Local Area Energy Plan

Denbighshire County Council

2024

Mae'r ddogfen hon ar gael yn Gymraeg

This document is also available in Welsh

Figure 1 Rooftop solar panels

Abbreviations

Acronym	Definition or meaning
ANW	Ambition North Wales
AONB	Area of Outstanding Natural Beauty
BEIS	Business, Energy and Industrial Strategy
CAPEX	Capital Expenditure
CCGT	Combined Cycle Gas Turbine
CCR	Cardiff Capital Region
DESNZ	Department for Energy Security & Net Zero
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
ECOFLEX	Flexible Eligibility Energy Company Obligation
ECR	Embedded Capacity Register
EfW	Energy from Waste
EGW	Energy Generation in Wales
EPC	Energy Performance Certificate

Acronym	Definition or meaning
ESC	Energy Systems Catapult
EV	Electric Vehicle
EVCI	Electric Vehicle Charging Infrastructure
FES	Future Energy Scenarios
GDN	Gas Distribution Network
GHG	Greenhouse Gas
HGV	Heavy Goods Vehicles
HVO	Hydrotreated Vegetable Oil
LAEP	Local Area Energy Planning or Local Area Energy Plan
LDP	Local Development Plan
LGV	Light Goods Vehicles
LPG	Liquid Petroleum Gas
LSOA	Lower Super Output Area, a small area classification in the UK designed to have a comparable population
LULUCF	Land Use, Land Use Change and Forestry

Acronym	Definition or meaning
MSOA	Middle super output area, a medium-sized area classification in the UK designed to have a comparable population
NAEI	National Atmospheric Emissions Inventory
NDP	National Development Plan
NHS	National Health Service
NZ	Net Zero
NZIW	Net Zero Industry Wales
OS	Ordinance Survey
PEDW	Planning and Environment Decisions Wales
PSB	Public Services Board
REA	Renewable Energy Assessment
REPD	Renewable Energy Planning Database
RFI	Request for Information
RIIO	Revenue = Incentives + Innovation + Outputs, a regulatory framework used by the UK energy regulator Ofgem
RIIO-ED2	See above. The current price control period for electricity distributors (ED) that runs from 2023-2028

Acronym	Definition or meaning
RIIO-GD3	See above. The next price control period for gas distributors (GD) that runs from 2026-2031
RSP	Regional Skills Partnership
SLES	Smart Local Energy System
SMR	Steam Methane Reformation
SPEN	SP Energy Networks
ULEVTF	Ultra-Low Emissions Vehicles Transformation Fund
UNESCO	United National Education, Scientific and Cultural Organisation
WDQR	Welsh Development Quality Requirements
WHQS	Welsh Housing Quality Standards
WIMD	Welsh Index of Multiple Deprivation
WWU	Wales and West Utilities

Note: full definitions for terms used through the report are provided in the glossary at the end of the document

Acknowledgements

This Local Area Energy Plan was prepared by Arup, The Carbon Trust and Afallen on behalf of Denbighshire County Council and Ambition North Wales. Energy Systems Catapult are the Technical Advisors for the LAEP Programme in Wales.

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Foreword

A note from Denbighshire County Council

Denbighshire County Council is committed to addressing the climate change and ecological emergency and contributing to achieving Wales's collective goals of a Net Zero public sector by 2030 and Net Zero Wales by 2050. We declared a Climate Change and Ecological Emergency in 2019 as a Council, changed our constitution in 2020 for all decision-making to take account of tackling these emergencies, adopted our Climate and Nature Strategy in 2021, outlining our Net Carbon Zero and Ecologically Positive Council Goals, and reinstated our commitment to creating a "Greener Denbighshire" within our Corporate Plan.

Since April last year, we have been working with Arup, The Carbon Trust and Afallen and engaging with stakeholders to create a Local Area Energy Plan, an evidence-based, holistic plan that outlines the scale of change and opportunity to decarbonise Denbighshire's local energy system. Workshops have brought us together to discuss our current local energy system, explore what our future local energy system might look like and how we might work together to influence and deliver what is needed for a decarbonised energy system. We all have a role to play in shaping Denbighshire and Wales's transition to Net Zero, and as the Local Authority, we understand how important it will be for us to do this in a way that protects and supports our most vulnerable communities, and delivers additional benefits, such as improved health and employment opportunities across the county.

