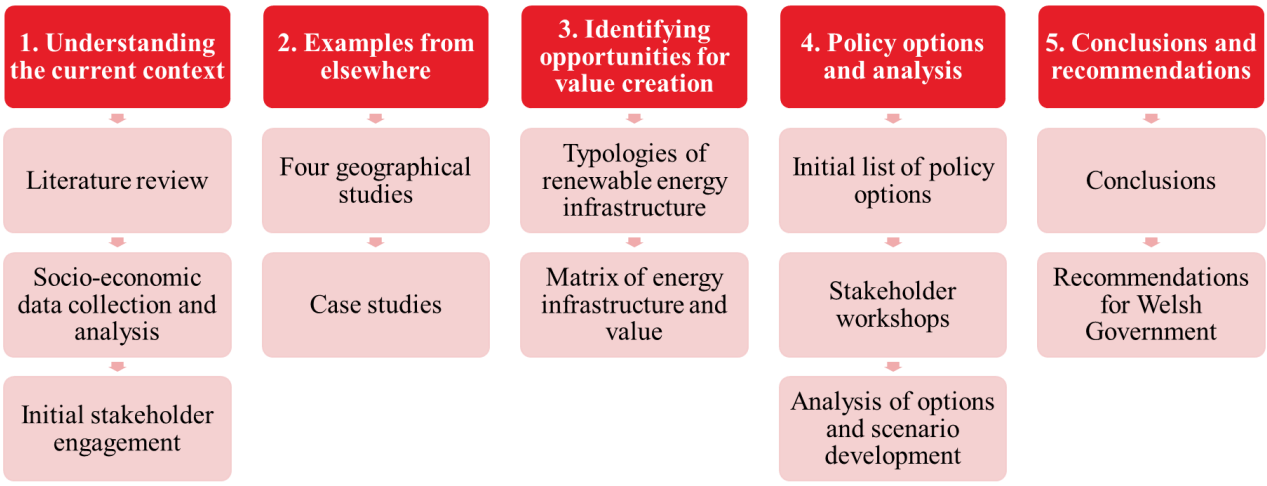
It was agreed at project inception that the scope of the research is renewable energy generation, rather than use, with a focus on renewable electricity. While the scope does not include other sectors such as transport, it does take account of the wider context and related issues around increasing demand from the electrification of transport and domestic heating, for example. The temporal scope of the research is the target of net zero by 2050, but with the recognition that some social and economic benefits from investment in renewable energy infrastructure may accrue after this time.

It was also agreed at inception that the ultimate audience for this piece of work is Welsh Government, and that the report should make clear policy recommendations that are workable within the levers that Welsh Government has available in the short to medium term, and may also include bolder recommendations for the longer term.

1.3.3 Research methods

Figure 1-1 shows the process that has been followed to undertake the research.

Figure 1-1: Research methods workflow



The first stage involved a detailed literature review, collection and analysis of socio-economic data, and an initial round of targeted stakeholder engagement. Key documents used in the literature review included Welsh Government publications such as Energy Generation in Wales and Future Wales: The National Plan 2040, Regional Energy Strategies and LAEPs. Socio-economic data was analysed to identify areas of Wales that could potentially be at risk of economic impacts from the transition to net zero. Stakeholders representing Welsh Government, academia, the private sector and community energy sector were contacted by email and interviewed virtually via Microsoft Teams, using an interview schedule developed by the research team.

The second stage involved detailed studies of renewable energy in four key geographies, and a range of case studies. Scotland, Germany, New Zealand and the Republic of Ireland were chosen as the geographies for these studies because of physical, economic or regulatory similarities to Wales, and/or because of best practice in terms of renewable energy production, community renewables, and value. Case studies cover renewable energy developments in Wales, the UK and across Europe, as well as exemplar infrastructure projects that have been recognised for delivering social value.

The third stage involved developing typologies of renewable energy infrastructure, and plotting these in a matrix against different types of value, in order to identify where there might be opportunities for value creation. The fourth stage drew on the information gathered through previous stages and involved developing an initial list of policy and delivery options, testing and refining these through stakeholder workshops, and conducting a multi-criteria analysis to identify a refined list of options to be taken forward. This stage of the

research also included developing scenarios based on different mixes of potential policy and delivery options. The final stage of the research was answering the research questions set out above, and providing a set of recommendations for NICW to put forward to Welsh Government.

1.3.4 Structure of this report

The report follows the following structure:

- **Section 2: Understanding the current context** – provides a summary of evidence collected through the literature review, socio-economic analysis and initial stakeholder engagement;
- **Section 3: Examples from elsewhere** – provides geographical studies of renewable electricity in four other countries, and case studies of renewable electricity projects from across the UK and Europe;
- **Section 4: Identifying opportunities for value creation** – provides typologies of renewable electricity infrastructure and a matrix of energy typologies and value;
- **Section 5: Policy and delivery option development** – describes the process undertaken to develop and analyse potential policy and delivery options, and sets out scenarios based on different policy mixes; and
- **Section 6: Conclusions and recommendations.**

A list of references and further information regarding the stakeholder workshops are included in the appendices.

1.3.5 Assumptions and limitations

At the time of writing in February 2023, Welsh Government's Net Zero Skills Action Plan had not yet been published and so the draft report does not take full account of the plan.

2. Understanding the current context

The initial stage of the research involved a literature review and interviews with key stakeholders to understand the current context around what is being delivered in Wales in terms of renewable electricity and value. The literature review included analysis of a range of relevant socio-economic datasets to identify areas that could be at risk of experiencing disbenefits from the transition to net zero.

This section sets out the key findings and is structured around a set of questions that was used to guide the research. A list of stakeholder organisations represented is included in Appendix B, and the sources used in Appendix C.

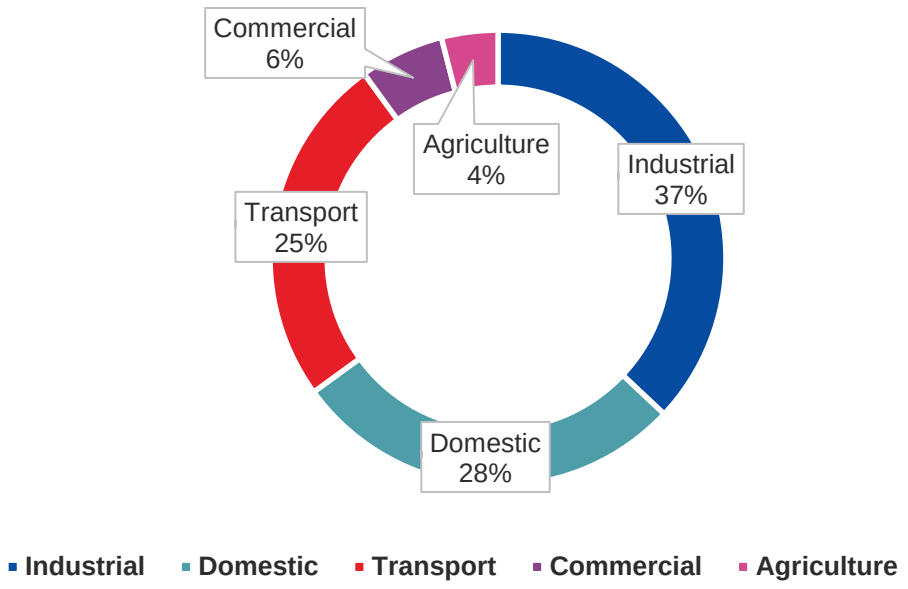
2.1 Renewable electricity generation in Wales

2.1.1 What is the current and projected need for renewable electricity in Wales?

Welsh Government has set targets for Wales to meet the equivalent of 70% of its electricity demand from Welsh renewable sources by 2030 and to achieve net zero by 2050. Proposed changes to these targets, published for consultation in January 2023, include Wales to meet the equivalent of 100% of its annual electricity demand from renewable sources by 2035[10]. The consultation document recognises that the generation of renewable electricity has a key role to play in the decarbonisation of the whole energy system that will be required to achieve net zero by 2050.

As shown in Figure 2-1, current energy consumption in Wales comes from the industrial (37%), domestic (28%), transport (25%), commercial (6%) and agriculture (4%) sectors, although the proportion accounted for by industrial uses has decreased over the last five years while the proportion accounted for by transport has increased. In terms of emissions, it is estimated that 42% of CO2 emissions from energy use in Wales were from industry in 2019, with 26% from transport and 20% from domestic consumption[11].

Figure 2-1: Energy consumption by sector, 2019 (Source: Welsh Government (2022), Energy Use in Wales)



The last coal-powered electricity station in Wales, at Aberthaw in the Vale of Glamorgan, closed in 2019, and 2020 was the first year since the 1800s that there was no electricity generated from coal in Wales.

[10] Welsh Government (2023), Consultation Document: Review of Wales' Renewable Energy Targets. Available online at: Review of Wales' Renewable Energy Targets | gov.wales

[11] Welsh Government (2019), Energy Use in Wales. Available online at: Energy Use in Wales | gov.wales

However, Wales continues to generate significant amounts of energy from fossil fuels, mostly from natural gas. In 2021, Wales generated 19.5 TWh of electricity from fossil fuels, 72% of the total generated in Wales, and enough to meet 140% of its consumption[12].

Electricity consumption is expected to increase significantly from 2030 onwards, as a result of projected population increases and from the electrification of transport and heat. The Climate Change Committee's (CCC) 6th carbon budget estimates that, while total energy consumption should continue to reduce in Wales, electricity demand will increase as a result of increasing electricity consumption in the heat and transport sectors[13]. The CCC's net zero scenarios for Wales all suggest that electricity consumption will remain broadly steady until 2030, before increasing by as much as 200% to 300% by 2050[14].

It will be important that Wales follows an energy hierarchy approach, including measures such as demand reduction and retrofit of low-carbon technologies to reduce energy consumption and increase energy efficiency; however, significantly increasing the generation of zero carbon electricity will be a key if Wales is to fully decarbonise and meet its target of net zero by 2050. Increasing renewable electricity generation could also allow the production of green hydrogen to support the decarbonisation of heat, transport and industry, and to provide long-term energy storage which could help Wales to maximise its renewable generation potential, avoid network constraints, and generate value[15]. Welsh Government has commissioned the Energy Systems Catapult (ESC) to develop and model the range of pathways that Wales could take to decarbonise its energy system by 2050, to inform network and infrastructure planning.

2.1.2 What is being delivered in terms of renewable electricity?

Welsh Government's Energy Generation in Wales 2021 report estimates that, in 2021, 55% of electricity demand and 28% of electricity generation in Wales came from renewable sources, decreases from 56% and 33% in 2020 respectively[16]. The decrease in the share of electricity generation delivered by renewables is accounted for by an increase in electricity generation from gas, and the figure for absolute renewable electricity generation increased from 2020-2021. However, the commissioning of new renewable capacity has slowed significantly in recent years, and in 2021 was nearly 90% lower than its peak in 2015.

Table 2-1 summarises the projects, capacity and estimated generation associated with each type of renewable electricity technology operational in Wales in 2021. Onshore and offshore wind are responsible for over two thirds of Wales's progress towards the 70% renewable electricity target, with onshore wind accounting for close to 40% of total renewable electricity generation in Wales in 2021, and offshore wind for close to 29%. Solar PV accounted for 13.9%, biomass electricity and combined heat and power (CHP) for 8.9%, with other technologies (hydropower, energy from waste, anaerobic digestion, landfill gas and sewage gas) each contributing less than 5%.

Table 2-1: Renewable electricity generation in Wales, 2020 (Source: Welsh Government, Energy Generation in Wales 2021)

	Number of projects	Capacity (MW)	Estimated generation (GWh)	% of total estimated generation
Anaerobic digestion	47	19	100	1.3%
Biomass electricity and CHP	50	131	686	8.9%
Energy from waste	2	26	133	1.7%
Hydropower	376	170	338	4.4%

[12] Welsh Government (2022), Energy Generation in Wales, 2021. Available online: energy-generation-in-wales-2021.pdf (gov.wales)

[13] Welsh Government (2021), Energy Generation in Wales, 2020. Available online: energy-generation-in-wales-2020.pdf (gov.wales)

[14] Ibid.

[15] Ibid.

[16] Welsh Government (2022), Energy Generation in Wales, 2021.

	Number of projects	Capacity (MW)	Estimated generation (GWh)	% of total estimated generation
Landfill gas	23	24	66	0.9%
Offshore wind	3	726	2,226	28.8%
Onshore wind	753	1,266	3,053	39.5%
Sewage gas	5	12	43	0.6%
Solar PV	63,707	1,134	1,075	13.9%
Total	64,966	3,508	7,720	100.0%

Figure 2-2 shows that there is considerable variation in total renewable electricity capacity and in the mix of renewable electricity technologies installed at local authority level (note that this figure does not include data for offshore wind). The Swansea Bay City Region accounts for 27% of Wales's renewable electricity capacity, with the local authorities of Neath Port Talbot and Carmarthenshire having the largest capacities of all Welsh local authority areas at 330 MW and 264 MW respectively. Powys in Mid Wales, Rhondda Cynon Taf in the Cardiff Capital Region, and Pembrokeshire in the Swansea Bay City Region also have renewable electricity capacity in excess of 200 MW. In Neath Port Talbot, Powys, Carmarthenshire and Rhondda Cynon Taf, the largest share of renewable capacity is accounted for by onshore wind. In Pembrokeshire, the largest proportion is from solar PV, which also accounts for a large share of renewable generation in Carmarthenshire.

Figure 2-2: Renewable electricity capacity by local authority (Source: Welsh Government, Energy Generation in Wales 2021)

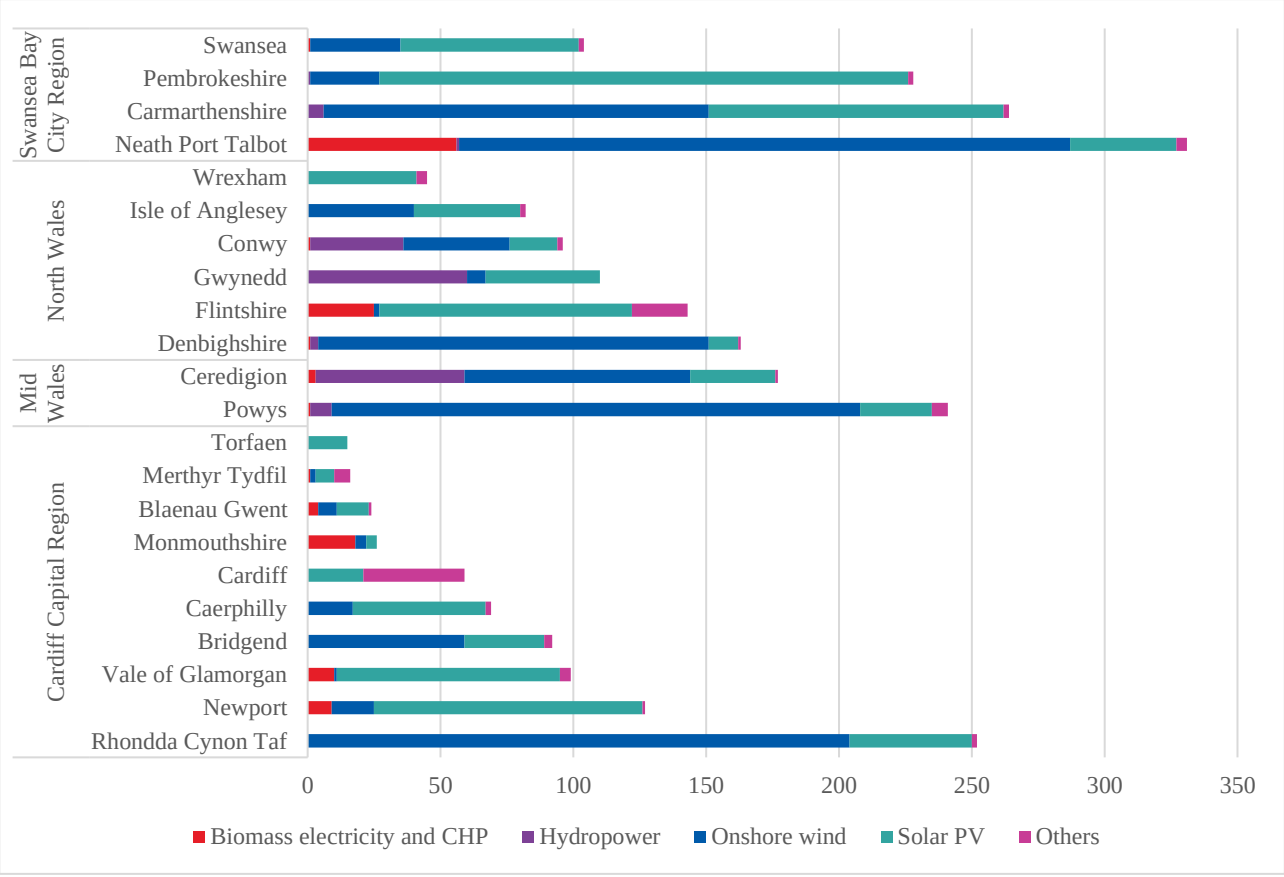
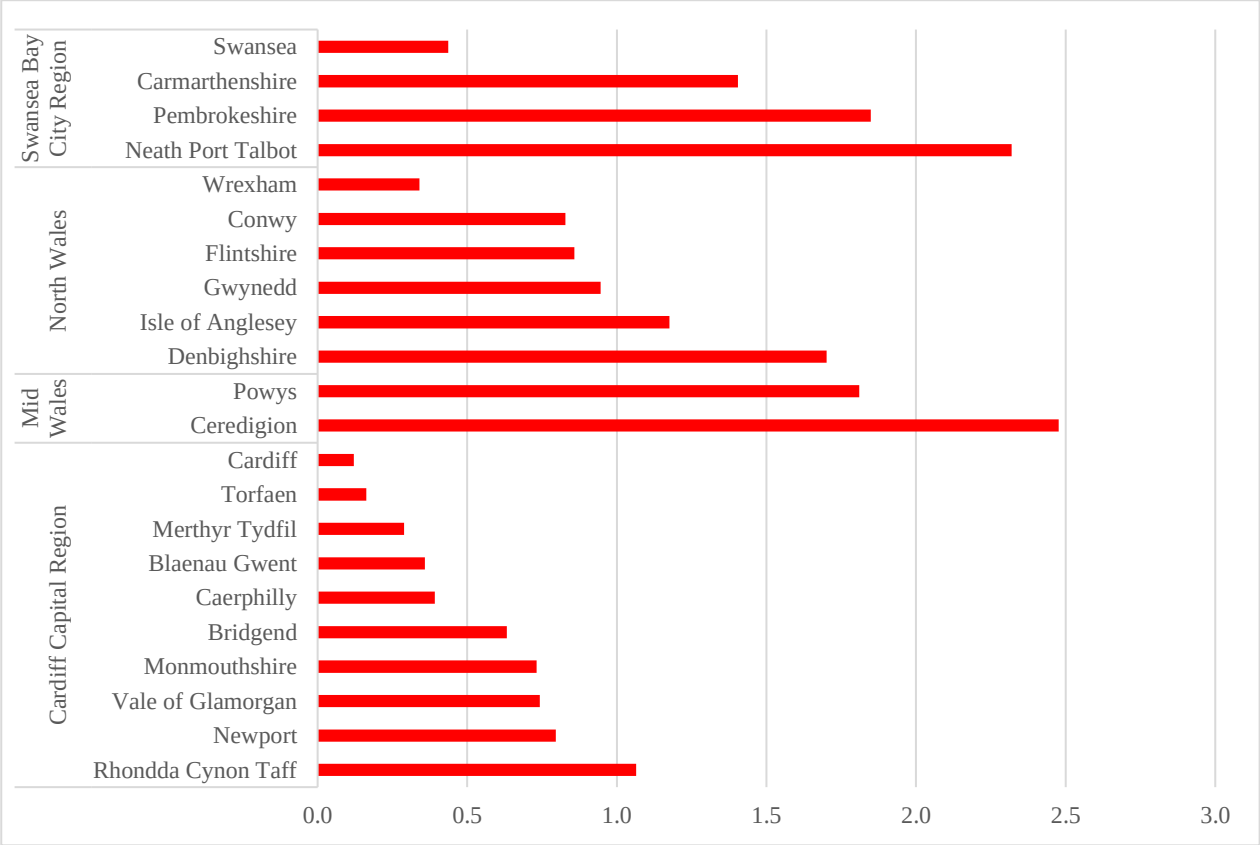


Figure 2-2 shows capacity by population at local authority level. By this measure, Ceredigion and Neath Port Talbot have the largest capacity, with Pembrokeshire, Powys, and Denbighshire also having capacity of more than 1.5 MW per 1,000 residents. Urban areas such as Cardiff, Swansea and Wrexham have among the lowest capacity by population, reflecting the space constraints within built-up areas. Local authorities in the

South Wales valleys, including Torfaen, Merthyr Tydfil, Blaenau Gwent and Caerphilly, also have low capacities by population, which may reflect the topographical constraints in these areas, as well as their relatively urban nature restricting the availability of sites.

Figure 2-3: Renewable electricity capacity by local authority (MW per 1,000 population) (Source: Arup calculations based on data in Welsh Government, Energy Generation in Wales 2021)



The above data does not include offshore wind capacity as this is considered a national rather than a regional asset. Capacity is currently concentrated in North Wales, with three operational offshore wind farms off the North Wales coast: Gwynt y Môr, Rhyl Flats, and North Hoyle[17]. In 2018, North Wales generated 1,183 MW of renewable energy, including 726 MW of offshore wind[18]. In future, it is anticipated that offshore capacity will be developed in the Celtic Sea and at other sites (see section 2.4 for further detail).

2.1.3 What proportion of renewable electricity generation is locally owned?

Welsh Government's policy statement on local ownership of energy generation in Wales estimates that Wales could be exporting between 6% and 10% of its GVA in energy bills[19], and it is likely that this has increased since the energy price cap increases in April and October 2022. Local ownership is therefore identified as a strong opportunity to retain this wealth within Wales and to contribute to increased prosperity for communities across the country.

The policy statement sets out Welsh Government's targets to have 1 GW of renewable electricity and heat capacity in Wales locally owned by 2030, and for all new energy projects to have at least an element of local ownership from 2020[20]. The review of Wales' Renewable Energy Targets, published for consultation in

[17] Natural Resources Wales, Offshore Wind Developments: Offshore wind developments | Natural Resources Wales

[18] Welsh Government Energy Service (WGES) (2021), North Wales Energy Strategy. Available online at: North Wales Energy Strategy | gov.wales

[19] Welsh Government (2020), Policy Statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations. Available online at: Draft Policy Statement on Local Ownership | gov.wales

[20] Ibid.

January 2023, includes a proposal to increase the local ownership target to at least 1.5 GW of renewable energy capacity to be locally owned by 2035, excluding heat pumps[21].

The policy statement provides the following definitions of local, shared and community ownership:

- **Local ownership** – 'energy installations, located in Wales, which are owned by one or more individuals or organisations wholly owned and based in Wales, or organisations whose principal headquarters are located in Wales.' This includes businesses, farms and estates, households and other domestic scale generation, local authorities, other public sector organisations, registered social landlords, and third sector organisations including social enterprises and charities.
- **Shared ownership** – 'a project owned by more than one legal entity. Examples exist where the ownership of a project is shared between a developer and a community group, individuals, landowners, or a public sector organisation… In order to be considered as a shared ownership project under the target set by Welsh Government, we would expect one or more of the owning bodies to be in one of the categories included in the definition of 'local ownership'.'
- **Community ownership** – 'a renewable energy or renewable storage development located in Wales, which is wholly owned by a social enterprise whose assets and profits are committed to the delivery of social and/or environmental objectives.[22]'

As of 2021, total renewable electricity and heat capacity in Wales in 2020 was 4.2 GW and Wales had achieved nearly 90% of the 1 GW local ownership target, with 897 MW of renewable capacity locally owned[23]. There are now 78,500 locally owned renewable electricity and heat projects in Wales, the vast majority (over 90%) of which are in the domestic sector, comprising over 56,200 domestic solar PV projects and over 10,500 domestic heat pumps[24]. Renewable electricity capacity in local ownership is 581 MW, approximately 39% of the proposed 1.5 GW target.

In terms of community ownership, there were estimated to be 67 community energy organisations active in Wales in 2021, generating a total of 27.5 MW, an increase of 13% from 2020[25]. Most of this increase was attributable to Ripple Energy's Graig Fatha wind farm, the UK's first consumer-owned wind farm, which generates 2.5 MW. Data from the Regional Energy Strategies shows that Cardiff Capital Region has the largest proportion of its total renewable capacity in local ownership, at 31%, while North Wales has the lowest proportion, at 8%, despite having the largest capacity overall. It is likely that this reflects the high proportion of renewable electricity capacity in North Wales that is accounted for by large scale offshore wind.

2.1.4 What different ownership and benefit models are in use?

Renewable electricity projects in Wales have been brought forward by commercial energy developers, other private businesses, the public and third sector, community renewables organisations, and by private individuals, and there is a range of models of ownership in use which can each create economic, social and environmental value in different ways and at different scales. Further case studies of renewable electricity projects across Wales, the UK and Europe are set out in section 3 of this report and referred to in the typologies of energy infrastructure provided in section 4, demonstrating the range of models that are being taken forward.

Commercial sector

Commercial developers are responsible for many of the large scale renewable electricity projects that have been brought forward in Wales, including in the onshore wind, offshore wind and ground-mounted solar PV

[21] Welsh Government (2023), Consultation Document: Review of Wales' Renewable Energy Targets.

[22] Welsh Government (2020), Policy Statement: Local ownership of energy generation in Wales.

[23] Welsh Government (2022), Energy Generation in Wales, 2021.

[24] Ibid.

[25] Community Energy (2022), State of the Sector Report. Available online at: State of the Sector Report | Community Energy Scotland

sectors. The three existing offshore wind farms in Wales, for example, are all operated by the German multinational RWE.

Large scale projects can generate significant employment and training opportunities, particularly during construction, although the specialist nature of some elements of construction in the wind sector in particular can mean that it can be difficult for local workers and businesses (including SMEs) to access and benefit from these opportunities. Operation and maintenance can offer more sustainable employment and supply chain opportunities for local communities and businesses in the longer term. The construction of Gwynt y Môr Offshore Wind Farm off North Wales generated 2,450 jobs during construction, and now supports around 100 long term jobs within the UK[26].

Much of the local value that is derived from large commercial wind projects comes through Community Benefit Funds which are dedicated funds paid by the developer to support local community initiatives in the immediate area surrounding a project. There is no standard approach to measuring the value generated from Community Benefit Funds, and methods for distributing funds can vary across projects, although there are industry-led approaches such as the Community Benefits Protocol developed by RenewableUK[27], and good practice guidance for onshore wind developments in England[28].