Having a Local Area Energy Plan for Denbighshire brings our local climate action plan and associated energy planning more in line with regional and national energy infrastructure planning and ensures that our local priorities remain at the heart of the energy transition. It demonstrates our collective commitment to Net Zero, and is an evidence base that will be invaluable for a wide range of stakeholders to influence change, such as:

- Helping determine what products, partnerships or services could be offered and delivered in a local area
- Highlighting areas with significant potential to developers
- Helping better prepare organisations for public funding opportunities
- Informing regional views and decision-making, to achieve a cost effective transition or
- Strengthening the case for policy change needed at the UK government level

As a Council, we are motivated to drive Net Zero at a local level and acknowledge our role as convener and co-ordinator, to motivate others to do the same. It is vital that we set our goals on what we can contribute as a Local Authority to drive the transition to a greener future.

However, our influence over the energy system is limited, and we cannot deliver this plan without input from others in North Wales, most importantly the energy networks who have influence over what critical network investment is made, and Welsh Government, who can establish the supportive policy environment our LAEP needs to reach its full potential. It's intended that we will work with others in North Wales to deliver these plans. They will steer the programme going forward, with a steering group made up of representatives of key organisations who have expertise to lend. We must maintain the momentum and we will be in touch to arrange further working group sessions once we have established the full project governance structure.

Thank you all for helping us establish Denbighshire's LAEP.

Councillor Barry Mellor, Lead member for environment and transport

Local Area Energy Plan Outline

This plan collates evidence to identify the most effective route for Denbighshire to achieve a Net Zero energy system by 2050

Overview

As part of this project, two separate documents have been produced. This will ensure the content is accessible to a variety of audiences whilst also making it easier to find information relevant for the reader.

These two documents are the:

- Local Area Energy Plan (this document) contains the overarching plan, focusing on Denbighshire's area-wide energy plan and actions
- Technical Report contains the graphs, charts, maps and supporting data for the results published in the Local Area Energy Plan. It also provides more detail about the approach to modelling and scenario analysis that we took. To request further information, please contact climatechange@denbighshire.gov.uk

A note on the use of "we" throughout this report:

Achieving the transformation that is needed for the energy system to reach Net Zero will not be easy and will need a collaborative approach. In this plan, the term "we" has therefore been used to refer to the range of people and organisations in Denbighshire who will support the ambition set out and agreed in this plan. The Council and Ambition North Wales have taken facilitating roles in developing this LAEP but cannot deliver the ambition it sets out alone. This Plan has been developed with input from a range of stakeholders, and we all hope that you will be inspired by the actions that stakeholders have committed to, to take action to transform Denbighshire's energy system too.