Funds are usually administered by an independent third-party organisation which allocates funds to community groups or projects. For example, the Community Benefit Fund associated with the Gwynt y Môr is administered by Community and Voluntary Support Conwy and is worth £768,000 each year[29]. In the onshore wind sector, the Pen y Cymoedd Community Fund administers community benefit funding associated with the Pen y Cymoedd wind farm, operated by the Swedish state-owned company Vattenfall, and has an annual budget of £1.8 million until 2043 to support community projects in the upper Neath, Afan, Rhondda and Cynon valleys[30].

Commercial developers are also active in the solar sector in Wales, although solar development slowed following the removal of feed-in tariffs in 2019. One of the largest solar farms in the UK is located at Shotwick in Deeside, and supplies a neighbouring recycled paper manufacturing plant by private wire[31]. The solar farm provides 60% of the factory's energy needs, resulting in significant cost savings, and demonstrating the role that large scale renewable electricity developments and private wire power purchase agreements (PPAs) can play in supporting the decarbonisation of energy-intensive industries[32]. Llanwern Farm Solar Park was constructed on the Gwent Levels, near Newport, in 2021, and is now the largest in the UK. It was developed without subsidies, and employed over 200 workers on site at peak construction[33].

Government and the public sector

Welsh Government recognises that a number of large scale renewable electricity projects in Wales, such as Pen y Cymoedd, have been developed by state-owned developers from other countries, with the profits from these sites therefore going back to those countries rather than benefiting public finances in Wales[34]. In response to this, Welsh Government has recently (October 2022) announced a new, publicly-owned renewable energy developer for Wales, to enable energy profits to deliver greater benefit for Wales, for

[26] Renewable Technology, Gwynt y Mor Offshore Wind Project, Liverpool Bay, North Wales: Gwynt y Môr Offshore Wind Project | Renewable Technology

[27] Renewable UK, Community Benefits Protocol: Community Benefits Protocol - RenewableUK

[28] Department for Business, Energy and Industrial Strategy (BEIS) (2021), Community Engagement and Benefits from Onshore Wind Developments: Good Practice Guidance for England. Available online at: Community Engagement and Benefits from Onshore Wind Developments: good practice guidance for England (publishing.service.gov.uk)

[29] RWE, Our community funds at a glance: Wales: Our community funds at a glance: Wales | RWE

[30] Pen y Cymoedd Wind Farm Community Fund CIC: Home | Pen Y Cymoedd Community Fund

[31] British Solar Renewables, Shotwick Solar Park: BSR | Shotwick Solar Park, Flintshire | 72.2 MW | British Solar… (britishrenewables.com)

[32] Solar Power Portal, 3rd February 2017, Foresight splashes the cash on UK's largest solar park: Foresight splashes the cash on UK's largest solar park | Solar Power Portal

[33] Welsh Government (2022), Energy Generation in Wales, 2021.

[34] Welsh Government, 25th October 2022.

example through reinvestment in energy efficiency measures in homes and in creating good quality jobs in the energy sector[35]. It is intended that the new Welsh energy developer will initially develop onshore wind projects on Welsh Government woodland estate[36].

The Welsh public sector more widely also has a role, both in providing sites suitable for renewables development (for example on the NRW woodland estate or on the roofs of public sector buildings) and as a developer. Table 2-2 summarises locally owned renewable energy projects in Wales (note that this includes heat as well as electricity generation), including those owned by local authorities, housing associations, and other public sector organisations. Local authorities across Wales owned 303 projects in 2021, generating 40 GWh of energy. Other public sector and charity organisations owned 418 projects, generating 84 GWh.

Table 2-2: Locally owned renewable energy in Wales (Source: Energy Generation in Wales 2021)

Ownership category	Total number of projects	Capacity (MWe)	Capacity (MWth)	Estimated generation (GWh)
Community	198	40	1	54
Domestic	70,575	209	142	500
Farms and estates	798	23	126	444
Housing association	5,687	7	5	9
Local authority	303	22	3	40
Local business	394	271	16	797
Other public sector and charity	418	9	24	84
Total	78,373	581	316	1,928

Recent projects brought forwards by local authorities include a solar farm installed on a landfill site at Lamby Way in Cardiff in 2020. Lamby Way Solar Farm is connected to the local distribution network and also has a private wire supplying electricity to a nearby Welsh Water site that comprises a water treatment works and a food waste processing centre that produces electricity through anaerobic digestion[37]. This demonstrates the benefits associated with private wire PPAs (or sleeved PPAs in other contexts), allowing locally-owned developments to provide renewable electricity at an agreed price to other public sector facilities. Other examples of this model include the UK's first hospital-owned solar farm at Brynwhilach, which provides electricity by private wire to Morriston Hospital in Swansea[38]. Brynwhilach Solar Farm began exporting in November 2021, and by March 2022 had saved the hospital board an estimated £120,000 in electricity bills[39].

The data shows that housing associations owned 5,687 projects in 2020, generating 9 GWh. The large number of housing association-owned projects and comparatively small amount of generation reflects the installation of solar PV and heat pumps in housing association properties, each one of which is counted as an individual project. The same is also seen in the data for domestic-owned projects, with 65,111 projects generating 453 GWh. Installing solar PV on domestic properties, either as newbuilds or through retrofit schemes, can generate value at the local level by reducing the cost of electricity for residents, and by supporting jobs in the local solar PV supply chain.

[35] Ibid.

[36] Ibid.

[37] Cardiff Council (2019), Lamby Way Solar Farm, Environmental Scrutiny. Available online at: Microsoft PowerPoint - Lamby Way Solar Farm - Scrutiny Apr 19 amended AG | moderngov.co.uk

[38] Welsh Government (2022), Solar farm powers Morriston Hospital for 50 hours without back-up from the grid in winter months: Solar farm powers Morriston Hospital for 50 hours without back-up from the grid in winter months | gov.wales

[39] Welsh Government (2022), Energy Generation in Wales, 2021.

Community sector

Community energy projects provide income streams that can be delivered directly to communities through Community Benefit Funds, often in the form of grants or loans. These can be used to support initiatives around energy efficiency, increasing awareness of low carbon technologies, sustainable travel, carbon reduction, and fuel poverty reduction as well as more general community and environmental projects. There can be considerable economic benefits for local communities associated with community energy organisations, with an average of 70% of community energy organisational expenditure spent locally, helping to support local jobs and supply chains[40].

Ripple Energy

Ripple Energy launched Graig Fatha, the UK's first consumer-owned wind farm, in Rhondda Cynon Taf in 2020. Graig Fatha operates as a co-op with members owning shares in the wind farm and benefiting from stable electricity prices. Ripple is currently developing a second wind farm in Ayrshire, Scotland, and has announced a third project in the pipeline. Ripple is also exploring community-ownership in the offshore wind sector in Scotland.

At UK level, 57% of community energy companies are run as community benefit societies (bencoms), co-operatives (co-ops) or community interest companies (CICs), with the majority of organisations (70%) run entirely by volunteers. Community Energy Wales defines four models that allow for community ownership of a renewable project: owner operator; commercial developer led; joint venture; and community developer[41]. Welsh Government's Community Energy Toolkit notes that, while 100% community owned models offer the highest potential financial returns, they also carry with them the highest level of risk.

Energy Local

Energy Local is based in Bethesda, North Wales, and supports groups of households to partner with small scale renewable generators to form local power markets known as Energy Local Clubs (legally established as co-ops). Members have smart energy meters installed to show when and how much power they are using, and agree a 'match' tariff that is paid to generators when they match their usage to when electricity is being generated locally (e.g. when a local hydro scheme is in full operation).

The Community Energy in Wales State of the Sector Report for 2021 notes that, since the end of the feed-in tariff in 2019, small-scale community renewables projects have become broadly unviable in Wales, and that the sector's pipeline is now dominated by large-scale projects to achieve economies of scale comparable with the commercial renewable sector. The report also notes that the community renewables sector is gradually moving away from renewable electricity generation, and focusing more on transport, energy efficiency, and low carbon heat[42].

Working in partnership with the public or commercial sector therefore provides opportunities for community renewables organisations to de-risk and/or scale-up their developments. Egni Co-op, for example, works with local authorities and other public sector bodies to install solar PV on the rooftops of community buildings, enabling organisations to benefit from reduced energy bills, without the resource or cost commitments of developing the site themselves.

2.1.5 What regional and local energy planning is underway in Wales?

As noted in the introduction to this report, a key recommendation of Welsh Government's Renewable Energy Deep Dive was the creation of a National Energy Plan by 2024 which would map out future energy demand and supply for all parts of Wales and aim to match local renewable energy generation with energy demand[43]. Regional energy strategies have now been developed for each of the four regions of Wales, and

[40] Community Energy (2022), State of the Sector Report. Available online at: State of the Sector Report | Community Energy Scotland

[41] Ibid.

[42] Ibid.

[43] Welsh Government (2021), Renewable energy deep dive: recommendations.

local authorities across Wales are now beginning to develop LAEPs, with Conwy, Pembrokeshire, Newport and Bridgend the first to produce their plans. Welsh Government has, in the Deep Dive, committed to scaling up local and regional energy planning in developing the National Energy Plan. Support for the LAEP process has included commissioning a technical adviser to Welsh Government, and direct resources for regional bodies to employ officers and procure consultants to support local authorities with the development their plans.

Each regional energy strategy identifies a different mix of interventions, at different scales, required to meet the region's objectives for decarbonising its energy system, covering energy efficiency, heat and transport, as well as energy generation. With regards to electricity generation, objectives are informed by the constraints and opportunities that exist in each region. The Regional Energy Strategy for South West Wales, for example, recognises the opportunities associated with the proposed Swansea Bay Tidal Lagoon project, a strategic project with a capacity of 320MW which could stimulate a new tidal energy industry and generate over 500 GWh per annum[44]. The Regional Energy Strategy for Mid Wales notes that the topography of the region mean that it is unsuited to large scale ground-mounted solar farms, and instead focuses on onshore wind and roof-mounted solar[45]. In North Wales, there is a focus on offshore wind and tidal lagoon technology[46], while the Cardiff Capital Region focuses on onshore wind and solar PV[47]. The Regional Energy Strategy for North Wales also proposes the creation of local energy networks or microgrids in remote locations where grid capacity or connection costs may be a barrier[48]. The Regional Energy Strategy for Mid Wales similarly notes that the creation of local energy markets could enable more renewables projects to connect to the grid in constrained areas[49].

LAEPs allow for the further consideration of interventions that could be brought forward to support delivery of net zero in a local context. The LAEP for Pembrokeshire, for example, highlights the importance of continuing to develop local onshore renewables (primarily ground and rooftop PV), as well as the potential to build on existing work in Milford Haven by developing projects to pilot the use of hydrogen which could position Pembrokeshire as a market leader in this technology. Local ownership is a key focus throughout the plan, and the LAEP notes that community-scale wind should be considered alongside ground and rooftop PV to ensure a more balanced and resilient energy system[50]. The LAEP for Conwy notes the potential of both offshore wind in the area associated with the proposed Gwynt y Môr wind farm extension and tidal lagoon technology, and also recommends the scale-up of onshore renewables.

2.2 The current context: existing supply chains and the transition to net zero

2.2.1 Where in Wales are there existing or emerging clusters of low carbon energy jobs and skills? How well established are local low carbon energy supply chains?

Existing jobs

Recent research by the Energy and Climate Intelligence Unit and the Confederation of British Industry has sought to map the net zero economy in the UK using a classification based on 16 sub-sectors of the economy, including energy co-operatives, grid, low-carbon energy and renewables, and highlights the role that these sub-sectors can have in 'levelling-up', increasing productivity and driving economic growth. This research finds that Wales has a strong net zero economy, with the third highest proportion of GVA from net zero sectors of any region in the UK, and the highest net zero economy GVA per employee. Productivity,

[44] WGES (2022), South West Wales Energy Strategy. Available online at: South West Wales Energy Strategy | gov.wales

[45] WGES (2020), Mid Wales Energy Strategy. Available online at: Mid Wales energy strategy | gov.wales

[46] WGES (2021), North Wales Energy Strategy. Available online at: North Wales Energy Strategy | gov.wales

[47] WGES (2021), Cardiff Capital Region Energy Strategy. Available online at: Cardiff Capital Region Energy Strategy | gov.wales

[48] WGES (2021), North Wales Energy Strategy.

[49] WGES (2020), Mid Wales Energy Strategy.

[50] Pembrokeshire County Council (2022), Pembrokeshire's Local Area Energy Plan.

measured by GVA per employee, is over three times higher in the net zero economy in Wales than in the Welsh economy overall[51].

However, other research suggests that the low carbon electricity sector remains relatively small in Wales in terms of overall direct employment. A 2022 report by Data Cymru considers the jobs and skills that will be required in Wales as it transitions to a green economy[52]. The report uses data from the ONS Low Carbon and Renewable Energy Economy Survey (LCREE), which estimates that, as of 2019, there were 6,000 businesses and 9,700 jobs in the low carbon sector in Wales, of which 2,500 businesses and 1,100 full-time equivalent (FTE) jobs were in low carbon electricity[53]. As shown in Table 2-3, this comprises approximately 200 FTE jobs in offshore wind, 300 in onshore wind, 400 in solar PV, and 100 in hydro. By comparison, the LCREE data estimates that in Scotland in 2019 there were 1,600 FTE jobs in offshore wind, 2,300 in onshore wind, 600 in solar PV, and 700 in hydro[54].

Table 2-3: Estimated number of FTE jobs in renewable electricity employment in Wales (Source: Data Cymru (2022), The labour market of tomorrow)

Sector	2014	2015	2016	2017	2018	2019
Offshore wind	300	c[55]	500	~	300	200
Onshore wind	300	200	500	400	500	300
Solar PV	500	200	100	200	500	400
Hydro	200	~	c	~	200	100

Supply chains

Table 2-4 is taken from Institute of Welsh Affairs (IWA) modelling of the potential economic costs and benefits of the renewable energy transition and shows the proportion of total direct and supply chain spend that could be retained within Wales from investment in different typologies of renewable electricity generation, if supply side sectors grow and relevant skills area available[56]. The lowest proportion of spend that would be retained within Wales is associated with offshore wind, and the highest with hydro. In the solar sector, it is estimated that 46% of spend could be retained within Wales, reflecting a relatively well-developed local supply chain, supporting jobs in installation and maintenance across Wales without the geographical concentration seen in some other sectors.

Table 2-4: Estimated spending that could remain within Wales from renewable energy transition (Source: Institute of Welsh Affairs, 2018, The Economic Costs and Benefits of Renewable Energy Transition in Wales)

Technology	Regional sourcing
Onshore wind	35%
Offshore wind	22%

[51] Energy and Climate Intelligence Unit and the Confederation of British Industry (2023), Mapping the Net Zero Economy: Net zero impacts in national, regional and local economies. Available online at: https://ca1-eci.edcdn.com/Mapping-net-zero-economy-ECIU-CBI-DataCity-Jan2023.pdf?v=1675131416

[52] Data Cymru (2022), The labour market of tomorrow – jobs, skills and the transition to a green economy. Available online at: The labour market of tomorrow – jobs, skills and the transition to a green economy | CH Cymru

[53] The number of businesses is higher than the number of jobs because a business could be e.g. an individual solar PV installation that does not support any employment.

[54] ONS, Low Carbon and Renewable Energy Economy (LCREE) survey estimates, UK, 2014 to 2020: https://www.ons.gov.uk/economy/environmentalaccounts/datasets/lowcarbonandrenewableenergyeconomyfirstestimatesdataset

[55] A c indicates that data has been suppressed for confidentiality reasons.

[56] Institute of Welsh Affairs (IWA) (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales. Available online at: Economic Costs and Benefits | IWA

Technology	Regional sourcing
Solar PV	46%
Marine: Wave	44%
Marine: Tidal stream	41%
Marine: Tidal range	40%
Hydro	69%
All technologies	39%

Analysis of the future potential for offshore wind has noted that the three offshore wind projects off the coast of North Wales have been criticised for the low proportion of spend that was retained within Wales, particularly during construction. For example, the construction of Gwynt y Môr attracted £2 billion of investment, with 35% of value retained in the UK but just 5% within Wales[57]. Some Welsh facilities and companies have benefited from the construction of the three wind farms, however. The Port of Mostyn, for example, was used as construction base for all operations at North Hoyle and Rhyl Flats, and as a construction base for turbine assembly for Gwynt y Môr. Welsh companies have also had greater success in supplying the wind farms during operations and maintenance, and a high proportion of technicians have been recruited locally.

2.2.2 Are there areas of Wales where jobs are at risk as we transition to a low carbon future?

As noted above, the last coal-powered electricity station in Wales closed in 2019. Most remaining gas-powered capacity is accounted for by two large plants, at Pembroke and at Connah's Quay in Flintshire[58]. Outside of the energy sector, there are a number of areas of the economy that have been identified as particularly at risk from the transition to net zero. Research by Data Cymru on jobs, skills, and the transition to a green economy highlights the proportion of employees in each region of Wales that are in high-emitting sectors – agriculture, production and construction – that could be exposed to changes associated with the transition to low carbon and could therefore require reskilling[59]. Mid Wales has a considerably higher than average proportion of its workforce employed in agriculture, forestry and fishing, at 13.6% compared with 3.1% for the whole of Wales.

The Wales TUC[60] estimates that around one in five workers in Wales are in what it identifies as 'climate critical' sectors such as manufacturing, construction, transport and energy, that are likely to be highly impacted by the transition. Figure 2-4 uses data from the Business Register and Employment Survey (BRES) and shows the proportion of jobs in these climate critical industries in each local authority in Wales. The local authorities with the highest proportion of jobs in climate critical industries are Flintshire in North Wales, Neath Port Talbot in Swansea Bay City Region / South West Wales, and Blaenau Gwent and Caerphilly, both in the Cardiff Capital Region. Each of these local authority areas has over a quarter of jobs in climate critical industries, with the largest share of these jobs in the manufacturing sector.

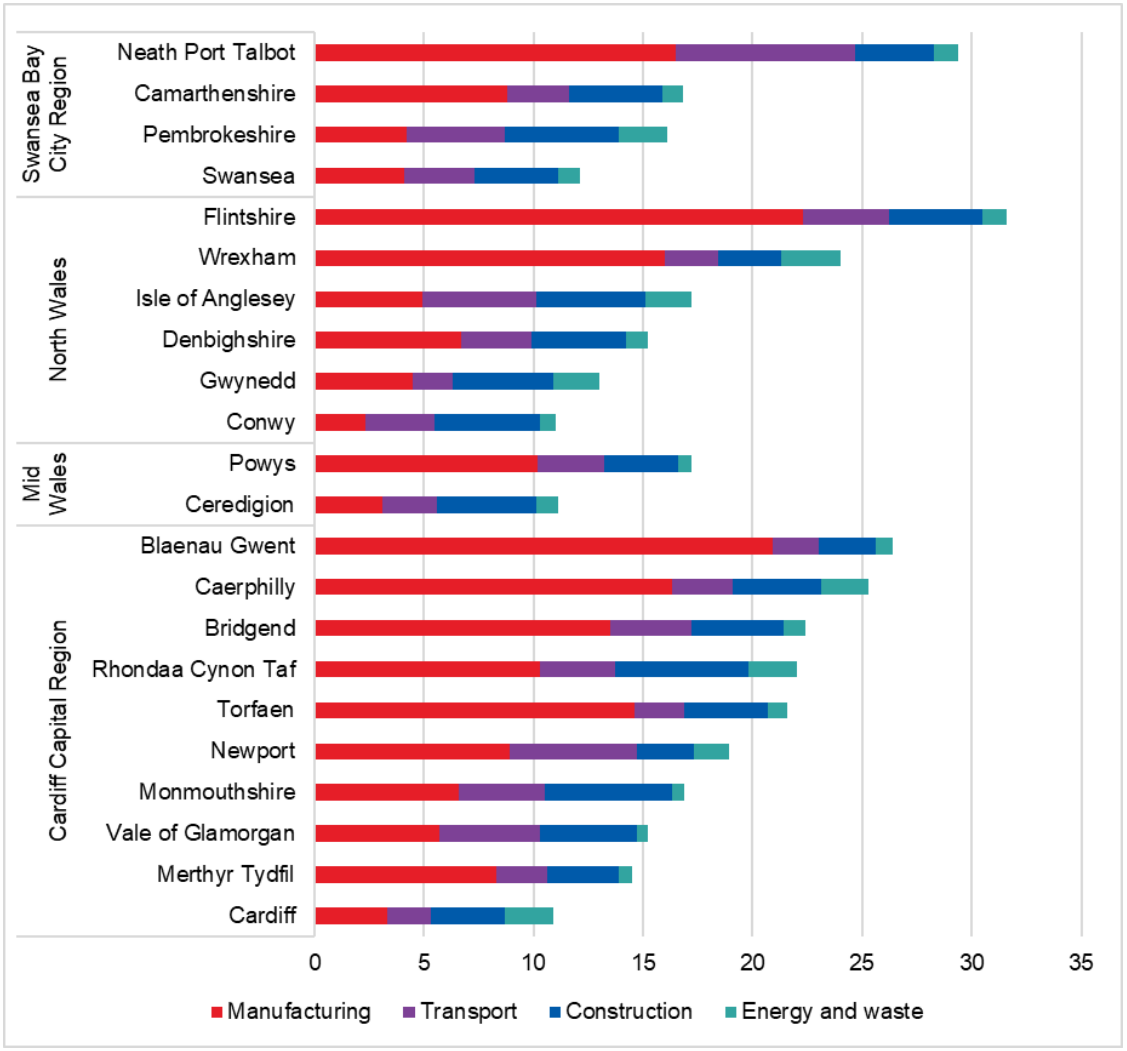
[57] Welsh Government and Carbon Trust (2018), Future Potential for Offshore Wind in Wales.

[58] Welsh Government (2022), Energy Generation in Wales, 2021.

[59] Data Cymru (2022), The labour market of tomorrow.

[60] Wales TUC (2020), A Green Recovery and a Just Transition.

Figure 2-4: Proportion of jobs in climate critical industries, by local authority and region (Source: ONS, BRES, 2021)



The TUC report identifies the steel industry as an example of an energy-intensive industry that faces particular challenges in reducing its emissions. Steel manufacturing employment in Wales is concentrated in Neath Port Talbot, Cardiff, Flintshire and Newport. The TUC report notes that many new, renewable technologies such as wind turbines require steel in their manufacture. There may therefore be an opportunity around investment to support research and development into lower-carbon, greener steel to support a local Welsh supply chain for the wind sector[61].

Welsh Government's Carbon Budget 2 for the period 2021-2025 notes that new skills and capabilities will be required across industry to meet the challenge of decarbonisation, and that new, highly skilled employment could offer opportunities to redeploy employees from traditional industrial sectors[62]. Stakeholders interviewed as part of this research also commented on the importance, but also the difficulty, of reskilling existing workforces and involving them in developing the skills required to support decarbonisation. Work in the South Wales Industrial Cluster (SWIC) has identified issues around recruitment, and the importance of attracting young people into STEM subjects in order to develop the skills needed to support further decarbonisation in future[63].

[61] Wales TUC (2020), A Green Recovery and a Just Transition.

[62] Welsh Government (2021), Net Zero Wales, Carbon Budget 2 (2021-2025). Available online at: All Wales Low Carbon Delivery Plan (2021-2025) | gov.wales

[63] South Wales Industrial Cluster (SWIC) (2022), Skills required for industrial decarbonisation and getting to Net Zero. Skills workshop 14/06/22: Feedback and recommendations.

2.3 Defining 'value'

2.3.1 How are different local areas, developers and governments defining value?

The socio-economic benefits of infrastructure investment have generally been reported in terms of jobs created, GVA, and investment or spending generated. However, there has been a shift towards identifying and reporting wider community and socio-economic benefits, or social value. The Social Value Act was introduced by the UK Government in 2012, and there is now a range of toolkits and frameworks used across industry to define and capture social value. The following definition is taken from an Institute of Civil Engineers (ICE) publication on Maximising Social Value from Infrastructure Projects[64]:

> 'Infrastructure projects can create jobs for previously unemployed people, nurture specialist supply chains, improve local air quality and the urban environment, remove barriers to social inclusion, and ultimately increase the well-being of individuals and communities.' Institute of Civil Engineers

In December 2021, Welsh Government commissioned research by Cwmpas into the social value landscape in Wales, and how best to take forward the implementation of social value within the Welsh context[65]. It was found that there is not currently a single definition or understanding of social value among public sector organisations in Wales, however it was generally agreed by such organisations that social value in Wales is linked to the goals of the Well-being of Future Generations Act, enacted in 2015. The Act defines the following seven well-being goals:

- A prosperous Wales;
- A resilient Wales;
- A more equal Wales;
- A healthier Wales;
- A Wales of cohesive communities;
- A Wales of vibrant culture and thriving Welsh language; and
- A globally responsible Wales.

The regional energy strategies for Wales all recognise the importance of the energy system in supporting the well-being of local communities. The Energy Strategy for North Wales, for example, links its energy objectives directly to the well-being goals, noting that maximising locally generated low carbon electricity to reduce fuel poverty and help local businesses to be more competitive, while allowing surpluses to be exported and therefore generating value for the region, will contribute to the well-being goals of a prosperous, healthier and globally responsible Wales[66]. Welsh Government's Carbon Budget 2 for the 2021-2025 period also recognises the role that locally owned renewables can play in promoting well-being goals such as community cohesiveness.

A key aspect of the approach set out by the ICE is the importance of understanding the needs and priorities of the local area where an intervention will take place. In Wales, Public Service Boards are required to carry out a well-being assessment and to publish an annual well-being plan, setting out how they will meet their responsibilities under the Well-being of Future Generations (Wales) Act. These help to identify local priorities and well-being goals. In Neath Port Talbot, for example, which has both a high proportion of

[64] Institute of Civil Engineers (ICE) (2020), Maximising Social Value from Infrastructure Projects. Available online at: Maximising Social Value from Infrastructure Projects | Useful Projects

[65] Cwmpas (2022), Welsh Government Social Value Review: Summary Report. Available online at: BROCHURE (gov.wales)

[66] WGES (2021), North Wales Energy Strategy.

Wales's renewable electricity capacity and a high proportion of climate critical jobs, the well-being assessment identifies that decarbonising industry remains a significant challenge[67].

The ICE research identifies that there is a range of existing frameworks in use across the infrastructure sector to measure and report social value. The most commonly used methods can be summarised as:

- Raw metrics – e.g. the number of contracts awarded to SMEs;
- Normalised metrics – e.g. the percentage of contracts awarded to SMEs;
- Monetised figures – the total value expressed as a monetary figure;
- SROI ratio – the social return on investment, e.g. £3 of sovial value for every £1 spent; and
- Case studies – to tell the story and benefits.

While social value is often reported as a monetary value, it is important that qualitative data is also captured and reported. The ICE report finds that the trustworthiness of data is often raised as a concern, and that there is a need, recognised across the industry, for a more consistent approach[68].

2.4 Future opportunities

2.4.1 What additional renewable electricity infrastructure is needed in Wales and what are the potential future opportunities?

Electricity generation

Welsh Government, in Future Wales, supports the principle of developing renewable and low carbon energy from all technologies and at all scales to meet Wales's future energy needs. As detailed in section 2.1, over two thirds of progress towards the 70% target has so far come from onshore and offshore wind, and it is likely that wind resources will continue to generate the largest share of renewable electricity in the near future. Energy Generation in Wales provides a summary of current and proposed activities for each of the established low carbon electricity technologies[69]:

- **Onshore wind:** there is strong Welsh Government support for onshore wind. In July 2022 there were three sites under construction, with a further 13 with planning permission and 14 awaiting planning permission, representing a combined pipeline of almost 74 MW. However, the amount of new capacity commissioned in 2021 was the lowest since 2005. The proposed new Welsh Infrastructure Consent is expected to streamline the planning process for onshore infrastructure projects.
- **Offshore wind:** additional capacity of both fixed and floating offshore wind (FLOW) is in development around the Welsh coastline. The Crown Estate has recently announced an ambition to unlock 4 GW of floating offshore wind in the Celtic Sea by 2035, with the potential to accommodate up to an additional 20 GW by 2045. It is estimated that FLOW could produce £682 million in supply chain opportunities across Wales and Cornwall by 2030, and could create 10,000 FTE jobs in Wales. RWE has announced that it has commissioned a project plan for delivering FLOW using ports at ABP Port Talbot and Pembroke Dock for foundation and turbine assembly.
- **Solar PV:** the majority of solar PV installations are small-scale rooftop installations, however 75% of solar capacity is accounted for by 128 larger ground-mounted projects. Capacity is concentrated in South Wales, with 71% in either Swansea Bay City Region or Cardiff Capital Region. The end of the feed-in tariff and other support schemes slowed deployment in the late 2010s, however recent developments including Llanwern Farm Solar Park suggests that subsidy-free business models for large scale ground

[67] Neath Port Talbot Wellbeing Assessment: nptwellbeing.wales – Well-Being-Assesment

[68] ICE (2020), Maximising Social Value from Infrastructure Projects.

[69] Welsh Government (2022), Energy Generation in Wales, 2021.

mounted solar are now coming forward. The deployment of rooftop mounted solar PV has also increased.

- **Marine:** there are no wave or tidal energy projects currently operating in Wales, however there has been significant investment in the sector and there are currently seabed leases in place for 465 MW of marine energy, including two tidal stream and wave energy demonstration sites currently in development. Magallanes Renovables have been awarded the first contract for marine technology in Wales through a Contracts for Difference (CfD) scheme, and will develop a 5.6 MW tidal stream turbine in the Morlais test and demonstration zone off Anglesey by 2025. Welsh Government has announced funding of £450,000 over three years to support Marine Energy Wales.
- **Hydropower:** three-quarters of hydropower capacity in Wales is represented by six large projects, all of which were commissioned before 1989. The majority of projects commissioned since 2010 have been small projects, below 1 MW in capacity. Following the removal of the feed-in tariff and other support schemes, financing hydro projects is challenging and there is very little new capacity coming forward.
- **Waste technologies:** Welsh Government has announced a moratorium on new Energy from Waste plans with capacity of 10 MW or greater, which has impacted the development of future plants[70]. Anaerobic digestion accounts for a relatively small share of electricity generation, with the majority of sites having a capacity of less than 1 MW. Sewage and landfill gas is expected to reduce in importance as the amount of organic waste in landfill sites also continues to reduce.

Energy Generation in Wales recognises that there is significant potential associated with the marine sector and FLOW technologies, which could create highly-skilled jobs and help to regenerate coastal and peripheral communities. The Marine Energy Wales State of the Sector report for 2022 states that Wales has an opportunity to become a leader in the marine industry and an exporter of marine technologies[71].

While the development of solar PV has slowed in recent years, rooftop-mounted solar PV offers opportunities to create value at the local level, particularly in urban areas where other renewable electricity typologies may not be viable or appropriate, and so the sector could have an important role to play in the future renewable electricity mix. There are also signs that subsidy-free models for large scale ground mounted schemes are emerging which could enable more solar capacity to come forward in future.

2.4.2 Where is additional energy infrastructure likely to be best placed?

As noted above, it is recognised in Energy Generation in Wales that wind generation offers the greatest potential to meet Wales' renewable electricity needs in the near future, although there are longer-term opportunities associated with other technologies such as tidal and an important role for solar. This section of the report focuses on the areas that have been identified for offshore and onshore wind.

Offshore wind (including FLOW)

Figure 2-5 is taken from Energy Generation in Wales and shows the location of offshore wind projects in Wales, both commissioned and in development. While the three existing offshore wind farms in Wales are all located off the coast of North Wales, there are five offshore projects currently in development in the Celtic Sea off the coast of South West Wales, including FLOW installations.

[70] The moratorium on energy from waste is due to Welsh Government's Beyond Recycling zero waste strategy and existing capacity in the system. See: beyond-recycling-strategy-document.pdf (gov.wales)

[71] Marine Energy Wales (2022), State of the Sector 2022. Available online at: MEW-2022-State-Of-The-Sector.pdf (marineenergywales.co.uk)

Figure 2-5: Location of offshore wind projects (Source: Welsh Government (2022), Energy Generation in Wales)

There are not currently any offshore installations in development off the coast of Mid Wales. The Mid Wales Regional Energy Strategy notes that The Carbon Trust's 2018 report for Welsh Government on the Future Potential for Offshore Wind in Wales identified more significant barriers to development of offshore wind in Mid Wales compared with other areas of Wales[72]. The Cardigan Bay area, for example, has no access to the transmission network, and so offshore development in this area would require considerable investment to connect prospective offshore wind farms[73].

In the longer term, and assuming these issues are resolved, there could be considerable opportunities associated with offshore development off the coast of Mid Wales. Modelling undertaken by Arup in 2021 for the Department for Business, Energy and Industrial Strategy, The Crown Estate, and The Crown Estate Scotland considered base ambition, balanced growth and high ambition pathways, and ten scenarios for the development of offshore wind by 2050, taking into account geospatial factors including fishing, shipping and seabird foraging. Scenarios developed under a high ambition pathway identified potential locations for fixed offshore wind farms around Anglesey, Cardigan Bay, and in the Celtic Sea, and potential locations for FLOW wind farms in Cardigan Bay and off the coast of Pembrokeshire[74]. This national assessment of a range of scenarios would need to be combined with local knowledge, additional environmental designations and additional Welsh Government policy (e.g. the Wales Marine Plan) in order to develop a comprehensive long-term offshore wind plan for Wales.

Onshore wind

Under Policy 17 of Future Wales: The National Plan 2040, there is a presumption in favour of large-scale wind development in pre-assessed areas where 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[75]. Figure 2-6 is taken from the plan and shows the locations of these pre-assessed areas. There are 10 pre-assessed areas, located in all regions of Wales.

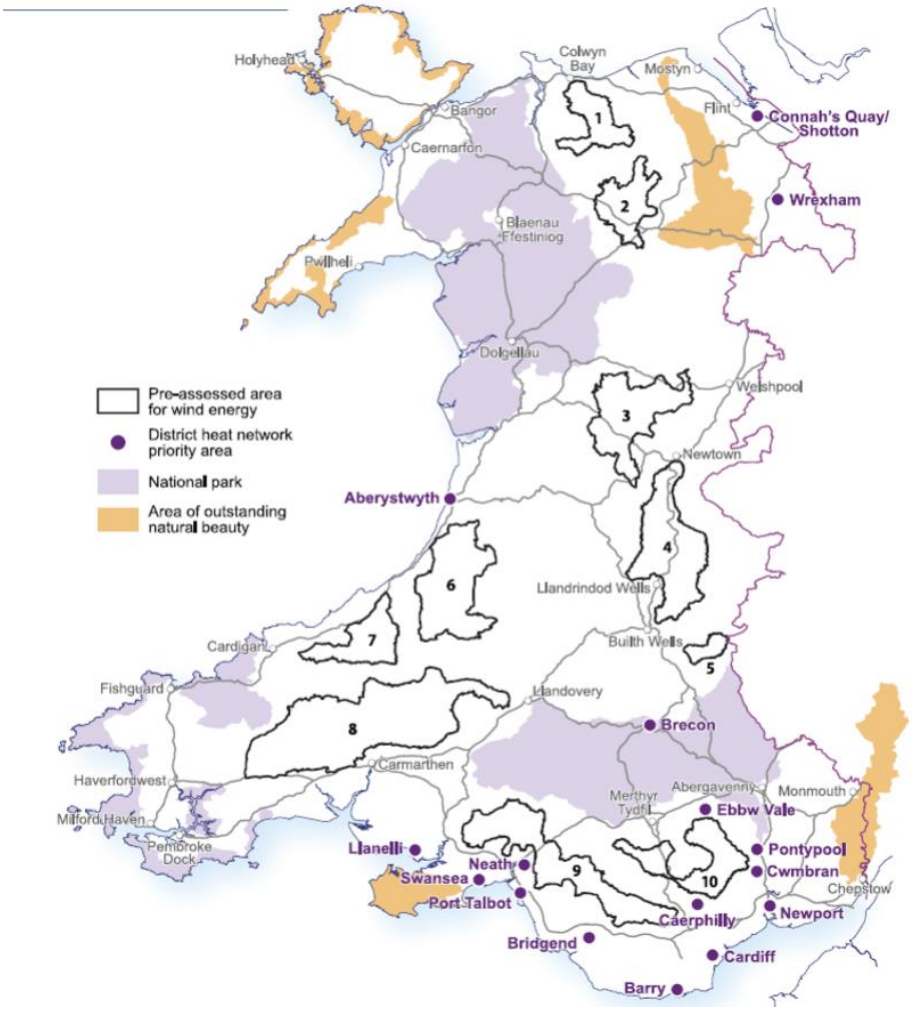
[72] WGES (2020), Mid Wales Energy Strategy.

[73] Carbon Trust (2018), Future Potential for Offshore Wind in Wales.

[74] Department for Business, Energy and Industrial Strategy, The Crown Estate and The Crown Estate Scotland, Future Offshore Wind Scenarios (FOWS) to 2050: FOWS (futureoffshorewindscenarios.co.uk)

[75] Welsh Government (2021), Future Wales: The National Plan 2040. Available online at: Update to Future Wales - The National Plan 2040 | gov.wales

Figure 2-6: Pre-assessed areas for wind energy (Source: Welsh Government (2021), Future Wales: The National Plan 2040)



As with offshore wind, however, there are constraints associated with onshore development in different parts of Wales. The Regional Energy Strategy for Mid Wales, for example, notes that connection costs can be prohibitive in the region due to grid constraints and longer connection distances[76]. Welsh Government is currently working with the ESC to develop whole system net zero scenarios, taking account of both gas and electricity networks, to identify the network infrastructure that will be needed to support Wales to reach net zero by 2050. Outputs from the Future Grid project will help network operators in Wales to understand the steps needed and to plan and build the networks needed in the future[77].

2.4.3 What are the policy levers and delivery mechanisms available to Welsh Government?

Energy policy is not devolved in Wales, however most powers in relation to local government, education, and planning policy are devolved to the Welsh Ministers, giving Welsh Government a range of levers to maximise the delivery of value from renewable electricity infrastructure.

In relation to planning, Welsh Government has provided strong support for renewables development, and for onshore wind in particular, through national planning policy as set out in Future Wales. Policy 17 of Future Wales states that 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'[78]. In the pre-assessed areas (see Figure 2-6), Welsh Government has committed to 'use its policy levers to assist in the delivery of

[76] WGES (2020), Mid Wales Energy Strategy.

[77] Energy Systems Catapult, Welsh Future Energy Grid for Net Zero: Welsh Future Energy Grid for Net Zero - Energy Systems Catapult

[78] Welsh Government (2021), Future Wales.

renewable energy projects in these areas by co-ordinating strategic action to build the case for new or reinforced grid infrastructure where necessary,' and to work with stakeholders to unlock economic, social and environmental benefits for communities[79].

In the community renewables sector, stakeholders recognise that Welsh Government has created a supportive policy environment, and that the Well-being of Future Generations Act has helped by encouraging public bodies in Wales to consider the long-term impacts of their decisions, to involve communities, collaborate, and to tackle issues such as climate change. Welsh Government Energy Service (WGES) provides technical, commercial and procurement advice for the public sector and community enterprises to reduce energy use, generate locally owned renewable electricity, and reduce carbon emissions[80]. The Community Energy in Wales State of the Sector report for 2021 identifies further support needed from Welsh Government and from local government, in terms of improving access to support, resources and finance; improving routes to market for generators to sell energy locally; increasing access to land and buildings for community energy projects; and putting communities at the heart of the net zero transition[81].

Welsh Government has a key role to play in providing leadership on renewables, working with UK Government and other key stakeholders such as Ofgem on issues such as finance, grid infrastructure, and innovation. It also has a role in facilitating use of public sector land and buildings, including for community or locally-owned projects. A key development in this regard is the announcement of the creation of a publicly-owned renewable energy developer for Wales. In relation to finance and funding, Welsh Government has control over some areas of taxation, including council tax and business rates, and partial control over income tax. Welsh Government also supports the Development Bank of Wales, established in 2017 to provide support to businesses unable to access commercial funding, who can demonstrate long term environmental, social and economic benefit[82]. The Development Bank of Wales manages a Local Energy Fund worth £12.5 million, which is available to community groups, social enterprises, local ownership models and SMEs, and has provided support to community renewables organisations.

[79] Welsh Government (2021), Future Wales.

[80] WGES: Energy Service (for public sector and community groups) | GOV.WALES

[81] Welsh Government and Community Energy Wales (2021), Community Energy in Wales: State of the Sector Report 2021

[82] Development Bank of Wales, Funds We Manage: Funds We Manage - Dev Bank (developmentbank.wales)

3. Examples from elsewhere

3.1 Geographical studies

This section of the report provides summaries of in-depth studies of renewable electricity generation across four geographies: Scotland, Germany, New Zealand, and the Republic of Ireland. These geographies were chosen because of physical, economic or regulatory similarities to Wales, and/or because of best practice in terms of renewable electricity production, community renewables, and social value. Each study considered the local policy context; what is being delivered in terms of renewable electricity and value; the extent of community and local ownership and any other models of ownership that are in use; key success factors; and any similarities and differences with the context in Wales. Key learning points for Wales are provided for each study area. These have informed our options development (set out in section 5).

3.1.1 Scotland

Scotland was chosen as a study area as it has some parallels with Wales in terms of its population size, topography and governance framework: as in Wales, most aspects of energy policy are reserved to the UK Parliament, restricting the powers available to both the Scottish and Welsh Governments in relation to renewable energy generation. However, the Scottish Government has control over a greater share of taxes than its Welsh counterpart, and a larger annual budget. Another key difference is that the Crown Estate in Scotland is devolved, giving the Scottish Government control over revenues raised from seabed leasing. In 2020, Crown Estate Scotland distributed £9.7 million to island and coastal local authorities. Scotland's island communities offer a distinct opportunity for wind development that does not exist to the same extent in Wales.

Scotland is recognised as a leader in the UK renewables sector, with large capacities of onshore and offshore wind and potential for significant expansion in offshore technologies including marine and tidal, particularly in the North Sea and around Orkney and Shetland. Total renewable energy capacity in Q3 2022 was 13.6 GW, most of which was from onshore (65%) and offshore (16%) wind, and in 2021 Scotland met 85.2% of its gross electricity consumption from renewable sources[83]. The economic impact of Scotland's renewables sector is considerable: it is estimated that, in 2021, the renewable energy industry directly and indirectly generated a total of £2.6 billion in GVA and supported over 27,000 FTE jobs in Scotland[84].

Alongside largescale wind projects, the Scottish Government recognises the value of smaller, locally or community owned renewables projects, and has a target in the Scottish Energy Strategy of 2 GW of operational renewable capacity in local or community ownership by 2030[85]. As of December 2021, community and locally owned renewable energy projects account for 896 MW of operational renewable energy capacity in Scotland, comprising farm and estate owned installations (41% of capacity), local authority owned installations (16%), local business owned installations (13%), community owned installations (10%), and installations owned by housing associations, other public sector bodies and charities (20%). Close to half of the 27,000 locally owned renewable energy installations in Scotland are solar PV[86], highlighting the important role that rooftop solar can play at the local level in providing opportunities for local and community ownership.

[83] Scottish Government, Scottish Energy Statistics Hub: Scottish Energy Statistics Hub (shinyapps.io)

[84] Fraser of Allander Institute (2022), The Economic Impact of Scotland's Renewable Energy Sector - 2022 Update. Available online at: The Economic Impact of Scotland's Renewable Energy Sector | Fraser of Allander Institute These results should be interpreted with a degree of caution, however, due to the wide margin of error in the survey and data estimation constraints in 2020 associated with the pandemic.

[85] Scottish Government (2017), Scottish Energy Strategy: The future of energy generation in Scotland. Available online at: Scottish Energy Strategy | gov.scot

[86] Energy Savings Trust (2022), Community and Locally Owned Energy in Scotland. Available online at: Community and Locally Owned Energy in Scotland | Energy Savings Trust

Factors that have contributed to Scotland's success in delivering value from renewable electricity projects include:

- **Education and skills** – the Climate Emergency Skills Action Plan sets out the Scottish Government's policy on employment and training to support the country's transition to net zero, and is the first plan on the national scale in the UK that provides a holistic assessment of the workforce and SMEs in relation to changing demands and employment opportunities.
- **Access to finance** – the Scottish Government has invested in research and development in emerging technologies in the marine and tidal sector and has also provided funding for community renewables organisations through the Community and Renewable Energy Scheme (CARES). Since 2010, CARES has provided more than £58 million in funding across more than 600 projects[87].
- **Planning policy** – Scottish Planning Policy, first published in 2014, includes policies to support the delivery of outcomes including to reduce carbon emissions and adapt to climate change. Proposals in the Revised Draft National Planning Framework 4 will require that Local Development Plans in Scotland 'seek to ensure that an area's full potential for electricity and heat from renewable sources is achieved'[88].

Learning for Wales: The Scottish Government has provided strong policy support for renewables, including through the planning system, as well as funding for research and development and for the community renewables sector, and a plan for the skills required to meet its net zero targets. The devolution of the Crown Estate in Scotland allows offshore leasing revenues to be invested in rural and coastal communities.

3.1.2 Germany

Germany was chosen as a study area as it is a recognised global leader in renewable energy, with the largest installed capacity of wind and solar power in Europe. It provides a good example of the economic benefits of renewable energy, the education and training required to develop a skilled workforce in the sector, and of different models of ownership. While Germany is considerably larger than Wales in terms of size, population and its economy, there are some similarities associated with a shared history of manufacturing and energy-intensive industries that are having to adapt and innovate in response to the structural changes induced by the energy transition.

Germany has one of the largest and most well-established renewable energy sectors in the world. In 2021, renewables accounted for 45% of all electricity generated in Germany[89], and it was estimated that 344,100 people were employed in the sector, an increase of more than 300% since 2000[90]. Community energy has been one of the key pillars of Germany's energy transition under the Renewable Energy Sources Act (EEG). The Act included a feed-in tariff that guaranteed a stable price for 20 years for both large and community-based developments. This gave local communities an important role in getting smaller scale renewable energy projects up and running, contributing to the acceptance of the energy transition. In 2020, 40.4% of renewable energy capacity was owned by private individuals (30.2%) and farmers (10.2%), including 40.6% of onshore wind and 48% of solar PV[91].

Community or locally owned energy projects in Germany can be relatively large, and many cities own and manage their own distribution network or have set up a municipal company that manages the distribution system ('Stadtwerke'). Of the 900 DSOs (distribution system operators) in Germany, 700 are Stadtwerke[92],

[87] Scottish Government, Renewable and Low Carbon Energy: Renewable and Low Carbon Energy | gov.scot.

[88] Scottish Government (2022), Scotland 2045: Our Fourth National Planning Framework. Available online at: Scotland 2045: Our Fourth National Planning Framework | www.gov.scot

[89] Strom-Report, Electricity Mix and Electricity Generation: Strommix und Stromerzeugung | Strom-Report

[90] Erneuerbare Energien, 15th November 2022, 100 additional geothermal projects set to heat up Germany: 100 zusätzliche Geothermie-Projekte sollen Deutschland einheizen | Erneuerbare Energien

[91] Agentur für Erneuerbare Energien (2021), New study shows that community energy remains a central pillar of the energy transition: Neue Studie zeigt: Bürgerenergie bleibt zentrale Säule der Energiewende | Agentur für Erneuerbare Energien

[92] Clean Energy Wire 18th February 2015, Small, but powerful – Germany's municipal utilities: Small, but powerful – Germany's municipal utilities | Clean Energy Wire

and it is estimated that two-thirds of all electricity in Germany is bought from Stadtwerke[93]. Stadtwerke have been able to maintain their local customer bases due to their popularity and trust, with their profits staying in the local community[94]. Stadtwerke have also been instrumental in developing renewable electricity generation, with the Stadtwerke in Munich supplying enough renewable energy for every household in the city since 2016 and aiming to supply all of the city's industry by 2025[95].

Factors that have contributed to Germany's success in delivering value from renewable electricity projects include:

- **Policy support and access to finance** – feed-in tariffs available in the 2000s incentivised renewable power installations. As a result of this payment and strong policy support through the EEG, Germany experienced significant growth in the share of renewable energy in electricity generation, especially by private individuals. While these have now ended, feed-in-tariffs for solar installations of up to 750 kW were introduced in the EEG 2023 to incentivise solar PV installations on rooftops.
- **Community involvement** – when the EEG came into force in 2000, German citizens started driving the energy transition by becoming energy producers, investing in solar panels on their houses and buying shares in wind parks[96]. Having this large group of private individuals invest in renewable energy and directly receiving the benefits contributed to support and acceptance of the energy transition and decreased resistance from communities and individuals.
- **Education and skills** – Germany's vocational and education training (VET) system trains 500,000 apprentices in Germany every year[97]. Over 60% of renewable energy firms offer trainee positions within the VET. The VET system also offers advanced vocational degrees in renewable technologies. The supply chain is also well-established, although the German government has recently taken measures to increase energy security and supply chain resilience and reduce its dependence on imports[98].
- **Innovation** – the German government is using Carbon CfDs to finance the decarbonisation of Germany's industrial sites and rollout hydrogen infrastructure. Other innovative approaches to the transition include the development of a floating solar PV park on the former Hambach opencast mine, which could create up to 8,000 new jobs.

Learning for Wales: The EEG in Germany has been successful in embedding community and municipal ownership of renewables, and in building public support for renewable electricity schemes. The VET scheme provides an established, sustainable supply of skilled workers for the sector, and the German government has used CfDs to fund innovative approaches to decarbonisation.

3.1.3 New Zealand

New Zealand was chosen as a study area as it has some geographical and topological similarities to Wales, and significant potential for renewable energy, particularly offshore. In 2021, New Zealand had the fourth-highest share of renewable energy in electricity generation in the OECD, at 82.1%[99]. Historically, renewable electricity generation in New Zealand has been dominated by power from the hydro sector, geothermal and solid biofuels. However, generation from wind increased in 2021 was the highest on record. Transpower, New Zealand's state-owned grid and system operator, has estimated that by 2050 the country will need to

[93] The Guardian, 23rd September 2021, If the UK's energy suppliers were publicly owned, would we be having this crisis? If the UK's energy suppliers were publicly owned, would we be having this crisis? | David Hall | The Guardian

[94] Clean Energy Wire, 18th February 2015.

[95] The Guardian, 23rd September 2021.

[96] Neil Simcock, Rebecca Willis and Peter Capener, Cultures of Community Energy: International case studies. Available online at: (PDF) Cultures of Community Energy: International Case Studies (researchgate.net)

[97] Clean Energy Wire, 16th November 2018, How Germany's vocational education and training system works: How Germany's vocational education and training system works | Clean Energy Wire

[98] Tagesschau, 12th November 2022, Raw material dependency grows: Abhängigkeit bei Rohstoffen wächst | Tagesschau

[99] Invest New Zealand, Renewable Energy: Renewable Energy | nzte.govt.nz

generate nine times more electricity from wind to meet demand from population growth and the electrification of transport and industry[100].

It is recognised that offshore wind provides a significant opportunity, including in areas that could be hard-hit by decarbonisation such as the Taranaki gas field, and that the sector has the potential to support a just transition, by transferring skills in offshore gas and oil that already exist in the Taranaki area into the offshore wind sector, creating new, well-paid jobs in an area that could otherwise be badly affected by the move away from fossil fuels[101]. Enabling an equitable transition, including for Māori, and ensuring that no one will be left behind in the transition is a key element of the New Zealand government's first Emissions Reduction Plan (ERP), published in 2022.

The New Zealand government has earmarked community energy as an investment mechanism to assist the country in reaching its climate targets and lead to wider local benefits[102]. Community energy projects are seen as important in leading innovation and maturation of renewable energy technologies during periods when they may not be commercially attractive, as in Germany in the early 2000s. However, the community renewables sector is currently small and under-developed. A recent initiative that has aimed to change this is the Māori and Public Housing Renewable Energy Fund, introduced in 2020, which provides funds to trial renewable energy technologies on Māori and public housing.

Themes that have emerged in relation to delivering value from renewable electricity projects in New Zealand include:

- **Scaling up offshore wind** – New Zealand is recognised as having one the best offshore wind resources globally due to the prevailing westerly winds, and the wind energy sector is rapidly expanding as an integral part of New Zealand's energy infrastructure[103].
- **Encouraging community involvement in renewables –** although the community renewable sector has been relatively underdeveloped to date, community involvement is also seen as important in supporting the transition and delivering benefits at the local level. Supporting community renewable projects for Māori and public housing is identified as an action in the ERP.
- **Enabling an equitable transition** – ensuring the transition to net zero leaves no community, family or person behind is one of the five key principles of the ERP. In the New Zealand context, it is important that developers engage meaningfully with Māori and iwi communities, particularly in the Taranaki area where there is a perception that energy resources have been extracted without any returns for the community[104].

Learning for Wales: New Zealand is rapidly scaling up its offshore wind sector, with a focus on ensuring an equitable transition, including in existing industrial areas that could be impacted by decarbonisation. Community renewables schemes are recognised for their importance in developing technologies and encouraging participation**.**

3.1.4 The Republic of Ireland

The Republic of Ireland was chosen as a study area as it again has some geographical and topological similarities to Wales, and an expanding renewables sector. The Government of Ireland has set some ambitious targets in its Climate Action Plan 2021, including generating 80% of Ireland's total electricity

[100] Newsroom, 17th June 2022, 'An unlimited resource': NZ's offshore energy revolution: 'Unlimited resource': NZ's offshore energy revolution | newsroom.co.nz

[101] Newsroom (2022), 17th June 2022.

[102] Roberts, R., Brent, A. and Hinkley, J., 2021. Reviewing the impacts of community energy initiatives in New Zealand. Kōtuitui: New Zealand Journal of Social Sciences Online, 16(1), pp.45-60.