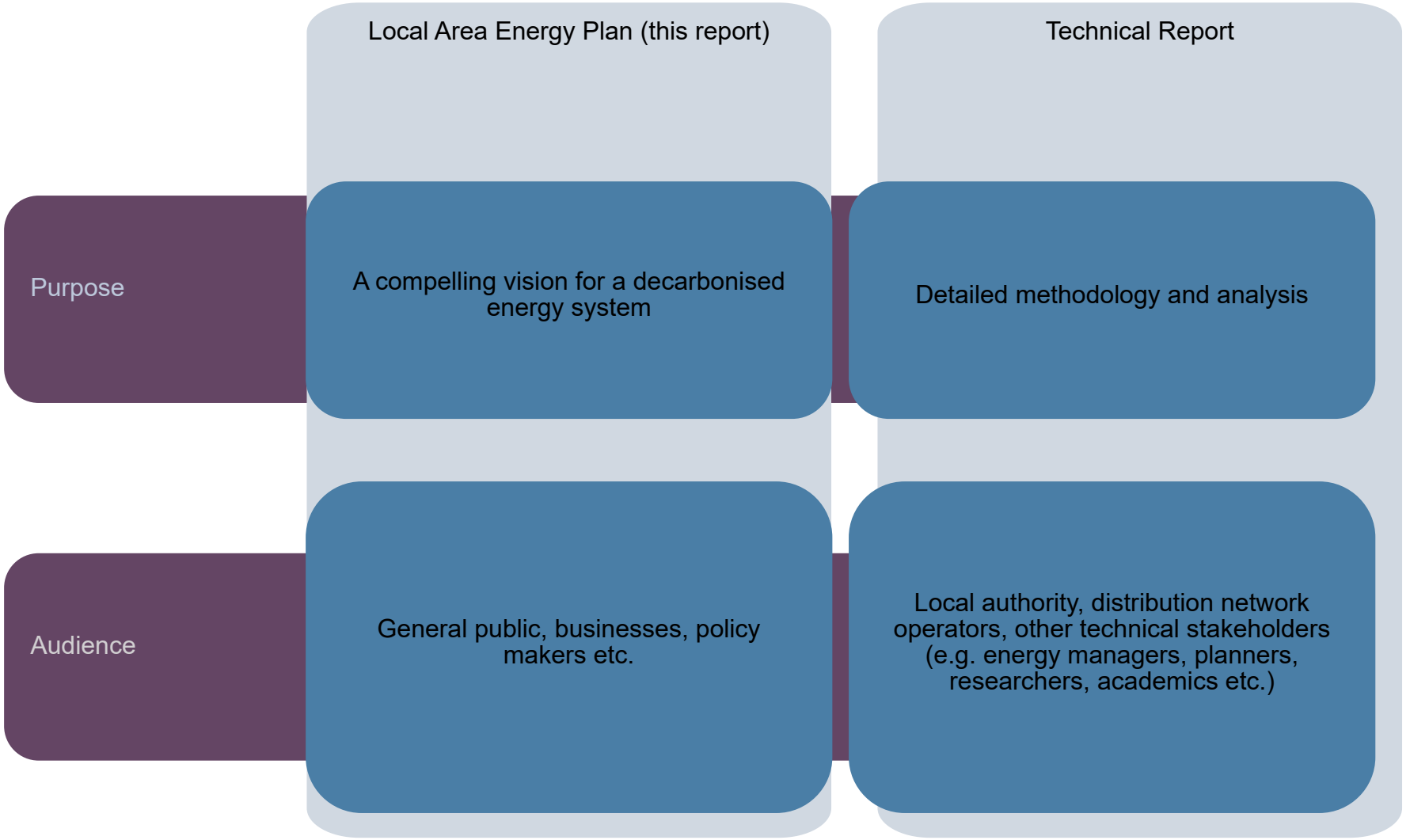
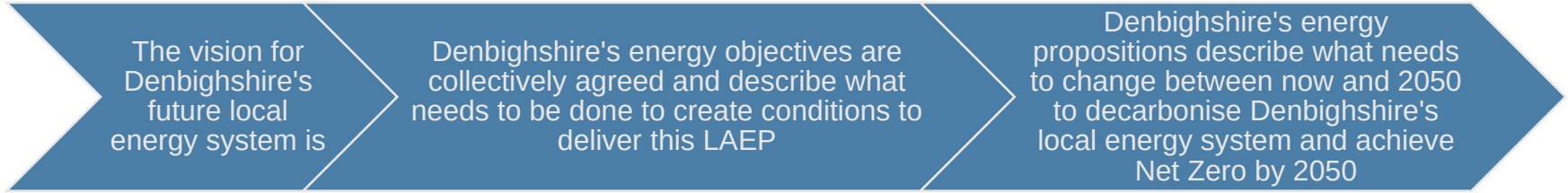


Figure 2 Summary of LAEP reports' purpose and audience

Executive Summary: Our Vision for a Net Zero Local Energy System



The vision, energy objectives and energy propositions.		
Our future energy system capitalises on our local renewable energy resources to provide an affordable and resilient energy system for our local communities without compromising our natural assets. Our local energy system empowers localities to generate and use energy more effectively which supports the development of a sustainable local economy.	Encourage the efficient use of energy in the built environment and improve access to good quality, energy efficient housing. Support the development of a resilient and efficient local energy system, exploring opportunities to reduce peak energy demand and offer flexibility services to the grid using storage technologies. Make sure the Net Zero energy transition is equitable and fair. Give support to sustainable and green transport plans that improve overall air quality, including active and healthy travel schemes that encourage walking and cycling. Maximise the local benefits from renewable energy generation by putting communities at the heart of our plans. Help us understand the opportunities for creating a flourishing low carbon economy, supported by a skilled workforce that is fit for the future.	1. Minimise energy demand, and support shift to low carbon, flexible heating systems in homes 2. Maximise local potential for onshore renewables 3. Decarbonise transport 4. Reinforce electricity and gas distribution networks 5. Explore opporunities for smart local energy systems

Figure 3 LAEP priority energy proposition areas for Denbighshire

Minimise energy demand, support shift to low carbon, flexible heating systems in homes

- Reduce the amount of energy used to minimise emissions and cost to consumers through insulation retrofits where viable.
- Deploy heat pumps as the near-term, least regrets heating technology to decarbonise heating in homes.
- Explore innovative business models to maximise local benefits, buy-in and confidence in low carbon heating systems.
- Low-regret system components: Retrofit, Heat Pumps