[103] Zhiguo Zhang, Xiran Liu, Dan Zhao, Scott Post, Jiasen Chen, (2022). *Overview of the Development and Application of Wind Energy in New Zealand*. Energy and Built Environment. Available online at: Overview of the development and application of wind energy in New Zealand | Science Direct.

[104] Newsroom (2022), 17th June 2022.

supply from renewables and achieving 8 GW installed onshore wind capacity by 2030[105]. Ireland is a member of the North Seas Energy Cooperation (NSEC), an EU initiative that supports the development of an offshore grid linking the nine countries in the North Seas region[106], and as part of an agreement with other NSEC countries reached in September 2022, set a target of reaching 7 GW installed offshore wind capacity by 2030, rising to 37 GW by 2050.

Ireland has installed wind power capacity of 4,306 MW at the end of 2020[107], and the Government of Ireland recognises that expanding wind capacity will play a central role in achieving its climate targets. A key initiative is the creation of FuturEnergy Ireland, a joint venture founded in 2021 by two majority-state owned organisations, the forestry company Coillte and the electricity company ESB (Electricity Supply Board) which owns and operates the distribution network in Ireland[108]. Coillte manages 7% of Ireland's land, and the joint venture therefore represents an opportunity for ESB to further its investment in and commitment to onshore wind generation in Ireland through development of wind capacity on state-owned forestry land.

Community owned energy is a small but growing industry in Ireland, with only a handful of community owned projects in operation at present[109]. However, the Renewable Energy Support Scheme (RESS) scheme has been effective for expanding community-owned renewable energy capacity, and the Government of Ireland recognises the importance of community energy generation for achieving its net zero targets. The first RESS auction, RESS-1, granted support for seven community-led projects, four of which are being developed in collaboration with Community Power, Ireland's first community owned electricity supplier. Community Power provides communities with optional PPAs, so they can sell their excess electricity to the national grid, thereby improving their revenue stream[110].

Factors that are supporting the expansion of renewables and the delivery of value in Ireland include:

- **Ownership and delivery models** – the FuturEnergy Ireland partnership is likely to play a key role in expanding renewable energy capacity in Ireland, by supporting the development of onshore wind energy projects on state-owned forestry land in partnership with the state-owned electricity supplier. Community Power, as a community owned supplier, is able to work with community energy groups to generate and supply renewable electricity in their communities and across Ireland.
- **Government support schemes** – schemes to support the development of renewables in Ireland include the RESS, an auction-based system that has a separate category within each auction for 100% community owned projects. The RESS awards a feed-in tariff guaranteed for 15 years, and sets a mandatory Community Benefit Fund of €2/MWh for all generation projects to be used for the wider economic, environmental, social and cultural well-being of the local community. Other schemes available include support for micro-generation and an offshore renewable electricity support scheme.
- **Education and skills** – the Government of Ireland's Climate Action Plan estimates that Ireland's energy transition could create up to 27,000 jobs by 2030. To meet this demand for labour, the government has invested €225 million for further education and research, including a skills package for upskilling and reskilling the workforce, and a Green Skills Action programme[111].

Learning for Wales: The partial state-ownership of the ESB enables efficiencies in the development of onshore wind on the Irish woodland estate, while the regulatory framework in Ireland allows community generators to supply their electricity locally and to communities across the country.

---

[105] Government of Ireland (2021), Climate Action Plan 2021. Available online at: Climate Action Plan 2021 | gov.ie

[106] European Commission, The North Seas Energy Cooperation: The North Seas Energy Cooperation | European Commission

[107] EurObserv'ER (2021), The State of Renewable Energy in Europe. Available online at: The State of Renewable Energy in Europe | EurObserv'ER

[108] FuturEnergy Ireland, The FuturEnergy Ireland Story: About | FuturEnergy Ireland

[109] Community Power EU, Community Power in Ireland: Community Power in Ireland | Community Power EU

[110] Claremorris Energy Co-op, Solar Energy: Solar Energy | Claremorris Energy Co-op

[111] Government of Ireland, 1st June 2021, Minister Harris announces €225 million investment in further and higher education and research under National Recovery and Resilience Plan. Available online at: Press Release | gov.ie

3.2 Case studies

This section sets out a range of relevant case studies from Wales, the UK and Europe. While most of these are in the renewable electricity sector, we have also included the Hinkley Point C nuclear project in Somerset as an example that demonstrates best practice in the delivery of wider socio-economic benefits and social value on a large scale infrastructure development. Each case study identifies key learning points for Wales.

3.2.1 Renewable energy projects in Wales

Gwynt y Môr, North Wales

Large-scale offshore wind farm, providing Community Benefit Funds through local, independent organisations, for community projects in North Wales.

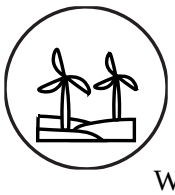
Gwynt y Môr, located off the coast of North Wales, is the world's second largest wind farm, and represents an investment of £2 billion. It is operated by the German multinational RWE. The Gwynt y Môr Community Fund was established in 2015 and, over the lifetime of the project (expected to be 25 years), is expected to invest up to £19 million in community schemes in Flintshire, Denbighshire and Conwy. Grants of up to £10,000 are available for projects that focus on three core themes, which align with the Well-being of Future Generations Act:

- Building strong, cohesive and sustainable communities;
- Developing prosperous, enterprising communities with strong economic growth; and
- Reducing poverty and inequality in communities[112].

The fund is administered independently by Community and Voluntary Support Conwy, with support from Denbighshire and Flintshire Voluntary Services Councils. As of 2018, over £635,000 of funding had been committed to a total of 48 projects, safeguarding 97.5 existing jobs and creating a further 33.5. In addition, close to £2 million of match funding had been secured. Projects supported have included community centres, sports organisations, charities, and other community organisations. The fund has provided a five year donation to the Royal National Lifeboat Institute in North Wales, and in 2018 funded training for all volunteer lifeboat crews along the North Wales coast[113].

In addition to the community fund, a one-off tourism fund of £690,000 during construction of the project made improvements to the pier and slipway at Llandudno, contributed to the redevelopment of Rhyl harbour, and provided funds to a project to promote walking and cycling opportunities, nature reserves and other attractions between Llandudno and Prestatyn[114].

Key learning point: value for coastal communities derived from Community Benefit Funds associated with large scale commercial wind development.



Cwm Arian Renewable Energy (CARE), West Wales

Co-operative in West Wales that has been through challenging process to get a community wind project approved.

Cwm Arian Renewable Energy (CARE) is a co-op or community benefit society in West Wales that has faced various challenges in pursuing a community wind energy scheme. Initial proposals for a wind energy project were refused at local authority level. In October 2019 a 700kW wind turbine was installed at Trefawr Farm near Llanfynach after the co-op won planning permission at appeal. It is hoped that local residents will be able to buy shares and become owners, to receive financial rewards in

[112] Carbon Trust (2018), Future Potential for Offshore Wind in Wales.

[113] Gwynt y Mor Community Fund (2017), Third Year Report 2017-2018. Available online at: Annual Report | RWE

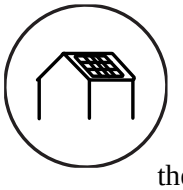
[114] Ibid.

the future[115]. This project is an example of what collective action in a community can achieve, as well as some of the barriers that community energy projects can face.

Developing a Community Action Plan encouraged local residents to come together and build a strong social network. This has led to a vision for the future of their community, which included a renewable energy scheme. In 2010 CARE was established with the intention to implement a wind energy project that would provide an income for the community, which is one of the two in Wales most at risk of fuel poverty, through selling electricity to the national grid. The aim was for this income to support community facilities and households to reduce their carbon footprint, and help them become more resilient to climate change by offering training and more. The wind energy scheme is therefore seen as a way to protect the more rural, local community and the limited facilities available.

External expertise and advice helped CARE to progress their renewable energy vision by covering the feasibility research and community engagement processes[116]. Another important element that helped make the project financially feasible was the availability of a feed-in tariff. Recent changes to the feed-in tariff, however, have meant that some of the initial plans became unfeasible and required CARE to change their business models. Another aspect that made it difficult for CARE to progress with their scheme was related to the planning system, and in particular a mismatch between the national support, which in the case of CARE was given by Welsh Government, and a local level where objections were raised by elected councillors and planning permission initially denied.

Key learning points: value generated by community renewable schemes, particularly in rural areas, from participation and community involvement.



Egni-Co-op, Wales

Co-operative with nearly a hundred rooftop PV sites in Wales on buildings owned by other organisations, including local authorities.

Egni Co-op develops rooftop solar energy in Wales and is the largest rooftop solar co-op in the UK, with over 1,000 members[117]. It was founded in 2013 and launched its first share offer in 2014, funding 179kW across seven sites. In 2022, Egni was awarded £2.35 million in funding by Welsh Government to install solar panels on community buildings that will produce nearly 2 MW of electricity annually[118]. Egni currently has 4.5 MW of capacity on 88 sites, including schools, community buildings and businesses.

Egni's financial model has been one of the key factors contributing to its success. The organisation has successfully raised over £3 million through its community share offering. Raising capital through shares reduces borrowing costs, whilst freeing up more of the money from grants for other projects. Profits generated from completed installations go towards a fund that is expected to reach £2.9 million over the next 20 years[119]. One of Egni's key objectives is the development of renewable energy resources for the benefit of the community, with surplus profits reinvested into climate change education initiatives. Egni has worked with schools in South Wales to reduce their carbon footprint by 20% in partnership with Energy Sparks and are now developing projects which engage pupils in learning about climate change and understanding its impact in Wales and the world.

Egni Co-op is a good example of how by hosting installations owned by community groups, local authorities and other public sector bodies can support and encourage renewable energy installations on community properties and reduce their energy bills, without the resource or cost commitments of developing the site themselves.

---

[115] Cwm Arian Renewable Energy, Community Wind Turbine: Community Wind Turbine | Care (cwmarian.org.uk)

[116] Simcock et al, Cultures of Community Energy: International case studies.

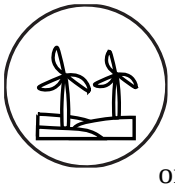
[117] Egni Co-op, About Us: About Us | Egni Co-op

[118] Welsh Government, 5th April 2022, Schools and public buildings to get solar panels as Wales drives community owned renewable energy. Available online at: Schools and Public Buildings to Get Solar Panels as Wales Drives Community Owned Renewable Energy | gov.wales

[119] Egni Co-op, New Community Hwb Taking Shape: News | Egni Co-op

Key learning points: co-operation between community renewables sector and the public sector to enable scaling-up of rooftop solar PV, enabling communities in more urban areas to benefit from local renewables.

3.2.2 Renewable energy projects elsewhere in the UK and Europe



Whitelee Windfarm, Central Scotland

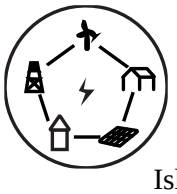
Large-scale commercial wind farm providing a wide range of social, economic and environmental benefits.

Whitelee Windfarm, located on Eaglesham Moor to the south of Glasgow, is the largest onshore wind farm in the UK and the second largest in Europe. It is operated by Scottish Power Renewables (SPR), part of the Spanish multinational Iberdrola. The site covers 83km^2 and three local authority areas and is leased from nine landowners including Scottish Water, Forestry and Land Scotland, and private landowners. The site was developed in two phases, with the first phase in operation since 2009, and the second since 2012.

At the peak of construction, Whitelee created over 4,000 FTE jobs in Scotland, and the site supports a further 600 Scottish FTE jobs through operation, including skilled jobs in operations and maintenance. In terms of supply chain, almost half of expenditure associated with the wind farm is expected to be spent with Scottish companies, and 60% with UK companies. An assessment of the economic, environmental and social benefits of the wind farm notes that the experience gained by the supply chain in supporting Whitelee has contributed to the successful expansion of onshore wind as an employer, both in Scotland and the UK[120].

As well as generating jobs directly and in the supply chain, the wind farm has had a range of social and environmental benefits. The Whitelee Windfarm Community Benefit Fund has awarded over £9 million to local projects in its three host local authorities, with a further £14.5 still to be paid. The Whitelee Windfarm Visitor Centre provides an exhibition room, café, shop and education hub and runs STEM-focused educational programmes for schools and community groups. There is also access to a network of over 130km of tracks for cyclists, walkers and horse riders. It is estimated that 200,000 people a year visit the wind farm for recreational activities, and in total there have been over 750,000 visits to the visitor centre. SPR has also committed to restoring 900 hectares of previously forested peatland on the site, and is working with partners including RSPB, Scottish Natural Heritage and Forestry and Land Scotland to improve biodiversity[121].

Key learning point: wide range of community benefits associated with large scale onshore wind development in an accessible location, close to a large population centre.



Eigg Electric, Isle of Eigg

Community owned microgrid system using solar, wind and hydro power to provide a reliable and sustainable source of electricity for a remote island community.

The Isle of Eigg is one of the Small Isles off the west coast of Scotland, to the south of the Isle of Skye. In 1997, it was subject of one of the first community buyouts in Scotland, when the Isle of Eigg Heritage Trust (a partnership of the community, Highland Council and the Scottish Wildlife Trust) raised funds to buy the island for £1.5 million from a private landowner. The island did not have access to mains electricity, and most households relied on diesel generators for power. Following the buyout, local residents and the Isle of Eigg Heritage Trust decided to pursue a mains-style electrification system that would provide reliable and affordable power to all households on the island[122].

Eigg Electric Ltd was set up to develop an electricity supply for the island that would be sustainable both environmentally and economically. The system started generating power in 2008, and was the first in the world to integrate the renewable resources of wind, water and solar generated power into a grid system

[120] Scottish Power Renewables and BVG Associates (2019), 10 years of Whitelee Windfarm: A decade of economic, environmental and social benefits. Available online at: BVGA SPR-Whitelee 10-year anniversary | BVG Associates

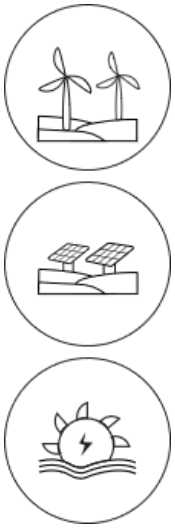
[121] Ibid.

[122] Wind and Sun, Case Studies – Isle of Eigg: Isle of Eigg, Inner Hebrides, Scotland | Wind & Sun (windandsun.co.uk)

designed to supply an isolated rural community. The system consists of three hydroelectric generators, four small wind generators, and an array of solar PV installed at locations around the island. A bank of batteries is also incorporated into the scheme to allow the system to optimise use of renewable resources, and there are back-up generators to provide power when renewable sources are in short supply[123].

To support a sustainable supply of electricity to all households on the island, each house has a maximum use limit at any one time of 5 kW, and each business a limit of 10 kW. Residents all have energy meters to help them monitor their consumption, and any excess generation is used to heat community buildings. Since the scheme was switched on in 2008, renewable sources have provided 95% of all electricity used on the island, with the remaining 5% from back-up generators[124]. The provision of a relatively affordable and secure electricity supply is one of several factors that have supported an increase in the population of Eigg since the community buyout, from 65 to around 110. The Isle of Eigg Heritage Trust has subsidiaries that own and manage community facilities on the island and that undertake renovations of housing and other community properties[125], and has also been active in promoting eco-tourism on the island[126].

Key learning point: value of microgrid / SLES solution in a remote location with grid constraints.



Ecopower, Belgium

Large-scale co-op with over 65,000 members operating in Flanders, Belgium. This co-op functions as a commercial player but is able to offer its members lower prices and maintains strong social goals.

The large scale co-op Ecopower has 40 staff and over 65,000 members, and generates and supplies electricity across the Flanders region of Belgium[127]. Ecopower operates and owns multiple generation projects ranging from wind turbines and solar PV to a hydro, and also operates a factory producing wood pellets. Together these produce about 100 million kWh per year[128], most (95%) of which comes from wind turbines. As a supplier, Ecopower produces around 50% of the power it supplies itself, and buys the other 50% from other green producers[129].

The co-op operates in a similar fashion as more commercial players, but emerged from concerns around energy security and climate change and has strong social goals, reinvesting most of their profits back into communities[130]. Members of Ecopower receive electricity at a lower price than the market rate and are entitled to a dividend of 6% per share when there are profits and a vote in the decision-making process. Through energy efficiency measures, Ecopower members have been able to reduce their electricity consumption by an average of 50% over the past 10 years. In terms of delivering value, Ecopower enters into direct partnerships with local municipalities to support economic and social value creation[131]. The Ecopower case study shows that community energy schemes are able to expand whilst maintaining strong social goals.

[123] Isle of Eigg, Eigg Electric: Eigg Electric - The Isle of Eigg

[124] Ibid.

[125] Ibid.

[126] Development Trusts Association Scotland (2021), Grassroots: Community pathways to sustainability. Case study: Isle of Eigg Heritage Trust. Available online at: Isle of Eigg Heritage Trust - Case Study | DTA Scotland

[127] Knack, 2nd May 2022, Ecopower: 'In Vlaanderen is het nagenoeg onmogelijk om nog een windturbine op land vergund te krijgen': Ecopower: 'In Vlaanderen is het nagenoeg onmogelijk om nog een windturbine op land vergund te krijgen' (knack.be)

[128] Friends of the Earth Europe (2018), Unleashing the Power of Community Renewable Energy. Available online at: community_energy_booklet_2018_en.pdf (energy-cities.eu)

[129] Energy Transition 3rd November 2014, Best in Class: Belgian energy co-op Ecopower: Best in class: Belgian energy co-op Ecopower | Energy Transition

[130] Simcock et al, Cultures of Community Energy: International case studies.

[131] Friends of the Earth Europe (2018), Unleashing the Power of Community Renewable Energy.

Key learning point: opportunity to significantly scale up and diversify community-owned renewables schemes, while maintaining strong social goals.

Som Energia, Catalonia

Co-op established in 2010 which now has 83,000 members, Som Energia both owns renewable energy generation and acts as electricity supplier to customers.

Som Energia (Catalan for 'we are energy') was founded in 2010 in Girona with 350 members and was the first co-op of its kind in Spain[132]. Initially Som Energia sold green energy from existing sources, before developing its own renewable energy projects.

The first project developed by Som Energia was a solar PV installation on an industrial building in the city of Lleida, which went into operation in 2012[133]. In 2016, it developed the first collectively owned solar field in Spain, which supplies 1,300 households[134], and reported profits for the first time[135]. As of 2018, Som Energia produces 10% of the energy that it supplies and buys the other 90% from certified green energy producers, and more than 11 million euros have been invested in new projects by members[136]. The co-op now has over 83,000 members, over 40 members of staff, and produces and commercialises energy from a range of renewable sources including solar, biogas and hydro. Its first wind turbine, the first of its kind in Spain, was under construction as of 2017[137].

The co-op works on the principle that any individual, company, or public administration sharing the same values can join the organisation by paying an entrance fee of 100 euros. Som Energia collaborates with over 300 municipalities and is contracted directly as the electricity supplier to around 160. Villages with fewer than 500 inhabitants can contract Som Energia to supply their electricity without paying the entrance fee. Each member can also share their membership with up to five others, meaning that they do not have to pay the fee, which helps to increase access to green electricity to people on lower incomes[138]. Som Energia acts against fuel poverty, by not charging households in precarious circumstances for their energy consumption for a year. It also collaborates with municipalities on fuel poverty, including four which have indicated that they will pay the electricity bill for vulnerable households in their area.

Key learning points: ability to both generate and supply renewable electricity, and importance of working with communities and the public sector to identify local need and deliver social value.

Middelgrunden Wind Farm, Denmark

Large-scale off-shore wind farm close to Copenhagen harbour that is half-owned by a local co-op and half by Copenhagen municipality.

Denmark has a longstanding supportive regulatory framework for community energy projects and in 2011 decreed that new wind farms must be at least 20% community-owned[139]. Middelgrunden Wind farm has been operational since 2001, and consists of 20 wind turbines outside the harbour of Copenhagen, providing a capacity of 40 MW. The project is one of the largest community-owned wind projects worldwide. Governmental support, grants, and one of the first feed-in tariffs early on in the project helped to turn this project into reality and navigate the complexities around feasibility and planning

[132] Europa Press, 11th December 2010, The first renewable energy cooperative in Spain is established in Girona: Constituyen en Girona la primera cooperativa de energía renovable de España | europress.es

[133] Transformative Cities, Co-operative breaks the mould to provide renewable energy: Som Energia: Cooperative breaks mould to provide renewable energy - Transformative Cities

[134] Transformative Cities, Co-operative breaks the mould.

[135] Energy Democracy, 14th November 2017, Som Energia, Catalonia: Som Energia | energy-democracy.net

[136] Transformative Cities, Co-operative breaks the mould.

[137] Energy Democracy, 14th November 2017.

[138] Transformative Cities, Co-operative breaks the mould.

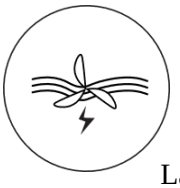
[139] Green Economy Coalition, 20th September 2017, Communal ownership drive's Denmark's wind revolution: Communal ownership drives Denmark's wind… | Green Economy Coalition

in the offshore wind sector. Other factors that have contributed to its success include decentralised governmental structures, giving local councils responsibility and means to start projects.

The project is half-owned by Copenhagen municipality through Copenhagen Energy and half by a local co-operative with over 10,000 members. Initially only residents living within the municipality were allowed to join but after legal changes now anyone in Denmark can become a member. The involvement of Copenhagen municipality has helped the project by contributing knowledge and experience, and by creating a sense of accountability, legitimacy and credibility. Both partners invested the total $60m needed for the farm[140] and locals who bought shares have all their money back and got about seven percent interest yearly[141]. The operations of the farm are managed by a company called SEAS Wind Energy Centre on behalf of its members.

Local commitment is seen as one of the reasons why the project has been so successful, helping with obtaining local investment to finance the project, increasing social acceptance, raising public awareness, and helping to resolve conflicts early on[142]. Engagement and participation early on in the project have also helped obtain public acceptance and trust from the local population. Their input led to changes in the number of wind turbines and their placing, to better fit the local environment. The site is now considered part of the cultural identity of the country and a source of pride. Twenty years into the project there are however concerns that a replacement of the wind turbines, that are now reaching their end of life, is too expensive and risky for a co-operative, especially now that the renewable industry no longer receives subsidies in Denmark[143].

Key learning point: co-operation between public sector and community sector supporting public acceptance of large scale renewables.



La Rance Tidal Power Station, France

The world's first commercial tidal power station and the second largest in the world, generating significant social and economic benefits, but with some adverse environmental impacts.

La Rance Tidal Power Station is the world's first commercial-scale tidal power station and the second largest in the world. It is located in the estuary of the Rance River in Brittany, northern France, and is operated by the state-owned energy company EDF. With an installed capacity of 240 MW, it was the world's largest tidal power station from its commissioning in 1966 until 2011. The Rance has one of the highest tidal ranges in the world with an average tidal range of 8m, rising to 13.5m during equinoctial spring tides, making it an attractive site for harnessing tidal power[144].

The total cost of the tidal power plant, converted from French francs, was €94.5 million, and it took 20 years for the costs of development to be recovered through savings made from its energy generation. The planthas 24 turbines that generate 500 MW of electricity per year, accounting for 12% of all electricity production in Brittany in 2020 and equivalent to the consumption of 225,000 inhabitants[145]. EDF estimates that the plant adds €25 million every year to the local economy. The tidal barrage functions as a road bridge, connecting the commune of Dinard to the port city of St Malo, and the power station is also a tourist attraction, with a museum and visitor centre attracting 40,000 visitors every year.

Whilst the power station has generated substantial economic benefits, the construction of the tidal barrage has completely transformed the ecosystem of the Rance estuary. This has resulted in negative environmental

[140] Renewable Technology, Middelgrunden Offshore Windfarm, Oresund: Middelgrunden Offshore Wind Farm, Oresund - Renewable Technology | renewable-technology.com

[141] Green Economy Coalition, 20th September 2017.

[142] The Middelgrunden Offshore Windfarm: A Popular Initiative: The Middelgrunden Offshore Wind Farm (socioeco.org)

[143] Energy Transition 10th February 2020, Denmark's Legendary Wind Park Middelgrunden at a Crossroads: Copenhagen's Legendary Wind Park Middelgrunden at a Crossroads | Energy Transition

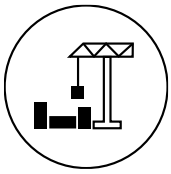
[144] EDF, The Rance Tidal Power Plant: L'usine marémotrice de la Rance | EDF Energy

[145] EDF, An exceptional industrial site: L'usine marémotrice de la Rance | EDF Energy

impacts, such as the disappearance of some native fish species. Larger fish are also vulnerable to being wounded or killed by turbine blades[146]. The tidal barrage has also caused the siltation of the river basin, impacting the navigability of the river and affecting the capacity of the power station. In 2020, EDF modified the operation of the plant to expand the foreshore habitat area to protect fish populations.

Key learning points: scale of economic and social opportunities associated with tidal power, and potential environmental constraints.

3.2.3 Social value exemplar projects



Hinkley Point C, Somerset

Large construction project that has worked with local stakeholders to provide access to jobs, training and supply chain opportunities.

Hinkley Point C (HPC) is a nuclear power station under construction in Somerset, set to be completed in 2027. Construction will create over 22,000 jobs over the construction timeline, and has so far supported over 900 apprentices. EDF Energy, the majority owner of the site, has worked collaboratively with local partners to support local suppliers and SMEs and to ensure that the project delivers social value for the local community. It is estimated that £4.1 billion has been spent with companies in South West England, and £24 million has been invested in education, skills and employment[147].

EDF has launched several initiatives aimed at building the capacity of business from across the region and support them into the supply chain. Many of these businesses are SMEs that have no previous experience of working in the nuclear sector or on large-scale projects. In 2017, the Hinkley Supply Chain Programme was set up by EDF in partnership with the Somerset Chamber of Commerce, Business West and the South West Manufacturing Advisory Service to help local businesses to tender for HPC nuclear construction and engineering contracts and to secure loans[148]. To date, this programme has matched 1,500 regional companies to opportunities in over 190 work packages and offered HPC-focused business support to more than 300 businesses[149]. EDF have also partnered with the University of Bath to launch the HPC Supply Chain Innovation Lab to provide a platform to connect business leaders, policymakers, and academics[150].

Another area of focus of the project has been to invest in education and skills training to help young people access career opportunities at HPC. EDF has two education and skills programmes tailored to different age groups[151]. HPC Inspire provides curriculum-linked resources and STEM workshops for Key Stages 2-4 in Somerset and the wider South West region. For 16–21-year-olds, EDF run the Young HPC skills programme to fast-track young people into apprenticeship and job opportunities and offers free skills development courses and career advice services.

Key learning points: investment in skills and supply chain development and co-operation with industry and the public sector to support large scale infrastructure project.