Maximise local potential for onshore renewables

- Focus on delivering pipeline opportunities for solar PV and particularly onshore wind (62MW in pipeline).
- Explore opportunities to capitalise on unused agricultural waste resources to generate energy (e.g. anaerobic digestion).
- Consider storage technologies to minimise dependency and exposure to grid price volatility and connection challenges.
- Low-regret system components: Rooftop solar PV, Onshore wind turbines, Ground-mounted solar PV

Decarbonise Transport

- Develop supporting EV charging infrastructure.
- Improve facilities for those who walk, cycle and use public transport to ensure a shift to active and sustainable travel modes.
- Where car journeys can't be avoided, support a fair transition to ultra-low emissions vehicles (ULEV) which will include transitioning public service buses and taxis.
- Low-regret System components EV chargers Active Travel Infrastructure

Reinforce electricity and gas distribution networks

- Reinforce the grid to manage increase in electricity demand.
- Even if hydrogen is not used for heating, the gas grid will need to be repurposed to provide hydrogen for uses that are not easily electrified such as industry, and to manage costs in a fair way as home heating transitions away from gas.
- Consider ways to provide flexibility to the grid through storage technologies.
- Low-regret system components. Flexibility, storage technology

Explore opportunities for smart local energy systems

- Use smart systems to connect energy generation, storage, demand and infrastructure in a smart, localised way. Energy resources are used more efficiently, it can alleviate pressures on the grid, avoid connection delays and minimise risk and exposure to price volatility.
- Explore heat and cooling network opportunities.
- Low-regret system components
- Waste Heat

Figure 4 A more detailed description of Denbighshire's energy propositions and the corresponding low-regret system components to focus on in the near-term

Denbighshire's local energy system will need to change significantly to achieve Net Zero by 2050

Denbighshire's local energy system today:

- **600 buildings with** heat pumps installed[a]
- **27% (13,000 homes)** rated EPC A-C
- **72** public EV chargepoints[b]
- **7MW (1,800** buildings[d,e]) with rooftop solar PV
- **1MW** installed ground-mounted solar PV capacity[e]
- **69MW** installed onshore wind capacity[e]

What Denbighshire's Net Zero local energy system could look like in 2050

- **Up to 55,000 buildings with** heat pumps installed [a]
- **Up to 42,400 insulation measures retrofitted**
- **Up to 40,400** public EV chargepoints [c]
- **Up to 156MW (39,000** buildings [d,e]) with rooftop solar PV
- **Up to 1,070MW** installed ground-mounted solar PV capacity [e]
- **Up to 156MW** installed onshore wind capacity [e]

a) Assuming one heat pump is approximately 6kWp
b) According to the National chargepoint Registry (1) as of May 2023. Refers to individual chargepoints
c) Assuming 4kWp per chargepoint. Note that the power rating selected will be dependent on location and use case. E.g. Rapid chargers are more suitable at service stations due to the length of stay of customers. In Denbighshire most chargers (95%) are likely to be slow chargers (<7kW) with a small number of fast (7-22kW) and rapid (42-350kW) EV chargers (based on the Wales EV Charging Strategy (2)).
d) Assuming 4kWp per roof
e) Renewable generation capacity is shown for technologies where current installed capacity is >5MW

The rate of change required to achieve this:

1. Between 2023 and 2030 we assume a slow but steady uptake of low carbon technologies due to factors such as limited awareness, higher capital costs and the need for network reinforcement	2. From 2030 onwards, we assume that deployment accelerates as technologies become more commercially attractive, awareness increases, supply chains develop and they become more affordable	3. From 2040 onwards, we assume that low carbon technologies are widely used and tend towards their maximum feasible adoption which causes the deployment rate to stabilise

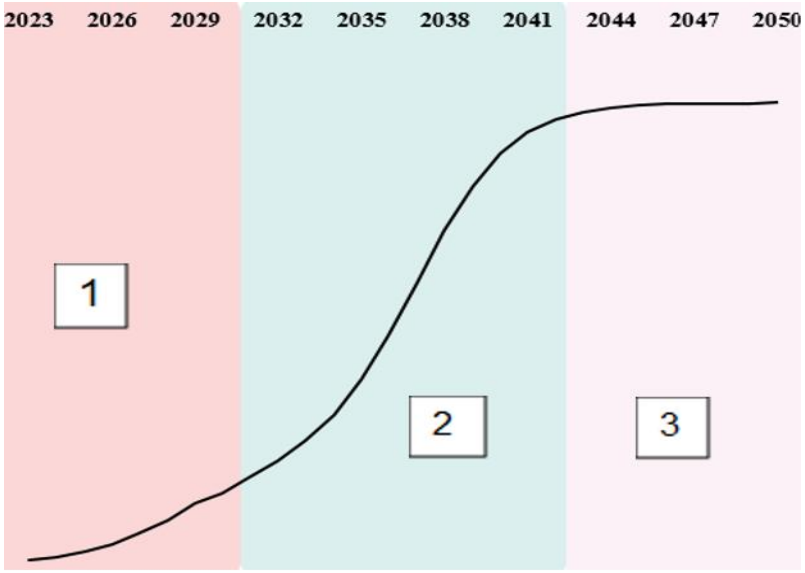


Figure 5 Summary of deployment of low-regret system components, showing quantities of technologies deployed today and what could be deployed by 2050. Figure also includes a description of how the rate of deployment of low carbon technologies could change between 2023 and 2050

Achieving a Net Zero local energy system in 2050 aligns with Wales's well-being goals and could lead to the following:

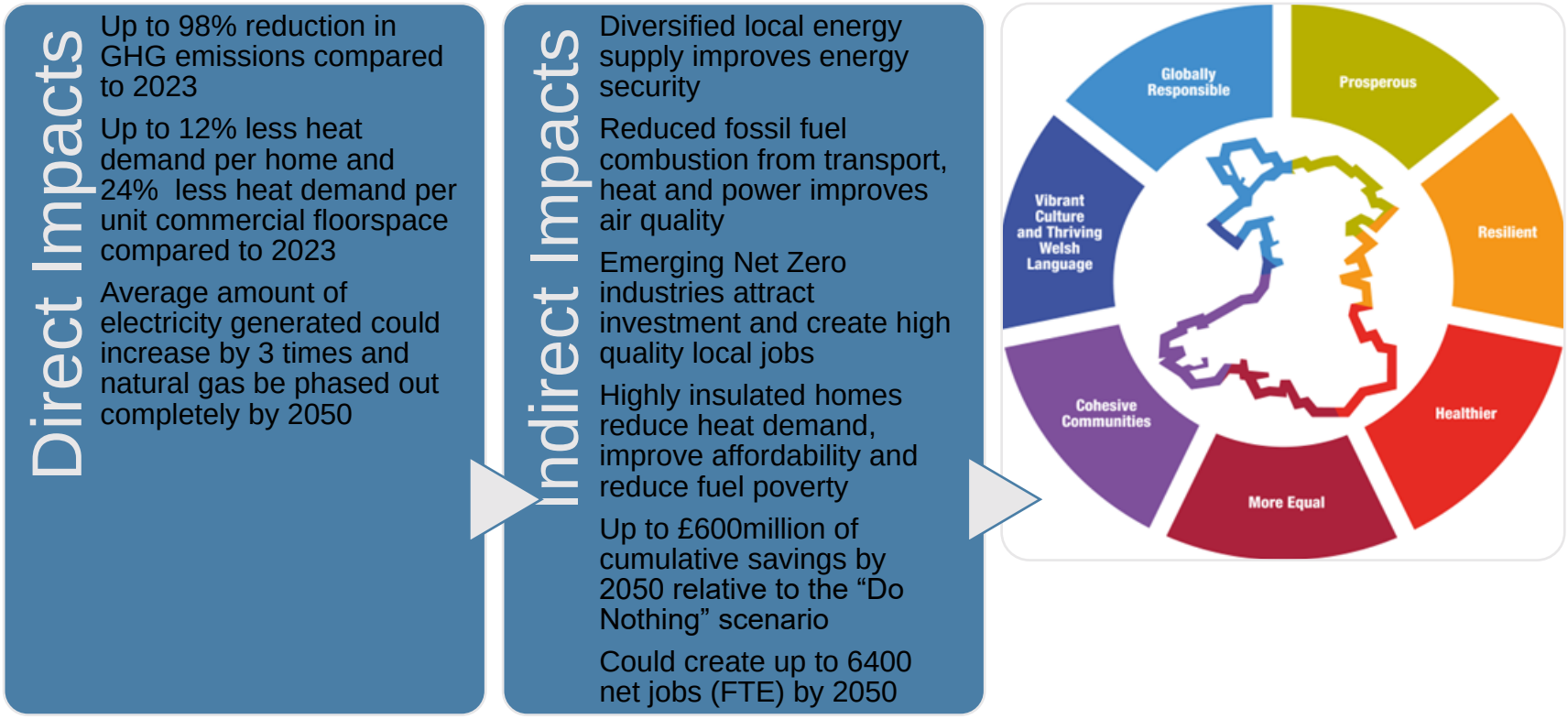


Figure 6 Illustration of the direct and wider benefits that a transition to a Net Zero local energy system could achieve, including the 'Well-being goals, Well-being of Future Generations (Wales) Act 2015 (3)'