[146] House of Commons, Energy and Climate Change Committee: Energy and Climate Change Committee | parliament.uk

[147] EDF, Hinkley Point C: Hinkley Point C | EDF Energy

[148] Hinkley Supply Chain, Engaging South West Businesses: About | Hinkley Supply Chain

[149] SWMAS, Hinkley Supply Chain Programme: Business Support | SWMAS

[150] Institute of Civil Engineers (2020), Maximising Social Value from Infrastructure Projects.

[151] EDF, Hinkley Point C: For teachers, students and educators: Hinkley Point C | EDF Energy

4. Identifying opportunities for value creation

Typologies of renewable energy infrastructure have been developed, based on the findings of the literature review, stakeholder engagement and learning from elsewhere. The typologies have then been plotted in a matrix against different types of value to identify opportunities for Welsh Government policy to support increased value creation from investment in renewables infrastructure in future.

4.1 Typologies of energy infrastructure

4.1.1 Offshore wind[152] [153]

Offshore wind developments are necessarily large-scale and require significant investment, but can generate a large amount of power (the three offshore wind farms in Wales represented 29% of all renewable energy generated in Wales in 2020). The three offshore wind projects currently in operation off the coast of North Wales are owned and operated by the German multinational RWE. An element of state or local-ownership in future offshore developments would enable more of the benefits to be retained in Wales.

Example project: Gwynt y Môr, North Wales

Benefits & Opportunities

- Potential to generate a relatively high proportion of Wales's future renewable energy needs.
- Significant employment generated during construction and also in operation, which could support regeneration in coastal areas.
- Potential to work with training providers to develop transferable skills in the local workforce, which could help to retain young people and support local communities.
- Potential for Welsh companies to benefit from supply chain opportunities.
- Potential for Community Benefit Funds o support local initiatives and community projects.
- Emerging opportunities around community ownership. This is discussed further under 4.1.5.

Barriers & Constraints

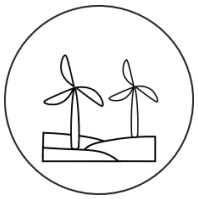
- High capital cost reduces potential for state or community ownership. The technology has a cost per MW rating of £2.1m, higher than onshore or solar PV[160].
- May require investment in enabling infrastructure such as ports, shipping and grid connections.
- Developments tend to be concentrated in certain areas which restricts potential benefits elsewhere, including areas that may be disproportionately affected by decarbonisation.
- Lack of capacity and specialist skills within Welsh labour markets and supply chains could lead to benefits 'leaking' outside of Wales, particularly during construction. Estimates suggest up to 22% of spend could be retained within Wales[161].
- Seabed is owned by the Crown Estate, restricting the opportunity to retain revenue from offshore generation within Wales.

[152] IWA (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales.

[153] Ibid.

4.1.2 Onshore wind

Large-scale, commercial or state-owned developer [154] [155]



Large-scale onshore wind projects require significant investment, and can generate a large amount of power (onshore wind accounted for 39% of renewable energy generation in Wales in 2020). Large onshore wind farms are located across the country, and are operated by commercial developers and by state-owned developers such as Vattenfall, the Swedish state-owned company that runs Pen y Cymoedd wind farm in South Wales. The recent announcement of a Welsh publicly-owned renewable energy development company offers an opportunity to retain more of the benefits of onshore wind development in Wales.

Example project: Whitelee Windfarm, Scotland

Benefits & Opportunities

- Potential to generate a high proportion of Wales's future renewable energy needs at a relatively low cost. Cost per MW is estimated to by £0.7m, lower than solar or offshore wind[162].
- Significant employment generated during construction and in operation, which could support regeneration in communities across Wales.
- Potential to work with training providers to develop transferable skills in the local workforce, helping retain young people and support communities.
- Potential for Welsh companies to benefit from supply chain opportunities.
- Potential for Community Benefit Funds to support local initiatives and community projects.
- Potential for wind farms to be opened up for public access, providing opportunities around recreation, wellbeing, community engagement and education.
- Recent announcement of Welsh publicly-owned renewable energy development offers opportunity to develop onshore wind on Welsh Government woodland estate, enabling benefits to be retained in Wales and reinvested by Welsh Government.
- Offers opportunities for environmental enhancements, e.g. peatland restoration.

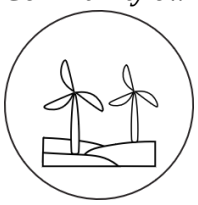
Barriers & Constraints

- May require investment in enabling infrastructure, particularly grid connections and capacity in areas where these are currently constrained.
- Although developments have been less geographically concentrated than offshore wind, some areas of Wales experience greater barriers in terms of grid capacity which could restrict the potential benefits.
- Land in upland Wales is constrained by uses such as National Parks and military training areas, which limit where development can take place. Providing suitable access to sites in rural areas can also be a challenge.
- Lack of capacity and specialist skills within Welsh labour markets and supply chains could mean that benefits 'leak' outside of Wales, although it is likely that a higher proportion of onshore jobs and skills could be sourced from within Wales than for offshore wind. Estimates suggest up to 35% of spending could be retained within Wales[163].
- Potential for local opposition to wind farm development and connecting infrastructure.
- Wind farms in more remote areas may have less opportunity for community benefits such as recreation and education.

[154] Ibid.

[155] Ibid.

Community owned [156] [157] [158]



Onshore wind also offers the potential for community ownership. While these projects contribute a relatively small proportion of total renewable energy generation in Wales, they represent opportunities for a greater share of value to be generated and retained locally, and for engagement and education around climate change and the need for net zero.

Example project: Cwm Arian Renewable Energy (CARE), West Wales

Benefits & Opportunities

- Historically has offered a source of income for local communities from selling electricity to the National Grid, however since the closure of the feed-in tariff in 2019 this has not been the case.
- New models are emerging, such as Ripple's Graig Fatha wind farm which allows households and businesses to become part-owners of the wind farm and to benefit from reduced electricity prices[164].
- Potential to create employment, develop skills and support supply chains at the local level[165].
- Potential to support greater community cohesion by encouraging residents to get involved in projects and share ideas and expertise. This can also reduce the potential for local objections or opposition to developments.
- Potential benefits in terms of raising awareness of climate change and net zero, and building resilience and energy security at the local level.

Barriers & Constraints

- Closure of feed-in tariff has made it more difficult to finance community renewable energy generation, and groups are now focusing on energy efficiency, low carbon transport and renewable heat instead[166].
- Individual community-owned projects generally generate only a relatively small amount of energy and so form part of a mix alongside larger-scale developments.
- Most community energy groups are run by volunteers and so can be constrained in terms of capacity and resources.

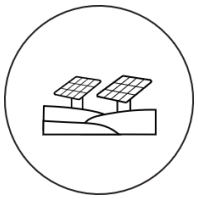
[156] Ripple Energy, Our Wind Farms: Our wind farms | Ripple Energy

[157] Community Energy (2022), State of the Sector Report.

[158] Ibid.

4.1.3 Solar PV

Ground-mounted [159] [160] [161] [162] [163]



Solar PV is a commercially mature technology that can be suitable for both community energy projects and larger scale ground-mounted farms. While solar development slowed following the removal of feed-in tariffs in 2019, new models are now emerging allowing new, large scale developments to come forward in the commercial and public sectors.

Example project: Brynwhilach, Swansea

Benefits & Opportunities

- Mature technology with a good market for panels and a well-functioning supply chain. Estimates suggest that up to 46% of spending could be retained within Wales[167].
- Less technologically complex as the installations do not have to be bespoke and do not require expensive installation or maintenance, which can be the case with other generation projects (e.g. hydro).
- Can be installed close to point of use and provide energy to power businesses and community facilities, e.g. Brynwhilach which is owned by Swansea Bay University Health Board, supplies Morriston Hospital with a fifth of its energy consumption[168].

Barriers & Constraints

- Larger ground mounted arrays can introduce complexity.
- Large scale solar PV projects slowed dramatically following the end of the Renewables Obligation, although there is evidence that developments in the sector are now growing again[169]. Cost per MW is lower than offshore wind, but above onshore wind (£1.5m.)[170]
- Land requirement for larger scale farms can be high.
- Larger farms in rural areas could be located at a distance from a point of connection to the grid, as the sites suitable for larger scale solar PV are often less attractive for other development requiring electricity supply.
- Developments in more remote areas may have less opportunity for community benefits.
- Current policy does not support solar PV development on designated BMV agricultural land (i.e. land that is grades 1-3a in the agricultural land classification)[171].

[159] IWA (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales.

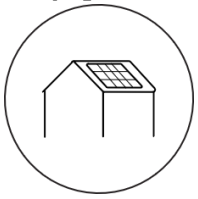
[160] The Guardian, 14th March 2022, Welsh solar farm exceeds expectations in powering Swansea hospital: Welsh solar farm exceeds expectations in powering Swansea hospital | Steven Morris | The Guardian

[161] Solar Energy UK (2022), Time to Shine: Impact Report 2021: STA019-impact-report-2021-spreads-vfinal.pdf (solarenergyuk.org)

[162] IWA (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales.

[163] Welsh Government, Best and most versatile agricultural land and solar PV arrays: Best and most versatile agricultural land and solar PV arrays | gov.wales

Rooftop-mounted [164] [165]



Roof-mounted solar PV installations can play an important role in the future energy system of Wales, especially in areas where space is limited, such as the more urban areas of Swansea and Cardiff, where solar PV already fulfil around 17% of the renewable energy demand. Rooftop solar is well suited to community ownership, including in urban areas.

Example project: Egni Co-op

Benefits & Opportunities

- Commercially mature technology that can be developed and funded by a community, and electricity can be used directly on site.
- Small scale solar PV on dwellings often fall under permitted development and do not require planning permission[172].
- Land use requirement can be low when the community has access to suitable roofs.
- Local authorities and other public sector bodies can support and encourage renewable energy installations on their assets and reduce energy bills, without the resource or cost commitments of developing the site themselves.
- Relatively short time needed to install, and maintenance of solar panels is low and less complex than for other technologies.
- Opportunity to create jobs in the supply chain and to generate community benefits in communities across Wales, including in urban areas where other typologies may not be appropriate.

Barriers & Constraints

- Small scale installations can generally be connected to the grid relatively easily by a certified installer, however multiple premises will follow a slightly more complex process[173].
- Installation of solar PV on listed buildings may require planning permission and/or listed building consent.
- Off-grid connections for solar PV systems require suitable barriers which can be costly and sometimes have a limited lifespan.
- Smaller scale projects tend to be less financially viable meaning that community groups have to take on larger, more challenging projects which increase development cost.
- Risk for roof-mounted schemes of owners or tenants of buildings changing and reducing the scope for on-site supply. Larger schemes such as Egni or larger solar co-ops can mitigate this risk.

[164] Welsh Government, Planning permission: solar panels: Planning permission: solar panels | gov.wales

[165] Welsh Government, Local Energy: Grid Connection Module: Grid Connection Module | gov.wales

4.1.4 Hydro [166] [167] [168]

Hydro projects use water from a stream or river to generate electricity and are by their nature often more complex. It is a proven and mature technology that can provide a predictable source of energy. It can be suitable for community ownership, including as part of a microgrid system (see Isle of Eigg). However, there is very little new capacity now coming forward and there is not expected to be significant growth in this sector in future.

Example project: TGV Hydro

Benefits & Opportunities

- Impact on local communities in terms of visual impact, perception of risk of accidents[174] and required land use from small scale hydro projects is relatively low.
- Can contribute wider environmental benefits such as flood control.
- Projects can offer recreational opportunities, and can become community assets.
- Hydro projects can offer job and supply chain opportunities. Estimates are that up to 69% of spend could be retained within Wales, significantly higher than other technologies.
- Predictable source of electricity that is less dependent on weather conditions as other technologies[175], and can be 'switched on' to provide energy when solar or wind power is not available.
- The return on investment from (large scale) hydro projects can be high, despite the initial cost required for installation[176]. In some areas, existing infrastructure from previous schemes may still be in place.

Barriers & Constraints

- Expensive and complex technology that requires a large number of people and organisations to work together. Cost per MW is £5.8m, significantly higher than wind or solar[176].
- Relatively high upfront cost and current lack of cost reduction potential make it unlikely to grow without support.
- New hydro projects often face long lead times, land ownership issues and lengthy planning procedures. Environmental designations on rivers can increase lead times and risk to developers.
- Difficult to estimate the performance of the system once it is up and running, affecting the business model.
- Environmental impact of hydro projects depends on the size, but could be adverse in terms of impact on land use, emissions and wildlife.
- In the longer term, potential to become less predictable due to the effects of climate change.

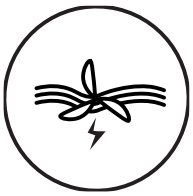
[166] Venus, Hinzmann, and Gerdes (2022), Public Acceptance of Hydropower. Available online at: Public Acceptance of Hydropower | Springer Link

[167] The Renewable Energy Hub, Is Hydroelectricity Generation Worth It? Is hydroelectricity worth it? | The Renewable Energy Hub

[168] IWA (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales.

4.1.5 Emerging typologies

Marine [169] [170]



The UK is estimated to have around half of Europe's tidal energy resource and therefore the marine energy sector provides a huge potential for decarbonisation[171]. This technology is still in an early stage and it is therefore also uncertain what the role of community ownership can be within this area of renewable energy generation.

Benefits & Opportunities

- Potential for investment to create highly-skilled jobs that could help to regenerate coastal areas. It is estimated that around 40% of spending could be retained within Wales[177].
- Potential to work with training providers to develop transferable skills in the local workforce, which could help to retain young people and support local communities in coastal areas.
- Potential for Welsh companies to benefit from supply chain opportunities, and for Wales to become a market leader in this technology.
- Tidal lagoon projects provide coastal protection against rising sea levels.
- Land capture potential as the tidal lagoon would alleviate the risk of flooding, making new land available.
- Tidal lagoons are designed to remain for generations to come, leaving a legacy for future generations.
- As with hydro, it provides a more predictable supply of energy that can be switched-on to provide energy when other renewable typologies are not available.

Barriers & Constraints

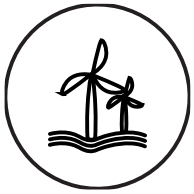
- Significant investment required, and questions over the viability of the technology without further innovation. Cost per MW is estimated as between £2.4m (for tidal stream technologies) to £4.1m (for tidal range technologies)[178].
- Because of the very large scale and early stage this technology is in there are no examples or experiences around community ownership.
- Potential ecological impacts associated with tidal and FLOW developments.

[169] IWA (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales.

[170] Ibid.

[171] Welsh Government (2019), Marine Energy Plan for Wales - Unlocking the Energy in Our Seas. Available online at: Marine Energy Plan for Wales | gov.wales

Offshore wind with state, local or community ownership[172]



The role of local and community ownership in the offshore wind sector is developing, but could have the potential to generate significant value for local communities[173]. There is also the potential for state involvement in offshore wind in future, or for partnerships between the state and community organisations (see Middelgrunden example).

Benefits & Opportunities

- Emerging opportunities around community ownership in offshore wind, e.g. in Scotland where Ripple Energy have partnered with NextGen with the aim of making a proportion of future offshore wind projects available via Ripple's community ownership platform[180].
- Could offer ownership opportunities for people who do not live locally or have space for energy generation projects.
- The scale and revenues generated from offshore wind project create scope for communities to receive larger benefits.
- Opportunity to build a new approach and narrative around communities and offshore energy systems.

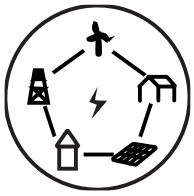
Barriers & Constraints

- Scale of community benefits may be dependent on the financial means of the developer.
- Defining community in the context of offshore wind energy projects can be challenging.
- Provide regional value by creating jobs and supply chain opportunities, but more local benefits are more difficult to distribute.
- Offshore projects are more long-term and take a longer time to design, build and thus receive benefits.
- Offshore local ownership models are relatively innovative.

[172] Offshore Wind, 28th September 2021, A UK First: community ownership of offshore wind farms: A UK First: Community Ownership of Offshore Wind Farms | Offshore Wind

[173] Regen (2022), Delivering local benefit from offshore renewables: Working towards a new model for community benefit and local ownership. Available online at: Delivering local benefits from offshore renewables | Regen

Microgrid / micro generation or local energy networks



Microgrid technologies, or local energy networks, can be used in more remote locations where grid capacity or connection costs may be a barrier to project development. Smart local energy systems (SLES) can help to balance supply and demand, and reduce pressure on the grid at peak times.

Benefits & Opportunities

- Provides a sustainable and reliable source of energy, increasing resilience and energy security in rural areas (see Isle of Eigg).
- Allows generation in areas where there is no grid connection capacity.
- SLES can additionally help to balance supply and demand at the local level.
- Potential to support community cohesion by encouraging residents to get involved in projects, raising awareness of climate change and net zero, and encouraging reduction in energy use.

Barriers & Constraints

- Requires investment as well as considerable local effort – capacity and resource at the local level could be a constraint.

4.2 Matrix of infrastructure and value typologies

The typologies described above have been plotted in a matrix against different types of value, in order to identify those areas where there may be greatest potential to deliver greater value for Wales from investment in energy infrastructure.

As discussed in section 2.3, the concept of value in Wales is closely linked to the well-being goals set out in the Well-being of Future Generations Act. Therefore, the matrix has used the relevant social, economic and environmental objectives set out under each goal. It also includes the socio-economic duty, enacted in Wales in 2021, which places a duty on public bodies in Wales to consider, in their decision making, how they can improve inequality of outcome for those who experience socio-economic disadvantage[174].

This analysis is at a very general, Wales-wide level, and does not take into account locally defined issues and opportunities, including the variation in value associated with how and where electricity is supplied and consumed (e.g. whether electricity is connected to the national grid or consumed locally, and any constraints associated with the grid). In any sector and typology there will be opportunities in the way in which a particular project is planned and delivered to improve the value that is generated and retained locally.

[174] Welsh Government, A More Equal Wales: The Socio-economic Duty: A More Equal Wales: The Socio-economic Duty | gov.wales

Table 4-1: Matrix of energy and value typologies

		Offshore wind		Onshore wind			Solar PV		Hydro	Marine	Microgrid / SLES
		C[175]	S[176], L	C	S	L[177]	Ground	Roof			
Economic											
A prosperous Wales	Fair and local procurement	✓	✓✓	✓	✓✓	✓	✓✓	✓✓	✓	✓✓	✓
	Decent work	✓✓	✓✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
	Local economies	✓	✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓
	Community energy and a low carbon society	✓	✓✓	✓	✓✓	✓✓✓	✓	✓✓✓	✓✓✓	✓	✓✓✓
	Skills for the future	✓✓	✓✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓	✓✓	✓
Environmental											
A resilient Wales	Biodiversity and soil			✓	✓✓	✓	✓	✓		✓	✓
	Natural green space			✓	✓✓	✓				✓	✓
	Knowledge of nature			✓	✓✓	✓✓		✓	✓		✓
	Water and air quality	✓✓	✓✓	✓✓	✓✓	✓	✓✓	✓	✓	✓✓	✓
	Using natural resources	✓✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
A globally responsible Wales	Supply chains	✓	✓	✓	✓	✓	✓✓	✓✓	✓✓	✓✓	✓
	Sustainable behaviour	✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓

[175] C = commercially developed

[176] S = state-owned, or partially state-owned, developer

[177] L = local or community ownership

		Offshore wind		Onshore wind			Solar PV		Hydro	Marine	Microgrid / SLES
		C[175]	S[176], L	C	S	L[177]	Ground	Roof			
	Efficient use of resources	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓✓	✓
	Financial decisions	✓	✓✓	✓	✓✓	✓✓	✓	✓✓	✓✓	✓✓	✓✓
Social											
A healthier Wales	An active nation			✓	✓	✓					
	Place-making and designing-in community health and well-being	✓	✓	✓✓	✓✓	✓✓		✓	✓	✓	✓
A Wales of cohesive communities	People active in their communities	✓	✓✓	✓	✓✓	✓✓		✓	✓	✓	✓✓
	Community anchor organisations	✓	✓✓	✓	✓✓	✓✓	✓	✓✓	✓✓		✓✓✓
	Culture and the Welsh language				✓	✓		✓	✓		✓
A Wales of vibrant culture and thriving Welsh language	Developing skills					✓					✓
Distributional											
A more equal Wales	Fair work	✓✓	✓✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓	✓✓	✓✓
	Educational opportunities	✓✓	✓✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓	✓✓	✓
	Participation	✓	✓	✓	✓	✓✓	✓	✓✓	✓✓	✓✓	✓✓✓
Socio-economic duty	Improving inequality of outcome	✓	✓✓	✓	✓✓	✓✓	✓	✓✓	✓✓	✓✓	✓✓

4.2.1 Analysis

Economic value

In relation to the well-being goal of **'a prosperous Wales'**, the matrix shows that onshore wind scores particularly highly, followed by solar PV and offshore wind. This is due largely to the scale of employment, supply chain and training opportunities associated with the construction and operation of large scale wind developments, and the potential role of a state-owned developer in facilitating the delivery of these benefits. Roof-mounted solar PV scores well due to its relatively well-established supply chain, and the opportunity for development across Wales, in urban as well as more rural areas.

The marine sector scores well in relation to skills, as this is an area where there is the potential for Wales to develop market-leading capabilities, focused in coastal parts of the country. Community-owned developments in the onshore wind sector, roof-mounted solar PV and microgrid developments or SLES score well in relation to the objective of supporting community energy and a low carbon society. These typologies also score well in relation to decent work, procurement and local economies as community energy organisations tend to employ people based in Wales and use local supply chains, while rooftop solar provides an opportunity to create jobs and support supply chains in communities across Wales. Hydro scores less well in terms of skills, as this is not expected to be a growth area in future and so opportunities for skills development may be more limited.

Onshore and offshore wind, particularly where there is an element of state or community ownership, therefore has the potential to deliver the greatest economic value in terms of jobs and skills at a Wales-wide level, although there are challenges associated with skilling-up the workforce and supply chain in time to support the scale of development required to deliver net zero by 2050. Community-owned onshore wind, microgrid or SLES solutions and rooftop solar PV can deliver economic value locally, while further research and development in the marine sector could deliver value in terms of skills and employment in the longer term.

Environmental value

In relation to the well-being goal of **'a resilient Wales'**, all typologies score well with regards to using natural resources and water and air quality, with offshore wind scoring particularly highly due to the high capacity associated with offshore wind projects and the proportion of Wales's renewable energy needs that they therefore have the potential to provide. Onshore wind scores well in relation to biodiversity and soil, natural green space and knowledge of nature, due to the potential to use onshore wind farms in appropriate locations to provide social and environmental benefits associated with education, recreation, and sustainable land use and soil management (see the Whitelee Windfarm case study, for example). State and locally-owned options score higher here as it is assumed that they may be more likely to deliver these benefits directly on site; however, as the Whitelee example shows, there is also the potential for commercially operated wind farms to manage their land in a way that generates substantial social and environmental value.

In relation to the well-being goal of **'a globally responsible Wales'**, offshore and onshore wind score most highly as these typologies represent the largest share of renewable energy produced in Wales, and currently offer the greatest potential to increase renewable generation in future. The marine sector also scores highly, as this is identified as an area with significant potential to provide future energy capacity, subject to viability and funding. Solar PV and hydro typologies score highly in relation to sustainable supply chains as these technologies have better established supply chains within Wales than others. State and community-owned typologies score well in terms of financial decisions, as these provide an opportunity for energy profits to be retained within Wales and/or at community level, and to be re-invested in projects that generate further value. Marine also scores well in relation to financial decisions as, despite the initial cost, it is anticipated that these technologies could generate renewable electricity for Wales and provide benefits for future generations in the longer-term.

Social value

In relation to the well-being goal of **'a healthier Wales'**, onshore wind scores more highly than other typologies, due to the potential for onshore wind farm sites (in relatively accessible locations) to be opened up to the public and used for recreation, supporting community health and well-being. Marine technologies

and microgrid also score well against placemaking and designing-in health and well-being, as some tidal technologies have the potential to open up new land, including for recreation, and provide flood defences, and microgrids could be valuable in engaging communities in the place-making process. In a related vein, state and community-owned typologies score well against **'a Wales of cohesive communities'** and **'a Wales of vibrant culture and thriving Welsh language'** by providing opportunities for engagement, education and community enrichment activities, which could be particularly valuable in a rural context.

As discussed elsewhere in this report, social value is locally defined in relation to community needs and priorities. Community and locally owned typologies may have the greatest potential to support the delivery of social value at the community level, however larger-scale commercial or state-owned developments in the wind sector could also support the delivery of social value at the local level through projects and initiatives funded through Community Benefit Funds and through opportunities to enable access to onshore wind farm sites for uses such as recreation.

Distributional value

In relation to the well-being goal of **'a more equal Wales'**, wind and solar PV typologies score well in terms of fair work and educational opportunities, with state-owned options scoring particularly strongly. Again, this reflects the scale of the employment and training opportunities associated with the wind sector, the relatively-well established supply chain in solar PV, and the potential for rooftop solar PV to support employment in communities across Wales, including in urban areas. It also assumes the role of a state-owned energy developer in helping to facilitate the skills transition required to support renewable energy deployment in future, and in brokering job and supply chain opportunities. Community-based typologies, and microgrid schemes in particular, score well in relation to participation.

Also relevant here is the **socio-economic duty**, which focuses on reducing inequality and increasing equality of opportunity for those who experience socio-economic disadvantage. All typologies score relatively well against this criteria. Larger-scale developments in the wind sector, for example, could contribute to reducing inequality by creating large numbers of jobs and training opportunities, and working with colleges and other training providers to increase access to relevant skills. However, these developments can be remote from large population centres and there are questions around how the benefits of such projects can be distributed more widely, both in terms of jobs and training opportunities and through community development funds. Smaller, community-based developments could support employment and skills development on a more local scale, and provide other benefits such as funding for energy efficiency measures or fuel poverty reduction, but again there are questions around how widely these benefits are felt.