Denbighshire's Plan on a Page

Figure 7 identifies modelling zones with particularly favourable conditions for different low carbon technologies identified in Denbighshire's energy propositions: heat pumps, EV chargers, rooftop solar PV, ground-mounted solar PV, onshore wind, and insulation retrofits.

We ranked the favourability of conditions in zones by ranking them against two or more criteria that reflect relevant characteristics of the area (e.g. Index of multiple deprivation, proportion of social housing, proportion of off-gas grid properties, electricity grid headroom) or the results from scenario modelling (e.g. Theoretical future renewable energy capacity requirements or EV chargers).

More details on the criteria can be found later in this report.

Reading the Plan on a Page

The Plan on a page is presented by "modelling zone", which was chosen as the smallest level of granularity used to present results in the LAEP. They are derived from primary substation service areas which are areas bounding the buildings or other electricity demands which are served by a primary substation or group of primary substations that act together. **They do not represent locations for specific projects.** This level of granularity has been chosen for several reasons:

- We needed to model for the most cost- and carbon- optimal generation profile using parameters that reflected the state of the current electricity grid.

- Presenting the results in this way helps Distribution Network Operators – who manage the operation, maintenance and interventions for primary substations - understand how future energy demand could change and how this might impact how investment in primary substation is prioritised.

In the map overleaf, green areas show priority focus zones for at least one energy system component. The tables indicate the total scale of change that the modelling suggests is needed by 2030 and indicates either the total capacity (MW) to be installed or the number of homes requiring retrofit and the associated investment figures. Blue areas show "progress" zones where the conditions are ranked less favourably against the selected criteria compared to the green areas. Only tried and tested delivery models should be deployed in these modelling zones. A consistent level of deployment will still be required in these zones to transform the local energy system at the pace indicated by the deployment analysis.

Using the Plan on a Page

The Plan on a Page is a high level, theoretical assessment for the areas where different low carbon technologies could be deployed, considering the impacts of grid capacity, cost and greenhouse gas emissions. The plan is not a presumption in favour of development nor is it a material planning consideration.

To support the transition to a Net Zero energy system, pilot projects may be useful. The map below highlights areas that could provide a useful focus for these pilots

Figure identifies modelling zones that rank highly against the previously specified criteria for specific energy components, making them ideal locations for pilot studies. The summary tables (shown below) detail the (i) installed capacity opportunity and (ii) required investment for each component then total investment necessary for both energy component installation and electricity network infrastructure in each zone **by 2030**. Ranges have been calculated by taking the minimum and maximum results from each future energy scenarios modelled (see Chapter 3 for more detail). Note: intervention should still be carried out in ‘progress’ zones to transition the local area to Net Zero.

Area	i)	ii)	iii)
A, Insulation	1000-5000 homes	£28-500M	Total for zone (max): £550M
A, Rooftop PV	14MW	£15M	Total for zone (max): £550M
A, EV charger	0.4MW (100 EV chargers)	£0.3M	Total for zone (max): £550M
B, EV chargers	270 Chargers (1MW)	£0.8-0.9M	Total for zone (max): £73M
C, Heat pumps	0.1MW	£0.04-0.08M	Total for zone (max): £16M
C, Ground-mounted PV	23MW	£9.7M	Total for zone (max): £16M
D, Ground-mounted PV	96MW	£42M	Total for zone (max): £210M
D, Onshore wind	0.4MW	£0.4M	Total for zone (max): £210M
E, Heat Pumps	0.1-0.2MW (10-30 Heat pumps)	£0.06-0.1M	Total for zone (max): £38M
E, Onshore Wind	0.4MW	£0.5M	Total for zone (max): £38M