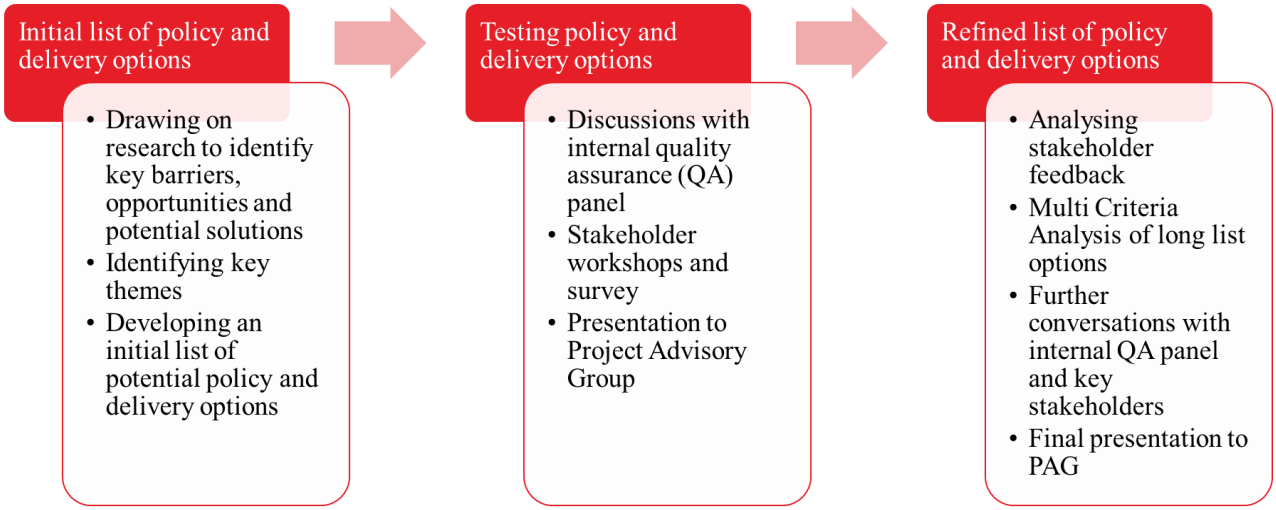
Developing the skills needed to support the renewable energy sector in future is important in delivering distributional value and reducing inequality, particularly where there is the potential to target support at areas that either currently experience high levels of deprivation and socio-economic inequality, or where there may be the potential for disproportionate impacts from decarbonisation in future. Encouraging the diversification of the engineering workforce and widening participation in STEM skills could also generate value in this area.

5. Option development

5.1 Introduction

Figure 5-1 summarises the process that was followed to develop a list of potential policy and delivery options that NICW could recommend to Welsh Government to increase the value for Wales from investment in renewable electricity generation. This section of the report describes each stage of the process and explains the steps that were taken to identify an initial list of options, to refine these based on stakeholder feedback and analysis, and to finalise a list of deliverable options. A set of scenarios is also provided, based on a range of combinations of potential policy and delivery options.

Figure 5-1: Option development workflow



5.2 Initial list of options

5.2.1 Identifying an initial list of options

The first stage in the process was to develop a long list of potential policy and delivery options, drawing on the findings of the literature review, socio-economic baselining, learning from elsewhere, and stakeholder interviews. Barriers and opportunities were identified and grouped around a set of key themes which had emerged from the research. These were:

- Planning and land use;
- Enabling infrastructure;
- Financial support and resources;
- Education and skills; and
- Retention and distribution of value.

The identified themes, barriers and opportunities were entered into a policy development spreadsheet, and potential solutions were then identified which could address two related issues:
address two related issues:

- unlocking delivery of renewable electricity developments at all scales; and
- increasing the value that is generated and retained within Wales from those developments, both nationally and at the local level.

Drawing on relevant examples elsewhere, and our understanding of interdependent work taking place in Welsh Government and across the industry, these were then developed into a long list of potential policy

options or measures that could be put in place in Wales, to be taken forward for discussion with stakeholders and further development.

5.2.2 Testing policy and delivery options

Internal discussions

The first stage in testing the initial list of potential options was a series of internal discussions with members of the Arup quality assurance panel, covering experts in planning, energy, finance, socio-economics, health and social value. This helped to refine the options for discussion with stakeholders at a series of workshops.

Stakeholder workshops

Three virtual workshops were held in December 2022, with the following stakeholder groups:

- Representatives of the community renewables sector;
- Representatives of young people; and
- Local authorities and the public sector.

An online survey was subsequently developed and shared with community renewables stakeholders to capture additional feedback. Further information on the workshops and survey, including details of the organisations represented, is included in Appendix B.

Presentation to PAG group

Following the workshops, we presented our emerging findings and initial list of policy and delivery options to NICW and the PAG. A key message that came out of this discussion was the importance of considering the longer-term remit of NICW and the opportunities that could arise over the period to 2050, and not concentrating only on options that would resolve issues or address barriers in the shorter-term. This feedback was taken forward into the analysis and informed the identification of a refined list of options to be taken forward.

5.3 Refining policy options

5.3.1 Analysing stakeholder feedback

Analysing the stakeholder feedback received through the workshops took two forms. SWOT (strengths, weaknesses, opportunities, threats) analyses completed in the community renewables and local authority and public sector workshops were reviewed, and any additional barriers or opportunities identified included in the policy development spreadsheet for further consideration. Feedback from the workshop with young people was also taken into account, and fed into the policy development spreadsheet as appropriate. This helped to identify those themes that were perceived as priorities by a range of stakeholders, and was also used to develop a number of additional policy options to be taken forward for further consideration.

Feedback from the policy option prioritisation tasks undertaken through the workshops and follow-up survey was used to inform the multi-criteria analysis (MCA) of policy and delivery options.

5.3.2 Multi-criteria analysis (MCA)

An MCA framework was developed to assess how each of the initial list of options might deliver different types of value, alongside criteria around their costs, novelty, stakeholder support, and deliverability. New or refined policy options that emerged or were developed through the analysis of stakeholder feedback, as discussed above, were fed into the MCA as part of an iterative process of policy development.

The full set of criteria used in the MCA is set out in Table 5-1. In relation to value, the criteria drew on the objectives of the Well-being of Future Generations Act, and the socio-economic duty. As noted above, the analysis took account of the stakeholder feedback received through the policy prioritisation tasks at the workshops and the follow-up survey, particularly in relation to deliverability and stakeholder support.

Table 5-1: Multi-criteria analysis framework criteria

Criteria	Sub-criteria
Strategic objectives	• Does the option help Wales to meet its strategic objectives? – Wales to be net zero by 2050 – Wales to meet 70% of its electricity demand from renewable sources by 2030 – 1GW of renewable electricity and heat capacity locally owned by 2030 – All new energy projects to have an element of local ownership from 2020
Novelty	• How unique or innovative is this policy or is this an area that is already being addressed?
Benefits	• Does it address current barriers identified in the research? • How well does it deliver different types of value? – Economic: A Prosperous Wales (Economic value retained in Wales). – Social: A Wales of cohesive communities: a Wales of vibrant culture and thriving Welsh Language.; a healthier Wales – Environment: A globally responsible Wales, A resilient Wales. – Equity (A more equal Wales).
Costs	• Relative total costs to Welsh Government
Stakeholder support	• Is it likely to be supported by Welsh Government? • Is it likely to be supported by the UK Government? • Is the general public likely to support? • Are impacted local communities likely to support?
Deliverability	• Flexibility (does it work for all Wales, or specific regions?) • How complex is delivery and are there significant dependencies? • Is it within the remit of Wales? If not, is it likely to be delivered by the UK government with Welsh Government lobbying? • Is the market able to supply the components needed for delivery? (Land, grid connections, technology, skills)

5.3.3 Refining the options to be taken forward

Internal discussions

Further internal discussions with members of the Arup quality assurance panel were held to scrutinise the emerging findings of the MCA, and to refine the list of policy and delivery options to be taken forward as recommendations. Options that scored poorly in the MCA or had not received support from stakeholders were discounted at this stage. The refined list of options was then discussed further with stakeholders in January 2023.

Further stakeholder engagement

Discussions with Welsh Government's energy policy and planning policy teams in January 2023 covered themes including work going on within Welsh Government around planning for grid infrastructure; the potential devolution of the Crown Estate; the creation of Welsh Government's publicly-owned renewables developer; and the Developments of National Significance (DNS) planning process.

A key issue raised in relation to the DNS process was the requirement for local planning authorities to produce Local Impact Reports (LIRs), for a small fee and often at relatively short notice. It was commented that this adds to the pressures facing local authority planning departments, which have seen significant cuts in their funding. Another issue raised was around grid infrastructure, and whether the planning system could be used to unlock capacity, for example by creating pre-assessed areas or a presumption in favour of development of grid infrastructure.

The refined list of policy and delivery options was then presented to RenewableUK Cymru's Strategy Group, representing commercial renewables developers, in January 2023. Planning constraints, including the issue

of DNS fees for LIRs, were again raised as a key issue. Stakeholders commented that more guidance for local authorities would be helpful, but expressed concerns that targets could be used to stop development of renewables rather than to increase development. It was noted that many of the issues around grid infrastructure are beyond Welsh Government's control, but recognised that Welsh Government – in partnership with developers – could play a role in planning for other enabling infrastructure.

Stakeholders commented that, in relation to the potential devolution of the Crown Estate, the key concern is that there is no interruption to the delivery of offshore projects. An idea raised was whether Welsh Government could have more access to funds from the Crown Estate, rather than devolving it fully. In relation to Community Benefit Funds, there was some resistance to the idea of giving these to local authorities to distribute, although one stakeholder commented that local authorities could have a role in coordinating how Community Benefit Funds are administered.

A separate call was held with Net Zero Industry Wales in February 2023. Key themes that emerged from this discussion were the importance of ensuring the resources and skills are in place to support the transition to net zero, financial options to support investment in low carbon industry and decarbonisation, the importance of hydrogen in the decarbonisation of industry, and the potential associated with Welsh Government investment in grid infrastructure.

5.3.4 Summary of MCA findings

The following section summarises the outcomes and findings of the MCA against each theme, taking into account stakeholder feedback.

Planning and land use

The planning process was raised by stakeholders as a key issue. In particular, stakeholders commented on resource constraints and local objections leading to delays in achieving consent. Options aimed at addressing these constraints scored well in the MCA, with the highest scoring option under the planning and land use theme being around continued public engagement on climate change and renewable energy to build awareness and support at the local level. This could help to reduce objections to renewables schemes and thereby reduce risk for both commercial developers and community energy groups, supporting the growth of renewable energy projects at all scales as well as generating value by building energy literacy.

Exploring the efficiencies that could be delivered through streamlining governance scored strongly, particularly in relation to strategic objectives and deliverability, as this would be within the remit of Welsh Government and there are established precedents regarding permitted development, for example. This option also scored well against value criteria, with caveats around what would be delivered in the local context. However, there is the risk that streamlining of governance, where it leads to any loss of local decision-making powers, could result in local objections and potentially tensions in affected communities (such as resentment of infrastructure developed under permitted development rights or perceptions of infrastructure being imposed on a community by an outside agency).

There was strong stakeholder support for additional targeted resource and training for planning teams and organisations involved in consenting, although this scored less well against criteria around cost and deliverability due to the need for additional, long-term investment and potential difficulties in recruiting planners with the skills and experience required. Options aimed at developing more supportive local planning policies and incentivising local authorities to develop more renewables generally scored well in relation to strategic objectives and delivering value, but less well in relation to deliverability. Stakeholder support for these options was mixed, with some stakeholders expressing reservations around how renewable energy targets would be used, for example, and commenting that more spatial planning is not needed.

Enabling infrastructure

Grid capacity has been highlighted by stakeholders as a major barrier to the deployment of renewable electricity generation in Wales. However, it is understood that there is already work ongoing within Welsh Government to unlock access to the grid and to plan for the grid infrastructure that will be required in future. While continuing conversations with Ofgem around changing the policy and regulatory environment to enable investment in grid infrastructure scores well in the MCA and will be important going forward, options under this theme that provide other solutions to the grid capacity problem score most strongly.

In particular, Welsh Government support to communities to develop SLES or microgrid schemes could enable additional generation to come on stream in areas where grid capacity is currently constrained, and scores well in relation to strategic objectives, value, cost and stakeholder support, although there are some uncertainties around the maturity and complexity of the technology which affect deliverability. Supporting SLES creates an opportunity to generate cost savings for households by making local systems more efficient, retaining value locally and sharing benefits in a more equitable and place based way, while also encouraging engagement and collaboration within communities. Working with Ofgem to explore regulatory reforms to allow small to medium generators to supply local customers could also help to reduce strain on the grid, as well as generating value at the local level, although this option has some greater complexities which affects how it scores in terms of stakeholder support and deliverability.

Supporting local authorities and other public sector bodies to use PPAs with community and local renewables could enable community energy groups to sell their electricity more easily, and to benefit from guaranteed prices which could help to fund deployment and make these projects more viable. This option therefore scores well in relation to the local and community ownership strategic objectives and the value criteria, although the change in regulation required adds complexity and affects how it scores in relation to deliverability. The development of a plan for the delivery of additional infrastructure such as port and road upgrades also scores well, attracting strong stakeholder support, particularly where this draws on information from LAEPs and from developers to understand where infrastructure will be needed in future and focus investment in the areas where it can make the most impact.

Bolder ideas around considering further investment in, or a degree of state-ownership of the national grid infrastructure could help Wales reach its strategic objectives by enabling more generation to be developed, including by the publicly-owned developer and on Welsh Government estate, which would result in more benefits being retained within Wales. However, there are significant cost implications and complexities in delivery and stakeholder support which affect how well this option scores.

Financial support and resources

In terms of financial support and resources, the highest scoring option was providing resource and technical capability to local authorities to deliver LAEPs, and explore how community energy organisations can best be engaged in this process. Stakeholders have commented on the importance of local authorities having the resources to implement their LAEPs, and this option therefore scores well in relation to strategic objectives and stakeholder support. As with the similar option regarding resourcing of planning departments under planning and land use, the option scores less well in relation to cost and deliverability due to funding and recruitment implications. Looking at how to engage community energy organisations effectively in the LAEP process would involve less cost and may be more easily delivered.

There was strong stakeholder support for options around revising business rates, particularly for smaller projects. This scores well against strategic objectives, particularly in relation to locally owned electricity generation. Abolishing rates for all developments below a certain size would reduce uncertainty for community energy organisations and could support the delivery of more locally and community owned electricity capacity, helping to generate value at the local level. Ringfencing a portion of rates from larger scheme for investment in the host authority, or in particular types of projects, could also help to deliver value for communities including those most affected by large scale developments. Facilitating additional investment vehicles to support the delivery of community renewables scored less well in the MCA, due in part to the degree of uncertainty around what form these vehicles could take and what implications that would have for cost and deliverability.

More ambitious options for the longer term around financial options to support development in the marine sector and to fund investment in green industry score strongly in relation to the net zero strategic objectives and delivering value, particularly economic value. However, these options would require the cooperation of the UK Government and have significant dependencies and funding implications that impact on their deliverability, affecting their overall score. Despite this, these options offer significant potential for job creation and supply chain development, including in industrial and coastal areas of Wales, supporting a just transition to net zero.

Education and skills

Developing relevant specialist skills in the Welsh labour market and supply chain to support the deployment of renewable electricity projects will be key in generating and retaining value from investment in renewables infrastructure within Wales in the medium to long term. Welsh Government's Net Zero Skills Action Plan is currently in development and is expected to be published in 2023. Without knowing the contents of the plan, there was strong stakeholder support for Welsh Government providing the resources and commitment to deliver on it in order to develop the skills required across the whole economy to support the transition to net zero. This option scored well against all criteria, including in relation to strategic objectives, value, and deliverability, as education is within the remit of Welsh Government.

Further support for WGES to deliver support, including mentoring, for community organisations to grow capacity and capability to deliver renewable electricity projects scored reasonably well, particularly in relation to the strategic objectives around local and community ownership, although there are some uncertainties around how this would be administered and delivered. Stakeholders representing community renewables organisations commented on the importance of making best use of the skills and knowledge that already exist in the sector. There was some stakeholder support for the idea of a Skills Centre of Excellence to support the renewables industry, although local authority stakeholders raised some concerns about where this would be located and the risk that it could concentrate skills and development in particular areas of Wales, potentially at the expense of others.

Creation, retention and distribution of value

Welsh Government's publicly owned renewables developer is recognised by stakeholders as a significant opportunity for increasing the delivery of renewable electricity and generating value that will be retained within Wales. There was strong support for using this vehicle to distribute the benefits of renewable development more widely across Wales, and for considering investing in offshore wind and other technologies such as tidal in future. These options scored particularly well against the value criteria, as offshore and tidal projects would be expected to create jobs directly and in the supply chain, and generate revenue that could be used to invest in projects creating other forms of value in communities across Wales.

The proposed devolution of the Crown Estate in Wales also offers opportunities for greater retention of value through the reinvestment of offshore leasing revenues, with potential benefits for coastal communities in particular. However, there is uncertainty around how likely this is to come forward, and around the wider implications for Welsh Government budgets, which affects the scoring of this option against cost, deliverability and stakeholder support criteria. A more centralised approach to the distribution of Community Benefit Funds from commercial renewables developments was not received very positively by stakeholders, who felt that local knowledge is important to ensure that funding is shared effectively.

In the longer term, there is a variety of opportunities associated with increasing generation beyond current and projected demand, which could both encourage more renewable electricity generation projects to help phase out fossil fuels, and generate significant value for Wales. For example, ensuring a stable and secure supply of renewable energy could enable energy-intensive businesses to reduce their carbon use, which could mitigate the potential negative effects of the transition to net zero on these sectors and potentially help to attract new industries to Wales, creating green jobs and supporting a just transition. As with other bolder, longer term ideas, however, there are complexities and uncertainties in the cost and deliverability of these options, which affect how well they score.

5.3.5 Options to be taken forward

The MCA helped to finalise a list of policy and delivery options to be taken forward by NICW as recommendations for Welsh Government, grouped around the themes identified above. These include options aimed at both increasing the deployment of renewable electricity infrastructure in Wales, and increasing the value that is generated and retained within Wales from investment in this infrastructure.

Options are set out in Table 5-2, and are discussed in more detail in the scenarios included in section 5.4 and in the recommendations included in section 6.2.

Table 5-2: Options to be taken forward as recommendations for Welsh Government

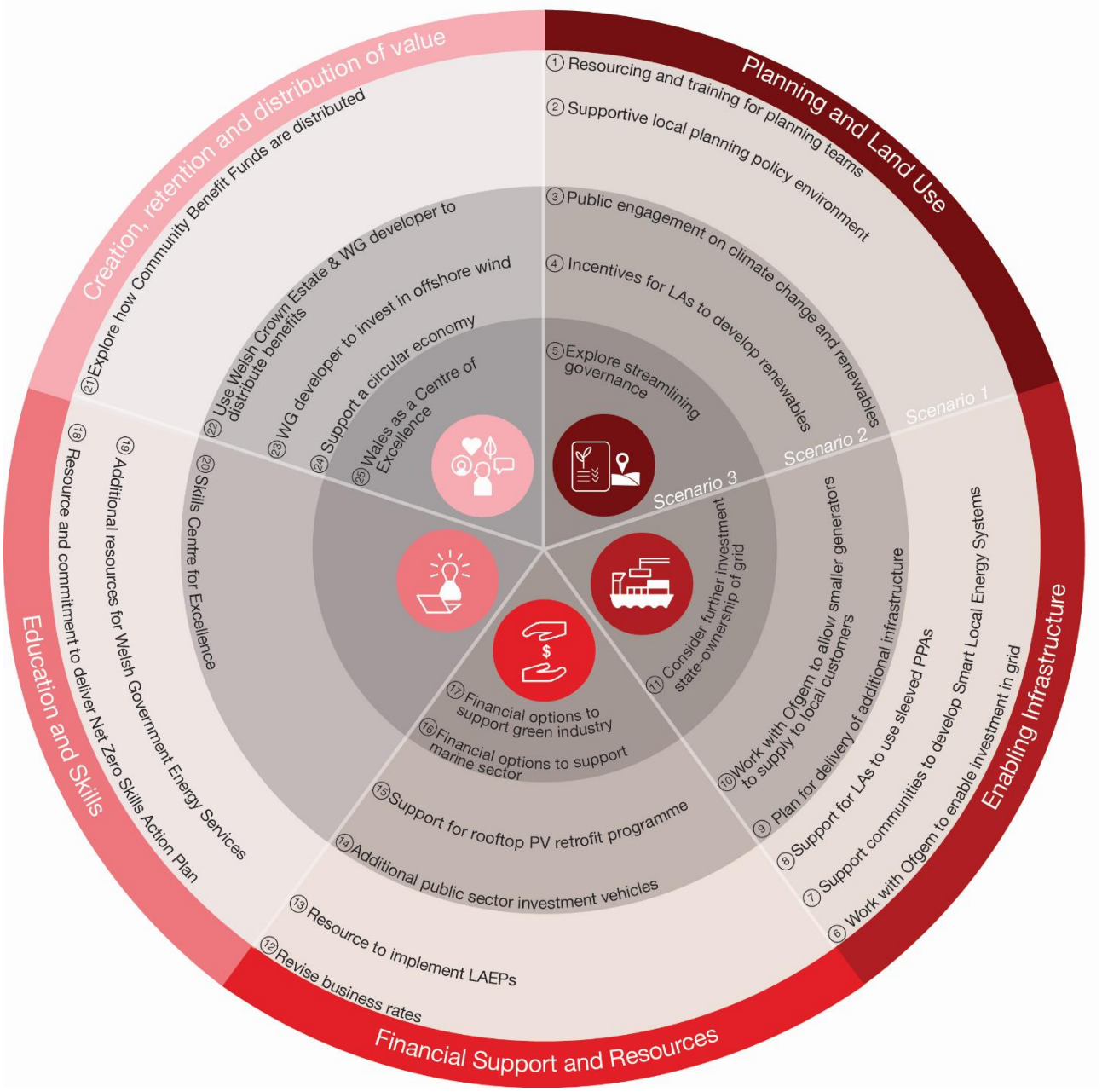
Theme	
Planning and land use	1. Provide support to local authorities, including ministerial directive and updated guidance, to develop a local planning policy environment to support the delivery of more renewables. 2. Provide additional targeted resource and training for planning teams and organisations involved in consenting, including local authorities and NRW. 3. Continue public engagement on climate change and renewable energy to improve energy literacy and build awareness and support for renewables at the local level, and to encourage a cultural shift in the approach to renewables within the public sector. 4. Provide incentives for local authorities to develop renewables on their land, or to host locally owned renewable projects, such as targets or reforms to carbon reporting. 5. Explore the efficiencies that could be delivered through streamlining governance in the public sector in Wales.
Enabling infrastructure	6. Continue to engage with Ofgem around changing policy and regulatory environment to enable investment in grid infrastructure, considering the timescales for delivery. 7. Provide support for communities to develop smart local energy systems, where these could help to balance supply and demand and / or provide a solution where grid capacity is constrained. 8. Provide support for local authorities and other public bodies to use sleeved PPAs with community and local renewables. 9. Collaborate with DNOs, local authorities, developers and other partners to develop a plan for the delivery of additional infrastructure needs to support renewable energy development, drawing on evidence from LAEPs to target investment where it is needed. 10. Work with Ofgem to explore ways to explore regulatory reforms to allow small to medium scale generators to supply to local customers, reducing stress on the grid. 11. Explore the feasibility of further investment in, or a degree of state-ownership of, national grid infrastructure, including gas networks as well as electricity.
Financial support and resources	12. Consider revisions to business rates for renewable energy projects, including abolishing rates for all renewable develop ments below a certain size. 13. Provide resource and technical capability to local authorities to deliver and implement LAEPs, and explore how community energy organisations can best be engaged in this process. 14. Facilitate additional investment vehicles or products supported by the public sector, to support the development of community renewables schemes. 15. Explore additional financial support that could be provided to support delivery of rooftop PV as part of a wider retrofit programme. 16. Explore financial options to support development in the marine sector in Wales. 17. Explore financial options to fund investment in green industry such as greener steel.
Education and skills	18. Provide resources and commitment to deliver the Net Zero Skills Action Plan, taking into account the implications of this study. 19. Work with industry and the further education sector to develop a Skills Centre for Excellence to support the renewables industry. 20. Provide a wider programme of support, including additional resources for WGES, for community organisations to grow capacity and capability to deliver renewable energy projects.
Creation, retention and distribution of value	21. Explore how the distribution of Community Benefit Funds from large projects could be coordinated to generate the most value.

Theme	
	22. Build on the potential devolution of the Welsh Crown Estate and the creation of the Welsh Government renewable developer to distribute benefits across Wales. 23. Explore the potential for the Welsh Government renewables developer to invest in offshore wind and other renewable opportunities in future. 24. Support a circular economy in electricity infrastructure, including reuse and refurbishment of existing infrastructure. 25. Support Wales to become a Centre of Excellence for renewable electricity
Monitoring and evaluation	26. Consider how to monitor and evaluate progress against these recommendations

5.4 Scenarios

This section of the report describes three different pathways for value capture in Wales, each based on different mixes of the policy and delivery options set out in Table 5-2 coming forward within a defined timescale. These are summarised in Figure 5-2.

Figure 5-2: Policy and delivery options under each scenario



While the scenarios look at the short, medium and long term, it is important that Welsh Government takes into account the timescales for delivery of renewable electricity infrastructure, and the importance of ensuring that the right physical and social infrastructure is in place in time to deliver on its net zero targets. Therefore, while some of these options are identified for the longer term, it is recommended that Welsh Government begins the work that would be needed to deliver on these ideas as soon as possible.

5.4.1 Scenario 1: what are the quick wins that can address immediate challenges and generate value in the short term (to 2025)?

Under this scenario, options are focused on addressing immediate challenges to increase the deployment of renewables, unlock capacity and capture value in the short term, i.e. over the period to 2025.

Options identified under the planning and land use theme could help to create a more supportive and better resourced local planning environment, removing some of the consenting barriers raised by stakeholders. While some elements of this option could be for the longer term, actions such as changes to guidance or ministerial letters setting out Welsh Government's position could be implemented more quickly. Welsh Government could also in this timescale consider expanding permitted development rights to streamline the planning process.

In relation to enabling infrastructure, support for SLES or microgrid solutions and for local authorities to use sleeved PPAs with community and local renewables could help to increase generation and create value locally without the need for grid upgrades. In the short term, continuing conversations with Ofgem around the need for further investment in grid infrastructure is recognised as important in unlocking investment and increasing grid capacity for the medium-long term.

Changes to business rates for renewable electricity projects, including abolishing rates for all renewable developments below a certain size, could be implemented relatively quickly and could reduce the cost burden for community renewable organisations, encouraging more schemes to come forward. Ring-fencing of business rates from larger schemes for use in host authorities could also incentivise local authorities to develop, or support the development of, more renewables in their areas. Additional resources for local authorities to deliver and implement their LAEPs could help to ensure that this process is effective in identifying opportunities for renewable generation at the local level.

Additional resources for WGES to provide a wider programme of support, including mentoring for non-renewables community organisations, could help to spread the value that can be created by community renewables schemes to areas that may not have had the opportunity to benefit from such schemes in the past. Exploring how Community Benefit Funds are administered and distributed also offers an opportunity to capture and distribute value more equitably, which could be implemented in the short term.

Providing the resources and commitment to deliver on the Net Zero Skills Action Plan is a short term action that could help to capture and retain value within Wales by providing increased certainty to developers that the skills and resources that will be needed in the renewable electricity sector and its supply chain in future will be available.

5.4.2 Scenario 2: how can we capture more value for Wales in the medium term (2025 to 2035)?

This scenario builds on scenario 1, and introduces options that are focused on increasing the value that is captured in Wales from investment in renewable electricity in the medium term, between 2025 and 2035.

In relation to planning and land use, continued public engagement on climate change and renewable energy could help to improve energy literacy and build support for renewables, reducing objections to developments at the local level, supporting public engagement, and also raising awareness of the need for change within the Welsh public sector. Related to this, incentives for local authorities such as ambitious, locally derived targets for renewable development could help to increase the deployment of renewables at all scales and in all areas of Wales in the medium term.