[a]Assuming average 6kW per heat pump

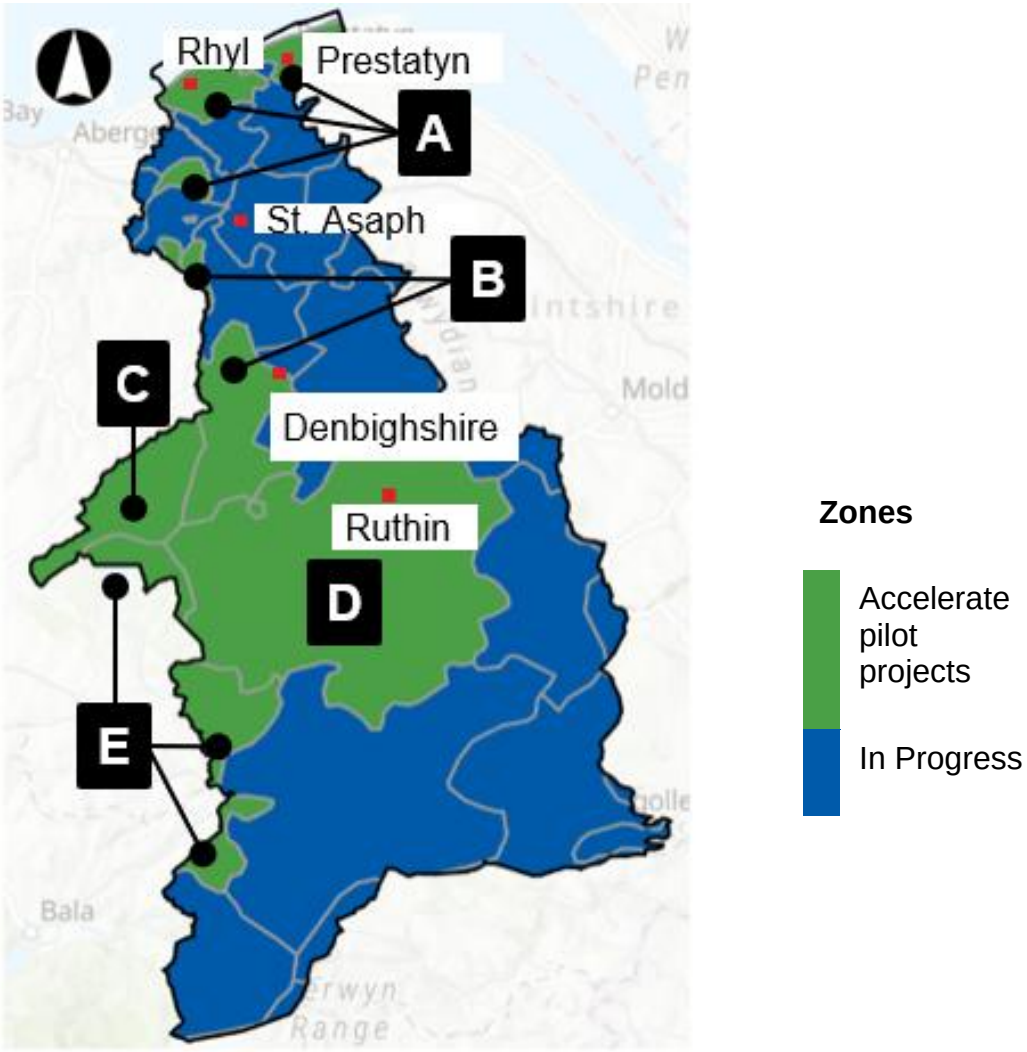


Figure 7 Denbighshire's spatial representation of opportunities, including 2030 ambition and investment (million £). Zone boundaries are defined by primary substation service areas

Action Routemap

Although the exact form of the decarbonised energy system in 2050 is uncertain, there are actions we can take now with relative certainty that will help us maintain the ability to meet our 2050 Net Zero ambition and capitalise on the opportunities that this transition will bring.

Denbighshire's action routemap takes each energy proposition and outlines critical, enabling actions that we will take collectively in the coming decade, with a particular focus on what we can achieve in the next 5-7 years.

The sequencing of activities in the routemap is highly dependent on the political, regulatory and strategic context it has been created in. Therefore, we expect it to evolve over time and be regularly updated to make sure it stays relevant. Denbighshire's routemap can be found in Chapter 4: Action planning.

Next Steps

Progressing energy propositions: For each prioritised proposition, we will undertake a series of development activities to progress towards delivery (such as feasibility studies, detailed technical and commercial development, business case, commercialisation and procurement).

Governance: Where possible, we will integrate oversight of LAEP delivery with existing governance structures. We will appoint a delivery programme manager, to lead the delivery of the actions in this plan.

Monitoring: We will work with regional and national partners to develop a monitoring framework which builds on existing processes and helps us understand the progress Denbighshire is making towards its committed actions and ambitions set out in this plan.