Within this timeframe, evidence from LAEPs (as well as from developers and other partners) should be available to inform Welsh Government's planning of additional infrastructure needs, targeted in the areas where it is most likely to be needed. Welsh Government could also work with Ofgem to remove regulatory barriers, enabling small and medium scale generators to supply electricity to local customers (as in the

Republic of Ireland and the Son Energia case study), reducing stress on the grid and generating additional value in the community renewables sector.

Additional investment vehicles supported by the public sector could realistically be developed, supporting the development of more community renewables schemes, and additional financial support for rooftop solar PV could encourage retrofit programmes. Building on the commitment to deliver on the Net Zero Skills Action Plan, a Skills Centre for Excellence for the renewables industry in Wales could also be developed within this timeframe, in consultation with stakeholders from across the sector and local authorities to ensure that it is planned in such a way that it provides the skills required by the renewables industry in the areas where they will be needed, while supporting the distribution of relevant skills and values to communities and workforces across Wales.

It is anticipated that Welsh Government's publicly owned renewables developer will begin developing schemes on Welsh Government woodland estate within this timeframe, and that further progress may have been made in relation to the devolution of the Crown Estate in Wales. These developments provide significant opportunities for the generation, retention and distribution of value within Wales. Also within this timescale, much of the existing installed renewables infrastructure in Wales will begin to reach the end of its life, providing opportunities to explore a circular economy in electricity infrastructure, which could generate value both by enabling more renewables to come on stream, and by creating jobs in recycling and repurposing existing equipment.

5.4.3 Scenario 3: what are the big ideas to deliver change in the longer term (2035 to 2050 and beyond)?

This scenario introduces bolder options that could deliver change in the longer term, looking ahead to 2050 and beyond.

In relation to planning, Welsh Government could explore the efficiencies that could be delivered through streamlining governance and creating economies of scale within the planning system. While there are actions under this option that could be delivered in the short term, such as expanding permitted development rights, in the longer term there could also be the potential to revisit the merger of local authorities, or to look at the possibility of centralising decision making around renewables within Welsh Government. Welsh Government could also consider the efficiencies that could be derived through further investment in, or a degree of state-ownership of, national grid infrastructure, drawing on the emerging example of FuturEnergy Ireland.

Welsh Government could look at financial options, such as the use of a carbon tax or CfD to support development in the marine sector in Wales, and to fund investment in green industry such as greener steel which could then be used in the renewables sector. The marine sector offers a significant long-term opportunity for Wales to become a market-leader, creating jobs, supporting supply chains, and delivering potentially transformational change in coastal and peripheral communities. Supporting green industry could also retain value by reducing the potential adverse impacts of decarbonisation on industrial areas of the country, and providing opportunities for the workforce in these areas to develop new skills to support the transition to net zero in the longer term.

Supporting Wales to meet its full potential and become a Centre of Excellence for renewable electricity generation, in tidal and other sectors, could also generate and secure value for Wales in the long term, offering opportunities to develop and export knowledge and skills, as well as energy, outside of Wales. Scaling up renewable electricity production for a variety of uses, including to support the decarbonisation of industry and the creation of a fully net zero energy system, could help to cement Wales' international reputation as a market leader in renewables, and to generate economic, social and environmental value in communities across the country, including those that may otherwise be at risk of experiencing adverse impacts from the transition to net zero.

6. Conclusions and recommendations

6.1 Conclusions

The following section presents the conclusions of the research, structured around the research questions identified at inception.

6.1.1 What do we mean by 'value'? Is that the same across Wales? Who would benefit from different types of value? Are there disbenefits too?

The research has found that there is no single definition of value. In the infrastructure sector, understandings of value have moved away from jobs and GVA to include a broader definition encompassing social and environmental, as well as economic, value. It is recognised that social value is often locally defined and related to the local social, environmental and economic context. In Wales, definitions of social value are generally linked to the goals and objectives of the Well-being of Future Generations Act and, more recently, to the socio-economic duty, which was enacted in 2021 and aims to improve inequality of outcome for people who experience socio-economic disadvantage.

Jobs and GVA do, however, remain an important measure of economic value, particularly at national level, although it is notable that the Well-being of Future Generations Act focuses on the importance of creating what it calls 'decent work'. At the more local level, the meaning of value can vary significantly by area depending on local issues and priorities. For example, in rural areas where there are particularly high levels of fuel poverty, creating social value could mean providing affordable energy or improving insulation in homes. In industrial areas with high proportions of jobs in carbon-intensive sectors, social value could mean support to re-skill the workforce or help SMEs to access opportunities in the renewables sector.

The potential disbenefits from the transition to net zero are also locally defined, and generally concentrated in those areas where there are high proportions of residents employed in industries that could be particularly at risk from decarbonisation, including the existing oil and gas sector, agriculture, and heavy industrial sectors such as steel, cement manufacturing and chemical processing. In some cases these areas overlap with areas where there could be particular opportunities around renewable technologies, such as in Neath Port Talbot where steel manufacturing is concentrated and where there is also significant onshore wind capacity as well as potential for port infrastructure to support offshore wind development.

However, there is also the risk that the transition to net zero could contribute to new or existing regional inequalities as investment in certain sectors, such as offshore wind and tidal, is likely to be concentrated in certain areas of Wales, which could limit the potential benefits for other parts of the country. There is therefore a need to put in place measures to support the distribution of value from such investment more widely across Wales, and to ensure that there are also opportunities for value to be created through investment in renewable electricity generation in a range of sectors and at a range of scales for the benefit of communities across Wales.

6.1.2 Can all types of renewable energy infrastructure deliver value in the same way and at the same scale?

It is recognised that large scale commercial developments, particularly in the offshore and onshore wind sectors, are likely to generate a relatively large proportion of Wales's future renewable energy needs and will therefore play a key role in helping Wales to meet its net zero targets. These projects also tend to generate the most value in terms of jobs and GVA at the national level, and provide local community benefits through Community Benefit Funds or through initiatives such as providing access to onshore wind farm sites for recreation or educational uses. There are also significant opportunities associated with emerging technologies such as tidal power, which has the potential to contribute to meeting net zero targets in future while delivering jobs and skills in coastal areas.

However, jobs, supply chain opportunities and community benefits associated with large commercial projects are generally concentrated in particular areas of Wales, and there are questions around how the value generated by these developments can best be captured and distributed more widely for the benefit of

communities across the country. The creation of a publicly-owned renewable energy developer for Wales provides an opportunity for a greater share of the benefits from large-scale onshore wind developments to be retained within Wales in the future, although this is at an early stage. The specialist skills required to construct and operate these developments also means that local supply chain linkages can be limited, and that economic benefits can therefore 'leak' outside of Wales.

Other renewable energy typologies deliver value in different ways and at different scales, and will also play a role in terms of delivering the energy for Wales to meet its targets in future. There are fewer geographical restrictions for roof-mounted solar PV, for example, which means that it can be suitable for use in built-up areas where there may not be the land required for other types of renewables infrastructure. Roof-mounted schemes therefore have the potential to support employment and supply chain effects in both urban and rural communities across Wales, as well as providing power to community facilities and assets on site or through direct wire systems, offering a more direct opportunity to change the cost of purchasing energy.

Local or community led development of solar, onshore wind or hydro schemes can also help to generate and retain value at the local level, including in areas that may not otherwise benefit directly from renewables infrastructure. Such schemes create jobs and support supply chains locally, as well as providing wider community benefits associated with increasing knowledge and understanding of climate change and encouraging participation and community cohesion. Locally owned schemes can also generate income streams for communities that can be used to support local initiatives, including for example in relation to energy efficiency and fuel poverty reduction. Community microgrid schemes or smart local energy systems could provide a solution in rural areas that are constrained by grid connections or capacity.

6.1.3 Are there different business or governance models that will deliver value in different ways?

As noted above, the commercial wind sector is key in generating the renewable energy to meet Wales's net zero targets, and is also important in delivering jobs, GVA and supply chain effects at the national scale. However, many of the large-scale developments currently in operation in Wales, including all three offshore wind projects, are owned by companies based outside of Wales, including state-owned operators such as Vattenfall and EDF Energy. This means that much of the value generated by these developments is exported outside of Wales. Welsh Government's recently announced renewable energy developer provides an opportunity to develop onshore wind schemes that will generate value that will be retained in Wales and that can then be reinvested into Welsh communities. There may also be the potential for this to expand into other sectors including offshore wind in the future.

Individual community led schemes may not provide the same capacity in terms of renewable electricity generation, but do generate value at the local level while also contributing to meeting net zero targets. The community renewables sector is relatively well developed in Wales, and models such as the Egni Co-op, which has over 1,000 members and 88 sites, have shown that it is possible to scale-up community owned schemes, delivering value for local communities while mitigating some of the risks associated with smaller schemes. Other models such as Ripple Energy have also emerged, enabling co-op members to own a share in a wind farm and benefit from lower energy prices. In Scotland, Ripple is also exploring the potential for community ownership of offshore wind. The Middelgrunden Windfarm case study in Denmark shows the potential benefits associated with public and community ownership in the offshore wind sector, as well as the role of collaboration between the state or local authorities and the community sector.

Microgrid or local energy networks can deliver value particularly in rural communities or communities where grid capacity or connection costs may be a barrier to project development. The Isle of Eigg case study shows the value of a microgrid system in a remote community which was previously reliant on diesel generators but now produces 95% of its energy from renewable sources. SLES can additionally help to balance supply and demand, which could be particularly important in future given grid constraints and the additional demand associated with the electrification of transport and domestic heating. In Wales, the Energy Local model is a local energy network which connects households with renewable generators and uses a 'match' tariff to encourage households to manage their energy usage around when local renewable schemes are operational. As well as supporting community cohesion, microgrid or local area networks can help to increase resilience and energy security in rural areas and provide a more reliable source of energy.

6.1.4 How can synergies and connections be derived through different scales of value creation?

Welsh Government, in its Renewable Energy Deep Dive, has committed to local and regional energy planning and the creation of a National Energy Plan by 2024, which will map out future energy demand and supply for all parts of Wales with the aim of matching local renewable energy generation with energy demand and creating a smart, flexible energy system[178]. Regional Energy Strategies and LAEPs were also included as commitments in Net Zero Wales[179]. Regional Energy Strategies have now been completed for the four regions of Wales, and LAEPs are now being taken forward at local authority level. This approach is likely to be key to identifying how and where connections can be derived across different scales and typologies, and how the benefits of renewable energy generation can be distributed more widely.

As discussed in the evidence review, the Regional Energy Strategies have each identified a different mix of interventions, at different scales, that will be needed to meet the region's net zero targets, informed by local constraints and opportunities. The Regional Energy Strategy for North Wales, for example, recognises the importance of the offshore and marine sector and the potential for the region to become a world-leader in offshore wind and marine technology, but also recommends developing local energy networks or microgrids in rural areas where grid capacity or connection costs could be a barrier[180]. This recognises both the strength of the commercial wind sector in North Wales, and the potential for smaller scale, community-based projects to deliver renewable energy and create value in areas that might not otherwise benefit directly from investment in commercial renewables infrastructure.

Welsh Government and the proposed National Energy Plan will have an important role to play in supporting the local and regional energy planning processes to ensure that synergies are made both between sectors and across geographies in order to deliver net zero and create value across the whole of Wales. The Regional Energy Strategy for the Cardiff Capital Region, for example, acknowledges that the region will struggle to meet demand for renewable energy itself, but that other regions have much greater potential for generation in relation to demand. LAEPs are at an early stage, however the process could be used to identify where there may be the potential to make connections or derive synergies between the commercial and community sectors. There are also likely to be opportunities between local authority areas across regions, or indeed nationally, where there may be the potential for collaboration between partners, information sharing and capacity building, and economies of scale.

Local area energy planning is also expected to play an important role in identifying the skills that will be needed in future, and planning the training and supply chain development that will be required to deliver the mix of renewable energy infrastructure planned in different local authority areas. It will be important that the National Energy Plan draws on this information, alongside the Net Zero Skills Action Plan, to ensure that communities are able to access and benefit from work and supply chain opportunities in the renewables sector as and when they become available. Again, it is likely that this could require support from Welsh Government to enable effective working between local authorities to avoid duplication and plan efficiently for the training that will be required.

Outside of the local and regional energy planning processes, the creation of a state-owned renewables developer in Wales provides a new opportunity for Welsh Government to bring the different scales and sectors of the renewables industry together. Examples such as Egni Co-op and Middelgrunden Windfarm in Denmark shows how successful joint ventures between the public and community sectors can be in delivering renewable energy and community benefits. Engaging with both the community and private sectors will be important to ensure support, and to allow stakeholders from across the renewable energy sector in Wales to identify the opportunities that the developer could create more widely.

6.1.5 What are the levers, policy interventions and delivery mechanisms that could maximise value across the whole system and all of Wales?

Energy policy is not devolved to the Welsh Ministers at present, however Welsh Government has a range of policy levers and mechanisms available to it that can help to maximise the delivery of value from renewable

[178] Welsh Government (2021), Renewable Energy Deep Dive.

[179] Welsh Government (2021), Net Zero Wales, Carbon Budget 2 (2021-2025).

[180] WGES (2021), North Wales Energy Strategy.

electricity infrastructure in Wales. Planning policy is a devolved area, and as has been discussed elsewhere in this report, it is generally accepted that Welsh national policy is supportive of renewable energy developments, although there is scope for local planning policy and practice to be strengthened in this area. Welsh Government has control of some areas of taxation, including business rates and council tax, as well as investment vehicles such as the Development Bank of Wales, giving some scope for financial measures and investment by Welsh Government in renewables. The education system in Wales is also devolved, giving Welsh Government control over the curriculum, and enabling it to plan for future skills requirements. The forthcoming publication of the Net Zero Skills Action Plan and the creation of a publicly-owned renewables developer for Wales offer significant opportunities to ensure that more of the value created by the renewables sector is retained within Wales.

6.2 Recommendations for NICW to consider

This section sets out recommendations for NICW to consider taking forward to Welsh Government, including suggested options and actions, that could maximise the delivery of renewable energy, and of value from renewable energy, for communities across Wales.

A key finding of the research has been that different renewable electricity typologies can generate different types of value, in different ways and at different scales, and that renewable electricity projects across all typologies are already delivering value for Wales. However, the renewables that will be required to meet net zero by 2050 are not being delivered at the speed or scale required, and there are therefore opportunities to increase the rate of delivery in a way that can maximise the value to be generated and retained within Wales. Recommendations therefore address two related issues:

- unlocking delivery of renewable electricity developments at all scales; and
- increasing the value that is generated and retained within Wales from those developments, both nationally and at the local level.

Recommendations are grouped around the themes identified above – planning and land use; enabling infrastructure; finance and resources; education and skills; and the creation, retention and distribution of value – and comprise a mixture of policy ideas aimed at increasing the speed and scale of delivery in the short to medium term, recognising relevant work that is already ongoing across Welsh Government and elsewhere, and more ambitious ideas for the longer term. A key finding is that, if Wales is to meet its target of 70% of its electricity demand from renewable sources by 2030 (or 100% by 2035) and net zero by 2050 then, given the timescales involved in developing renewables infrastructure, it is vital that action is taken now to scale up renewable deployment in a way that can deliver value for Wales.

6.2.1 Planning and land use

1. **Provide support to local authorities, including ministerial directive and updated guidance, to develop a local planning policy environment to support the delivery of more renewables.**

   Stakeholders recognise that Welsh national planning policy is generally strong in relation to renewable energy development, however there is scope for local planning policies to be more supportive and more consistent in this regard. It is recommended that Welsh Government work with local authorities to develop Local Development Plans that encourage renewables development, particularly local or community-based projects. In the short term, a helpful action could be for Welsh Government to provide a directive or ministerial letter to strengthen the case for renewables developments. A further short-term action could be to withdraw or update the guidance for Local Planning Authorities on renewable and low carbon energy, as the current guidance pre-dates Future Wales[181]. See also Recommendation 13 which discusses the need for resources to deliver LAEPs that meet the needs identified locally.

2. **Provide additional targeted resource and training for planning teams and organisations involved in consenting, including local authorities and NRW.**

[181] Welsh Government (2015), Planning for Renewable and Low Carbon Energy - A Toolkit for Planners. Available online at: Practice Guidance | gov.wales

Resourcing constraints in local authority planning departments and at NRW were raised by a range of stakeholders, including Welsh Government planners who commented on the pressures associated with the DNS process. Welsh Government has consulted on a new consenting process which would replace the DNS process with a Welsh Infrastructure Consent, however it is unclear at this stage how far this would help to address resourcing constraints in the planning system. It is therefore recommended that Welsh Government continue to monitor this and identify any further resource requirements in future. There is also a need for up-skilling of planners to give them confidence when consenting smaller renewable energy schemes and when advising on other relevant matters, such as building regulations and the cost implications of installing renewables on new housing, for example.

3. **Continue public engagement on climate change and renewable energy to improve energy literacy and build awareness and support for renewables at the local level, and to encourage a cultural shift in the approach to renewables within the public sector.**

   A lack of understanding of climate change and of the need for renewable energy infrastructure was highlighted by a range of stakeholders, particularly when this contributes to objections to planning applications for renewables developments or enabling infrastructure. Young people engaged as part of the Future Generations Workshop also commented on a lack of awareness of the work and training opportunities associated with the renewables sector. Welsh Government's Climate Change: A Strategy for Engagement and Action strategy document has recently (Autumn 2022) been consulted on. It is recommended that Welsh Government continues to support and monitor this strategy and provides sufficient resource to ensure that it is effective in raising awareness of the urgency and importance of taking action on climate change, as well as the opportunities around jobs and training in the renewables sector.

4. **Provide incentives for local authorities to develop renewables on their land, or to host locally owned renewable projects.**

   It is recommended that Welsh Government should consider implementing incentives for local authorities to develop renewables on their land. This could include ambitious locally derived renewable energy targets for the delivery of renewables on local authority land, to make it more advantageous for local authorities to develop their own schemes, or to host renewable schemes. It is understood that WGES is already looking into reforming how carbon reporting operates, however it is recommended that the concept of 24/7 Carbon Free Energy[182] is considered. While this is a relatively new idea, it could provide opportunities for local authorities and the wider public sector in future.

   Stakeholders representing the community renewables sector commented on the opportunities associated with local authority land-holdings, and the difficulties that they can experience in accessing suitable sites. Welsh Government could have a role in encouraging local authorities to identify sites that would be suitable for community renewables, maintaining a central database, and appropriate commercial arrangements for delivery. There may also be an opportunity for the Welsh Government renewable energy developer to develop a new model for combining commercial scale renewables with community renewables on public sector land.

5. **Explore the efficiencies that could be delivered through streamlining governance in the public sector in Wales.**

   There is a range of options available that Welsh Government could consider to streamline the planning process to encourage more renewable projects to come forward. Expanding permitted development rights for renewable energy developments up to a certain size (for example 5MW) in areas where there are no landscape, heritage or environmental designations could simplify the process for community organisations. Another option could be to consider relaxing planning restrictions to enable larger, more efficient wind turbines to be erected in areas where this would be technically appropriate in order to generate larger amounts of energy.

[182] United Nations, 24/7 Carbon-free Energy Compact: 24/7 Carbon-Free Energy | United Nations

Options that could be considered for the longer term include revisiting the potential merger of local authorities in Wales to enable economies of scale and support greater efficiency in the planning process or centralising all decision making around renewable energy infrastructure within Welsh Government.

6.2.2 Enabling infrastructure

6. **Continue to engage with Ofgem around changing policy and regulatory environment to enable timely investment in grid infrastructure, considering the timescales for delivery.**

   Grid capacity was raised as a significant concern by stakeholders engaged for this commission, which is reflected in the prominence given to this issue in Welsh Government's Renewable Energy Deep Dive. It is understood that forthcoming changes in policy and regulation (e.g. RIIO 2) should help to unlock investment in grid infrastructure and increase capacity, however it is recommended that Welsh Government should continue its engagement with Ofgem, as raised in the Deep Dive, to provide support and evidence around where further investment in the grid may be required in Wales in future, taking a proactive approach to identifying the need for grid upgrades based on the opportunities for renewables.

7. **Provide support for communities to develop smart local energy systems, where these could help to balance supply and demand and / or provide a solution where grid capacity is constrained.**

   Typologies such as microgrid and SLES can be a viable alternative in remote areas and/or in areas where grid capacity is constrained, allowing generation and demand to work together and easing the strain on the grid (see, for example the Isle of Eigg case study). It is recommended that Welsh Government provides support for communities to develop these systems in areas where they would be appropriate. This could involve work by WGES to identify suitable areas and to work with community organisations to build capacity and knowledge of these systems, or financial support such as a dedicated funding stream.

8. **Provide support for local authorities and other public sector bodies to use sleeved PPAs with community and local renewables.**

   Local authorities are often tied into electricity supply contracts with larger companies, making it harder for them to buy from smaller local generators. Using PPAs could enable community renewables groups to sell the power that they produce more easily, and to benefit from guaranteed prices which could help to fund deployment and make these projects more viable. Amending the approach to public sector procurement would encourage local authorities to commit to buying energy to power community facilities from local suppliers. Welsh Government's emerging Procurement Centre of Excellence[183] provides an opportunity to provide the guidance and support needed.

9. **Collaborate with DNOs, local authorities, developers and other partners to develop a plan for the delivery of additional infrastructure needs to support renewable energy development, drawing on evidence from LAEPs to target investment where it is needed.**

   Alongside grid infrastructure, stakeholders raised the need for investment in other forms of enabling infrastructure to support renewables such as port infrastructure, roads (particularly to access potential sites for onshore wind developments), and gas pipelines. It is recommended that Welsh Government work with DNOs, local authorities and other key partners to develop a detailed action plan and timeline for the delivery of the required infrastructure, using evidence from LAEPs and from the ESC Future Grid work to ensure that investment will be focused in the areas where it is needed and can be most effective.

10. **Work with Ofgem to explore regulatory reforms to allow small to medium scale generators to supply to local customers, reducing stress on the grid.**

    Supply licencing constraints were raised by stakeholders representing the community renewables sector. Removing these constraints to encourage small to medium scale generators to supply local customers, including domestic, could have benefits both in terms of allowing community energy organisations to supply their local communities directly, encouraging greater buy-in and flexibility in terms of community

[183] Welsh Government, 5th October 2022, Written Statement: Commencement of the Procurement Centre of Excellence Alpha (5 October 2022) | GOV.WALES

benefits (see for example the Som Energia case study in Catalonia), and in terms of reducing overall stress on the grid. Supplying at a domestic level as well as physically matching supply and demand also presents an opportunity for education and a cultural shift in people's perception of and use of energy. As Welsh Government doesn't have direct responsibility for this, we recommend engagement with Ofgem to explore this issue.

11. **Explore the feasibility of further investment in, or a degree of state-ownership of, national grid infrastructure, including gas networks as well as electricity.**

    The example of FuturEnergy Ireland highlights the efficiencies that can be associated with state-ownership of electricity networks when combined with state-owned forestry resources to develop renewable energy projects. It is recommended that Welsh Government explores the opportunities that could arise from investment in, or state-ownership of, elements of the Welsh national grid infrastructure, and the feasibility of achieving this, recognising that large scale state-ownership would require primary legislation change. For example, Welsh Government could explore existing regulatory models such as the OFTO (offshore transmission network owner) model used for offshore transmission networks, which could provide an example of what could be possible. It is recommended that Welsh Government consider gas networks, including for hydrogen, as well as electricity, to avoid the potential for competing priorities as the energy mix develops in future, whilst recognising the risk to the public purse of acquiring assets that may become stranded in the future.

6.2.3 Financial support and resources

12. **Consider revisions to business rates for renewable energy projects, including abolishing rates for all renewable developments below a certain size.**

    Community renewables organisations reported a lack of consistency between local authority areas, as some local authorities offer reductions for community schemes while others do not. Abolishing rates for all renewable developments below a certain size (e.g. 5MW) would remove this inconsistency and could help to enable more community renewable schemes to come forward. It is also recommended that Welsh Government consider revising how business rates from larger renewables schemes are used, for example a portion of these rates could be ringfenced to be spent in the host local authority area, and/or to be spent to address particular issues such as climate change mitigation, fuel poverty, or energy efficiency. Business rates (or non-domestic rates – NDRs) are currently collected by local authorities but then distributed by Welsh Government. Changes could be considered as part of the review of NDRs in Wales currently being undertaken by Welsh Government, which includes a review of reliefs and exemptions[184].

13. **Provide resource and technical capability to local authorities to deliver and implement LAEPs, and explore how community energy organisations can best be engaged in this process.**

    The LAEP process offers a strong opportunity to develop an evidence base and identify opportunities to increase renewable energy deployment and generate value for communities at the local authority level. It is recommended that Welsh Government ensures that sufficient resource and technical capability is in place both within local authorities, regional bodies and Welsh Government to deliver and implement effective LAEPs, and that local authority LAEP officers are able to access support and guidance from Welsh Government when needed. We recognise that there may ways in which Welsh Government can support the redirection of existing resources within local authorities, or explore alternative delivery models, but ongoing staff resource will be critical in driving forward delivery of the Plans.

    Welsh Government could also have a role in brokering the relationship between local authorities and the community energy sector to allow community energy organisations to be engaged meaningfully in the process, recognising the resource constraints of the sector to participate.

14. **Facilitate additional investment vehicles or products supported by the public sector, to support the development of community renewables schemes.**

[184] Welsh Government (2022), Consultation Document: Reforming Non-Domestic Rates in Wales. Available online at: Consultation on Reforming Non-Domestic Rates in Wales (gov.wales)

The closure of the feed-in tariff has been raised by stakeholders as a constraint on community renewables projects. It is recommended that Welsh Government look into other investment vehicles that could be used to support the development or scaling-up of community renewables projects. Options could include, for example, a Community Renewables ISA backed by Welsh Government that would allow members of the public to support the community renewables sector through their savings. Welsh Government could also consider using the opportunity presented by the proposed divestment of public sector pension funds from fossil fuels to invest instead in funds that would support renewable energy in Wales. Alongside this, Welsh Government could consider how to increase uptake of existing funding streams, and continue to work with organisations such as Community Energy Wales to explore the issues around financing for community energy schemes.

15. **Explore additional financial support that could be provided to support delivery of rooftop PV as part of a wider retrofit programme**

    Rooftop solar PV offers the potential for a more direct benefit to households, as well as to public, private and third sector bodies, as it can reduce the impact of major price shocks within the global energy industry. We also recognise that the provision of new renewable electricity generation for a building should be considered as part of a wider whole building retrofit solution to maximise benefits to reduce fuel poverty and minimise disruption. There are a number of existing retrofit schemes, and we recommend that Welsh Government builds on the success of these to explore additional support that could be provided to speed up delivery. Welsh Government could also consider the role of the Development Bank of Wales in providing additional financial support.

16. **Explore financial options to support development in the marine sector in Wales.**

    Marine typologies such as tidal power offer long-term opportunities for Wales, including the potential to become a market-leader in this technology and to develop local Welsh supply chains. There are also opportunities to generate significant social and environmental value including in coastal and peripheral areas. It is recommended that Welsh Government looks into financial options to support tidal development in Wales, and lobbies the UK Government for support where necessary.

    Investment in the nuclear sector in the UK is currently funded through CfDs and, from 2022, through regulated asset based (RAB) models, which have also been used to fund other large infrastructure projects such as the Thames Tideway Tunnel. CfDs are currently administered by UK Government, however Welsh Government could explore the use of similar models for tidal, for example buying energy produced through tidal systems using a PPA adopting the principle of CfDs so that Welsh Government would benefit when wholesale electricity prices are above the CfD ‘strike price’. Alternatively, Welsh Government could work to encourage a similar scheme to be rolled out across the UK.

17. **Explore financial options to fund investment and innovation in green industry such as greener steel.**

    We recommend that Welsh Government considers how they could financially support research and development in green industries in Wales such as the production of greener steel for use in the renewables sector, for example as turbines. This could have benefits in terms of mitigating the effects of decarbonisation on carbon-intensive sectors of industry and identifying Wales as a market-leader in lower-carbon manufacturing, as well as helping to develop sustainable Welsh supply chains for onshore and offshore wind. Options could include lobbying the UK Government for the powers to raise a carbon tax or carbon CfD, as used successfully in Germany, or to ringfence a share of revenues raised through the UK Emissions Trading Scheme (see work being taken forward by Net Zero Industry Wales and other stakeholders in this space). The use of carbon CfDs to fund other forms of innovation in industry and the renewables sector could also be explored.

6.2.4 Education and skills

18. **Provide resources and commitment to deliver the Net Zero Skills Action Plan, taking into account the implications of this study.**

    At the time of writing (February 2023), the Net Zero Skills Action Plan has not yet been published, however it is understood that this document will set out actions to promote equality in the transition to

net zero, including updates to the curriculum and apprenticeship programmes, and a new approach to adult education, training and retraining. It is recommended that Welsh Government provides the resources and commitment to deliver on the actions identified in this Plan, and that in doing so it takes into account any implications of this study.

19. Work with industry and the further education sector to develop a Skills Centre for Excellence to support the renewables industry.

It is recommended that Welsh Government develop a Skills Centre for Excellence for the renewables industry, working closely with industry, the further education sector and local authorities to ensure that it is in a sustainable and proportionate form that will be effective in delivering the skills required in communities across Wales to deliver the long-term renewables pipeline. Stakeholders expressed some concern that a Skills Centre for Excellence could result in skills and opportunities becoming concentrated in a particular area. An option could be that the centre could focus on training lecturers from existing further education colleges who could then disseminate this learning through their own institutions.

A Centre for Excellence could also play a role in developing vocational training programmes in renewable technologies which could then be delivered by other institutions, or by businesses or groups of businesses active in the sector. It will need to recognise the different skills required of manufacturing in the renewables sector, and operations and maintenance, and the likely distribution of each of these elements across Wales. The example of Germany, discussed above, highlights the importance of a vocational training system to train up apprentices and provide skilled workers for the renewables sector.

20. Provide a wider programme of support, including additional resources for WGES, for community organisations to grow capacity and capability to deliver renewable energy projects.

It is recommended that Welsh Government provides additional resources, including through WGES, to offer a wider programme of support and guidance for community organisations. This should build on the recommendations from the 2022 independent evaluation of WGES, and could include mentoring of organisations that may not previously have been involved in developing renewable energy projects, which could help to generate value in new areas. There may be a role for local authorities to work with WGES to identify existing non-energy community organisations which may have relevant local knowledge and capacity and therefore be well-placed to develop community energy schemes.

6.2.5 Creation, retention and distribution of value

21. Explore how the distribution of Community Benefit Funds from large projects could be coordinated to generate the most value.

Large commercial projects often generate considerable sums of money that are made available to local communities through Community Benefit Funds, usually administered by independent third-party organisations. It is recommended that Welsh Government explores how the administration of these funds could be coordinated, particularly where there are multiple projects within a local authority area, and how funds could be targeted to areas where they could have most benefit. For example, local authorities could be encouraged to produce strategies or local needs analyses that would help developers to identify where they could invest funds to meet local objectives and produce lasting value. It is understood that there is relevant work ongoing in Powys which could provide an example of how a more coordinated approach could work in practice.

22. Build on the potential devolution of the Welsh Crown Estate and the creation of the Welsh Government renewable developer to distribute benefits across Wales.

The creation of a publicly-owned renewable developer for Wales offers significant opportunities to retain value from onshore renewables which can then be invested in Welsh communities, and it is understood that benefits realisation will be an important strand. In establishing the developer, it is recommended that Welsh Government works closely with local and community partners to ensure that they feel engaged in the process and are able to benefit from the opportunities that it could generate.

The potential devolution of the Crown Estate to the Welsh Ministers could also offer opportunities to retain more value from offshore developments, although this is at an early stage and the potential benefits and disbenefits require further investigation. At this stage, Welsh Government should continue working

with the Crown Estate to explore what more could be done to bring benefits to Wales, for example by working with ports on offshore infrastructure, or helping to develop offshore supply chains. In the longer term, Welsh Government could look into ways in which revenue generated through the potential devolution of the Crown Estate could be used to support coastal communities and encourage greater local participation in the decision-making process, drawing on the Scottish example.

23. Explore the potential for the Welsh Government renewables developer to invest in offshore wind and other renewable opportunities in future.

It is understood that the Welsh Government renewables developer will initially invest in onshore wind on Welsh Government woodland estate. However, drawing on examples such as Middelgrunden in Denmark and work by Ripple Energy and NextGen exploring community ownership of offshore wind in Scotland, it is recommended that Welsh Government considers the opportunities associated with investment in offshore wind, and other renewable typologies such as tidal, in future to generate an increased revenue stream that could be invested in Wales.

24. Support a circular economy in electricity infrastructure, including reuse and refurbishment of existing infrastructure.

Much of the renewable electricity infrastructure currently installed in Wales will reach the end of its life, or become obsolete, over the next few decades. It is recommended that Welsh Government explores the steps that it could take to support a circular economy in electricity infrastructure, including the reuse and refurbishment of existing infrastructure. For example, when wind farms are repowered, and older turbines replaced with newer, more powerful models, the existing turbines could be repurposed for smaller, community-led schemes. Many of the materials used in wind turbines are also recyclable, and so Welsh Government could explore potential uses of recycled material in other products and processes, potentially creating new jobs and supporting Welsh supply chains.

25. Support Wales to become a Centre of Excellence for renewable electricity.

Wales has the potential to become a Centre of Excellence for renewable electricity generation. Welsh Government's ambitions should not be bound by current and projected levels of demand, but should instead consider opportunities around generating renewable electricity for a wide range of potential future uses, and exporting skills, technology and expertise to other parts of the UK and more widely, taking into account the bigger international picture and initiatives such as the Global Offshore Wind Alliance.

Generating enough electricity to meet peak demand, rather than the base load, would produce surplus energy that could then be used in different ways. For example, using renewable electricity to produce hydrogen for use in industry would have a significant benefit in terms of decarbonisation while also mitigating the potential adverse effects associated with the transition to net zero in areas with high levels of employment in carbon-intensive industries, and potentially creating new work and training opportunities. It is recommended that investment into research and development in this area continues.

Other opportunities that could be explored include producing energy for export outside of Wales, either by cable or in the form of hydrogen. The concept of 24/7 Carbon-Free Energy should be explored further, as well as the mix of typologies required to support a fully net zero energy system where, for example, hydro or tidal power could be used, rather than fossil fuels, to meet demand at times when supply from solar or wind is low. Battery technology is outside the scope of this study, but could be another opportunity for investigation. As discussed elsewhere, the tidal sector offers the potential for Wales to become a market leader, creating jobs, skills and supply chain opportunities, particularly in coastal areas, and creating opportunities to export knowledge and skills.

6.2.6 Monitoring and evaluation

26. Consider how to monitor and evaluate progress against these recommendations

It is recommended that Welsh Government considers how it can monitor and evaluate progress against these recommendations, for example through including value metrics in its Energy Generation in Wales report. Energy Generation in Wales is currently published annually. We recommend that Welsh Government consider presenting this data in an online dashboard or similar that could be updated more

regularly (see for example the Scottish Government's Scottish Energy Statistics Hub (shinyapps.io)) and provide a live update of progress in generating renewable electricity and value for Wales.

6.3 Summary and next steps

The targets for net zero mean that there is an urgent need for action. However, it is not possible to focus on those targets without thinking about the wider opportunities to create value for communities in Wales, or public consent for the action that is required could be at risk. Welsh Government is already doing a lot of work in this area that we recommend building on. One of the key success factors will be around a consistent policy environment, across the UK, Wales and local authorities. A clear theme that has emerged in our recommendations for NICW is that these policy signals need to be backed up by the capacity to deliver across all of the right organisations and at all scales. This will involve working closely with the UK Government and with Ofgem, particularly where key policy levers sit at UK level.

This piece of work is one of three commissioned by NICW as part of its Preparing Wales for a Renewable Energy 2050 project. Following completion of the three pieces of research, NICW will issue a single report to Welsh Government in summer 2023. The final NICW report will prioritise the recommendations to be taken forward to Welsh Government, and should set out the next steps to make progress against these recommendations. In some cases this will involve working with the UK Government and with Ofgem, and undertaking further research and feasibility studies to understand the steps that need to be taken to deliver the renewable energy required to meet net zero by 2050 in a way that is fair, just, and maximises value for the people of Wales.

Appendix A

List of abbreviations

Abbreviation	Definition
ABP	Associated British Ports
BEIS	Department for Business, Energy and Industrial Strategy (former UK Government department until 2023)
CARE	Cwm Arian Renewable Energy
CARES	Community and Renewable Energy Scheme (Scotland)
CCC	Climate Change Committee (Independent UK advisory body)
CfD	Contract for Difference
CHP	Combined Heat and Power
CIC	Community Interest Company
DNO	Distribution Network Operator
DNS	Developments of National Significance
DSO	Distribution System Operator
EEG	Renewable Energy Act (Germany)
ERP	Emissions Reduction Plan (New Zealand)
ESB	Electricity Supply Board (Republic of Ireland)
ESC	Energy Systems Catapult
FLOW	Floating Offshore Wind
FTE	Full-time Equivalent
GHG	Greenhouse Gas
GVA	Gross Value Added
GW	Gigawatt (1 gigawatt = 1,000 megawatts)
GWh	Gigawatt hour
HPC	Hinkley Point C
ICE	Institute of Civil Engineers
KW	Kilowatt (1 kilowatt = 1,000 watts)
KWh	Kilowatt hour
LAEP	Local Area Energy Plan
LCREE	Low Carbon and Renewable Energy Economy Survey
LIR	Local Impact Report
LDP	Local Development Plan

Abbreviation	Definition
MCA	Multi-Criteria Analysis
MW	Megawatt (1 megawatt = 1,000 kilowatts)
MWh	Megawatt hour
NDR	Non Domestic Rates
NICW	National Infrastructure Committee Wales
NRW	Natural Resources Wales
NSEC	North Seas Energy Cooperation
PAG	Project Advisory Group
PPA	Power Purchase Agreement
RAB	Regulated Asset Based Model
RESS	Renewable Energy Support Scheme (Ireland)
RIIO	Revenue = Incentives + Innovation + Outputs
SLES	Smart Local Energy Systems
SMEs	Small and Medium-Sized Enterprises
SPR	Scottish Power Renewables
SWIC	South Wales Industrial Cluster
SWOT	Strengths, Weaknesses, Opportunities and Threats
VET	Vocational and Education Training (Germany)
WGES	Welsh Government Energy Service

Appendix B

Summary of Stakeholder Engagement

B.1 Initial stakeholder engagement (October-November 2022)

Initial stakeholder engagement was undertaken in October and November 2022, and consisted of virtual interviews using an interview schedule developed by the research team. The interviews sought to understand what was being delivered by organisations in Wales in terms of renewable energy and value; how value was defined and understood by organisations in Wales; what barriers to renewable energy development organisations perceived; and what further support could be provided by Welsh Government to increase the deployment of renewables and the value generated for communities and the Welsh economy.

Stakeholders were interviewed representing the following organisations:

- Cardiff University Business School;
- Community Energy Wales;
- ESC;
- National Grid Electricity System Operator;
- RenewableUK Cymru;
- Wales and West Utilities;
- Welsh Government; and
- WGES.

The findings of these interviews were used to inform the evidence review, and helped to identify the key barriers and opportunities around renewable energy deployment and value creation perceived by stakeholders from a range of organisations across Wales.

B.2 Stakeholder workshops (December 2022)

Three virtual stakeholder workshops were held in December 2022 to present initial findings, discuss potential barriers and opportunities, and test policy ideas. Workshops were held on Microsoft Teams, and were arranged and facilitated jointly with colleagues at Mace working on a separate commission for NICW around the tensions associated with achieving net zero in Wales by 2050.

B.2.1 Community renewables workshop

A virtual workshop was held with representatives of the community renewables sector on 8th December 2022.

Attendance

The workshop was attended by eight stakeholders, representing the following organisations:

- CARE;
- Egni Co-op;

- Energy Local;
- Green Valleys;
- WGES; and
- Ynni Teg.

SWOT analysis

A SWOT analysis was completed using the online Miro whiteboard application. Participants were invited to use post-it notes to add their ideas to the board, which were then discussed as a group. The SWOT analysis identified a range of strengths, weaknesses, opportunities and threats to renewable energy deployment and the creation and retention of value for Wales.

Two new policy options emerged from the SWOT analysis and were included in the list for discussion at the local authority and public sector workshop.

Follow-up survey

A follow-up survey was developed and circulated to workshop attendees, using online survey software, to gather feedback on the initial list of potential policy options. The survey asked participants to score each policy on a scale of 1-5 for effectiveness in increasing the deployment of renewables in Wales, effectiveness in delivering value for Wales, and ease of implementation. Participants were also given an opportunity to provide any further comments or feedback in an open text box. Five responses to the survey were received.

Feedback on the policy options was used to inform the MCA of the initial list of policy options, particularly in relation to criteria around stakeholder support and deliverability.

B.2.2 Local authority and public sector workshop

A virtual workshop was held with representatives of local authorities and the public sector on 12th December 2022.

Attendance

The workshop was attended by 31 stakeholders, representing the following organisations:

- Blaenau Gwent County Borough Council;
- Bridgend County Borough Council;
- Caerphilly County Borough Council;
- Carmarthenshire County Council;
- Ceredigion County Council;
- Denbighshire County Council;
- Energy Systems Catapult;
- Flintshire County Council;
- Gwynedd Council;
- Isle of Anglesey County Council;
- Merthyr Tydfil County Borough Council;
- Monmouthshire County Council;
- Neath Port Talbot Council;
- Newport City Council;

- Powys County Council;
- Rhondda Cynon Taf County Borough Council;
- Snowdonia National Park: Eryri National Park;
- Swansea Council;
- Torfaen County Borough Council;
- Vale of Glamorgan Council; and
- Welsh Local Government Association.

SWOT analysis
Participants were divided into four break-out sessions, according to their specialism. Groups 1 and 2 were comprised primarily of energy officers, and groups 3 and 4 primarily of planners, economic development and community development officers. Each group completing a SWOT analysis using the online Miro whiteboard application. As per the community renewables workshop, participants were invited to use post-it notes to add their ideas to the board, which were then discussed as a group. Each group was then asked to identify one key barrier and one key opportunity to feedback to the whole group.

Policy prioritisation
Participants again split into the same four break-out groups. Each group was assigned one 'theme' (planning and land use; enabling infrastructure; finance and resources; education and skills) and asked to review the potential policy options identified under that theme, again using Miro. Participants were then asked to plot each policy option on a matrix of policy effectiveness and ease of implementation, and to feedback to the whole group.

B.2.3 Future Generations workshop

A virtual workshop was held with young people identified through the Future Generations Commissioner's Office on 8th December 2022. There were six attendees, all of whom were members and/or alumni of the Future Generations Leadership Academy.

The workshop took the format of an open discussion of renewable energy development in Wales, framed around two key themes: tensions and challenges, and skills and work opportunities. Participants were then asked to prioritise themes that had emerged from the discussion, using the online application Menti.

B.3 Further stakeholder engagement (January-February 2023)

A further round of engagement was conducted in January and February 2023 in order to discuss potential policy and delivery options with private sector organisations, and to identify any potential areas of overlap or duplication with other work already ongoing in Welsh Government.

- A discussion was held on 16th January 2023 with representatives of Welsh Government's energy team, focusing on particular issues around grid infrastructure and capacity, devolution of the Crown Estate to Wales, the publicly-owned renewables developer, and the Net Zero Skills Action Plan.
- A separate discussion with representatives of Welsh Government's planning team was then held on 19th January 2032, covering the DNS process, Future Wales, and some of the tensions in the planning system around renewables.
- The findings of the research and the potential policy and delivery options were presented to RenewableUK Cymru, also on 19th January 2023, in order to gather feedback from the commercial renewables sector.

- A further call was then held with Net Zero Industry Wales on 7th February 2023 to discuss findings and the policy and delivery options, with a particular focus on those around education and skills, and investment in low carbon industry.

Feedback from these conversations informed the finalisation of the MCA and helped to refine the list of policy and delivery options to be taken forward by NICW to consider as recommendations for Welsh Government.

Appendix C

References

Legislation

UK Parliament (2022), Crown Estate (Devolution to Wales) Bill.

Books and book chapters

Simcock, N., Willis, R., & Capener, P. (2016). Cultures of community energy: International case studies. British Academy.

Venus, T., M. Hinzmann, and H. Gerdes (2022), Public Acceptance of Hydropower. Novel Developments for Sustainable Hydropower. Springer, Cham.

Reports

Agentur für Erneuerbare Energien (2021), New study shows that community energy remains a central pillar of the energy transition.

Aquatera (2021), A Comparison of the Financial Benefits Arising from Private and Community Owned Wind Farms.

Cambridge Policy Consultants (2020), Evidence Base for a Climate Emergency Skills Action Plan.

Carbon Trust (2018), Future Potential for Offshore Wind in Wales.

Cardiff Council (2019), Lamby Way Solar Farm, Environmental Scrutiny.

Community Energy (2022), State of the Sector Report.

Cwmpas (2022), Welsh Government Social Value Review: Summary Report.

Data Cymru (2022), The labour market of tomorrow – jobs, skills and the transition to a green economy.

Department for Business, Energy and Industrial Strategy (BEIS) (2021), Community Engagement and Benefits from Onshore Wind Developments: Good Practice Guidance for England.

Development Trusts Association Scotland (2021), Grassroots: Community pathways to sustainability.

Energy and Climate Intelligence Unit (ECIU) and the Confederation of British Industry (CBI) (2023), Mapping the Net Zero Economy: Net zero impacts in national, regional and local economies

Energy Savings Trust (2022), Community and Locally Owned Energy in Scotland.

EurObserv'ER (2021), The State of Renewable Energy in Europe.

Fraser of Allander Institute (2022), The Economic Impact of Scotland's Renewable Energy Sector - 2022 Update.

Friends of the Earth Europe (2018), Unleashing the Power of Community Renewable Energy

Government of Ireland (2021), Climate Action Plan 2021.

Gwynt y Mor Community Fund (2017), Third Year Report 2017-2018.

Institute of Civil Engineers (2020), Maximising Social Value from Infrastructure Projects.

Institute of Welsh Affairs (2018), The Economic Costs and Benefits of Renewable Energy Transition in Wales.

Marine Energy Wales (2022), State of the Sector 2022.

National Infrastructure Commission Wales (NICW) (2022), Annual Report 2021/22.

Neath Port Talbot Public Services Board (2023), Neath Port Talbot Wellbeing Assessment.

Pembrokeshire County Council (2022), Pembrokeshire's Local Area Energy Plan.

Regen (2022), Delivering local benefit from offshore renewables: Working towards a new model for community benefit and local ownership.

Scottish Government (SG) (2022), Renewable and Low Carbon Energy.

SG (2022), Scotland 2045: Our Fourth National Planning Framework.

SG (2022), Scottish Planning Policy.

SG (2017), Scottish Energy Strategy: The future of energy generation in Scotland.

Scottish Power Renewables and BVG Associates (2019), 10 years of Whitelee Windfarm: A decade of economic, environmental and social benefits.

Senedd, Climate Change, Environment and Infrastructure Committee (2022), Renewable Energy in Wales.

Solar Energy UK (2022), Time to Shine: Impact Report 2021.

South Wales Industrial Cluster (SWIC) (2022), Skills required for industrial decarbonisation and getting to Net Zero. Skills workshop 14/06/22: Feedback and recommendations.

Wales TUC (2020), A Green Recovery and a Just Transition.

Welsh Government (WG) (2023), Consultation Document: Review of Wales' Renewable Energy Targets.

WG (2022), Consultation Document: Reforming Non-Domestic Rates in Wales.

WG (2022), Written Statement: Fuel Poverty, April 2022.

WG (2022), Wales Budget 2023-2024.

WG (2022), Renewable Energy Deep Dive Biannual Recommendations Update 1.

WG (2022), Energy Generation in Wales, 2021.

WG (2021), Energy Generation in Wales, 2020.

WG (2021), Tackling Fuel Poverty 2021-2035.

WG (2021), Net Zero Wales, Carbon Budget 2 (2021-2025).

WG (2021), Renewable Energy Deep Dive.

WG (2021), Future Wales: The National Plan 2040.

WG (2020), Policy Statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations.

WG (2019), Marine Energy Plan for Wales - Unlocking the Energy in Our Seas.

WG (2019), Energy Use in Wales.

WG (2019), Local Energy: Grid Connection Module.

WG (2015), Planning for Renewable and Low Carbon Energy - A Toolkit for Planners.

WG (2015), Community Energy Toolkit, Establishing a Community Group Module.

WG and Carbon Trust (2018), Future Potential for Offshore Wind in Wales.

WG and Community Energy Wales (2021), Community Energy in Wales: State of the Sector Report 2021.

Welsh Government Energy Service (WGES) (2022), South West Wales Energy Strategy.

WGES (2021), Cardiff Capital Region Energy Strategy.

WGES (2021), Energy Service for Public Sector and Community Groups.

WGES (2021), North Wales Energy Strategy.

WGES (2020), Mid Wales Energy Strategy.

Press releases

Government of Ireland, 1st June 2021, Minister Harris announces €225 million investment in further and higher education and research under National Recovery and Resilience Plan.

WG, 25th October 2022, Wales announces publicly-owned renewable energy developer.

WG, 5th October 2022, Written statement: Commencement of the Procurement Centre of Excellence.

WG, 5th April 2022, Schools and Public Buildings to get solar panels as Wales drives community owned renewable energy.

WG, 14th March 2022, Solar farm powers Morriston Hospital for 50 hours without back-up from the grid in winter months.

Newspaper and journal articles

Clean Energy Wire, 16th November 2018, How Germany's vocational education and training system works.

Clean Energy Wire, 18th February 2015, Small, but powerful – Germany's municipal utilities.

Energy Democracy, 14th November 2017, Som Energia, Catalonia.

Energy Transition, 10th February 2021, Denmark's Legendary Wind Park Middelgrunden at a Crossroads.

Energy Transition, 3rd November 2014, Best in Class: Belgian energy co-op Ecopower.

Erneuerbare Energien, 15th November 2022, 100 additional geothermal projects set to heat up Germany.

Europa Press, 11th December 2010, The first renewable energy cooperative in Spain is established in Girona.

Green Economy Coalition, 20th September 2017, Communal ownership drive's Denmark's wind revolution.

The Guardian, 14th March 2022, Welsh solar farm exceeds expectations in powering Swansea hospital.

The Guardian, 2021, 23rd September 2021, If the UK's energy suppliers were publicly owned, would we be having this crisis?

Knack, 2nd May 2022, Ecopower: 'In Vlaanderen is het nagenoeg onmogelijk om nog een windturbine op land vergund te krijgen'.

Newsroom, 17th June 2022, 'An unlimited resource': NZ's offshore energy revolution.

Offshore Wind, 28th September 2021, A UK First: community ownership of offshore wind farms.

Roberts, R., Brent, A., and Hinkley, J., 2021. Reviewing the impacts of community energy initiatives in New Zealand. Kōtuitui: New Zealand Journal of Social Sciences Online, 16(1), pp.45-60.

Solar Power Portal, 3rd February 2017, Foresight splashes the cash on UK's largest solar park.

Tagesschau, 12th November 2022, Raw material dependency grows.

Zhiguo Zhang, Xiran Liu, Dan Zhao, Scott Post, Jiasen Chen, (2022), Overview of the Development and Application of Wind Energy in New Zealand. Energy and Built Environment.

Webpages

BEIS, The Crown Estate and The Crown Estate Scotland, Future Offshore Wind Scenarios (FOWS) to 2050.

British Solar Renewables, Shotwick Solar Park.

Claremorris Energy Co-op, Solar Energy.

Cwm Arian Renewable Energy, Community Wind Turbine

Development Bank of Wales, Funds We Manage.

Community Power EU, Community Power in Ireland.

EDF, An exceptional industrial site.

EDF, Hinkley Point C.

Egni Co-op, About Us.

Egni Co-op, New Community Hwb Taking Shape.

European Commission, The North Seas Energy Cooperation.

FuturEnergy Ireland, The FuturEnergy Ireland Story.

Hinkley Supply Chain, Engaging South West Businesses.

House of Commons, Energy and Climate Change Committee.

Invest New Zealand, Renewable Energy.

Isle of Eigg, Eigg Electric.

Natural Resources Wales, Offshore Wind Developments.

ONS, Low Carbon and Renewable Energy Economy (LCREE) survey estimates, UK, 2014 to 2020.

Pen y Cymoedd Wind Farm Community Fund CIC.

RenewableUK, Community Benefits Protocol.

The Renewable Energy Hub, Is Hydroelectricity Generation Worth It?

Renewable Technology, Middelgrunden Offshore Windfarm, Oresund.

Renewable Technology, Gwynt y Mor Offshore Wind Project, Liverpool Bay, North Wales.

Ripple Energy, Our Wind Farms.

Ripple Energy, Why join Ripple?

RWE, Our community funds at a glance: Wales.

SG, Scottish Energy Statistics Hub.

Som Energia, Who are we?

Strom-Report, Electricity Mix and Electricity Generation.

SWMAS, Hinkley Supply Chain Programme.

Transformative Cities, Co-operative breaks the mould to provide renewable energy. WG, Commission unveils priorities for next year as it develops a future infrastructure plan for Wales.

United Nation, 24/7 Carbon-free Energy Compact.

Vlaanderen, General Framework for Integrated National Energy and Climate Plans.

Vlaanderen, Green energy.

WG, A More Equal Wales: The Socio-economic Duty.

WG, Best and most versatile agricultural land and solar PV arrays.

WG, Planning permission: solar panels.

Wind and Sun, Case Study, Isle of Eigg.