Engagement & collaboration: Many stakeholders with an interest and influence over the local energy system have come together to help shape this LAEP, and it is important that this collaboration continues as we all work to deliver this plan.

Figure 8 Summary of enabling actions that need to be established to support delivery of the propositions in the LAEP

Chapter 1: Introduction

Figure 9 Two Council-owned electric vans and charge points, Denbighshire

1. What is Local Area Energy Planning (LAEP)?

Overview

Definition of a LAEP

A LAEP sets out the changes required to transition an area's energy system to Net Zero greenhouse gas (GHG) emissions against a specified time. By exploring a range of technologies and scenarios through whole energy system modelling and analysis, the most cost-effective preferred pathway to Net Zero can be identified (4). The process follows standardised national guidance defined by ESC (4).

Being data-driven and evidence-based, a LAEP uses a whole energy system approach that is led by local government and developed collaboratively with defined stakeholders. It sets out to identify the most effective route for the local area to meet its local Net Zero target, as well as contributing towards meeting the national Net Zero target (5)

A LAEP results in an indicative costed spatial plan that identifies the change needed to the local energy system and built environment, detailing what changes are required, where, when and by whom. The level of detail in a LAEP is equivalent to an outline design or masterplan and is intended to identify core areas that require focus over the next 25 years. It proposes future sector-specific action plans that set out how each part of the area will be designed and built. Additional detailed design work will be required for identified specific actions, projects and programmes to progress to delivery. For example, a LAEP may identify a zone that is best suited to a district heat network by assessing the types of buildings in the zone, their characteristics, and density; however, to deliver the district heat network it would require a full feasibility assessment by an appropriately qualified installation or design company, along with assessment of commercial viability and delivery mechanisms.

Vision of a LAEP

A LAEP defines a long-term vision for an area but should be updated approximately every 3-5 years (or when significant technological, policy or local changes occur) to ensure the long-term vision remains relevant.

Scope of a LAEP

The UK government's 2021 Net Zero Strategy (6) estimates that **82% of the UK's emissions are "within the scope of influence of local authorities".**

The scope of a LAEP covers the current and projected future energy supply and consumption, and associated greenhouse gas (GHG) emissions in a defined geographic area, primarily focusing on:

- the built environment (energy used by all categories of domestic, non-domestic, and industrial buildings)
- energy used for road transport and supporting infrastructure (e.g. electric vehicle (EV) charging infrastructure)
- renewable energy generators
- the energy infrastructure needed to meet consumption (electricity heat and gas networks)

Some greenhouse gas (GHG) emissions sources are excluded from scope, because they are either not directly associated with the energy system (e.g. emissions from land, land use and forestry) or are produced from assets that are national (e.g. rail, aviation and shipping). More information on the boundary and scope can be found in Chapter 1: introduction and the Technical Report (*Chapter 1*).

A LAEP identifies near-term actions providing stakeholders with a basis for taking forward activity and prioritising investments and action. Site-specific data is used where available, with remaining areas covered by national datasets.

Benefits of a LAEP

A LAEP provides a long-term plan to deliver a Net Zero energy system. A benefit of LAEP is the ‘whole systems approach’, aligned to the Wellbeing of Future Generations Act (3) “ways of working” on integration. This provides consideration to the most cost-effective solutions to future energy system at the right time. For example, deploying different low carbon heat technologies to avoid a high-cost upgrade of the electricity network. Following the way of working on involvement and collaboration, by working closely with local stakeholders, incorporating their data, knowledge and plans, a LAEP is built on a common evidence base. The outputs can then be used reliably by stakeholders from Denbighshire’s public service providers to network operators to community groups, knowing they are working towards a common goal built on strong foundations.

1.1. The energy transition across Wales

Overview

The Welsh Government's Net Zero Wales plan (5) establishes an increased level of ambition on decarbonisation, with a legally binding target to reach Net Zero emissions by 2050. It is the first national government to fund the roll-out of LAEP to all its local authorities. The programme is being co-ordinated through a regional approach, where LAEPs are being developed for local authorities in Mid Wales, South West Wales, North Wales and the Cardiff Capital Region. The rationale for taking this approach was because there are efficiencies on data collection and management, as well as reinforcing the links between the regional and local plans to maximise opportunities across local authority areas and between regions. Several suppliers have been selected to produce the LAEPs for each region, as detailed in the map.

To contribute to the Welsh Government's commitment of producing a "National Energy Plan" in 2024, upon completion of the LAEP programme Energy Systems Catapult (7) will aggregate the LAEPs into a national view. To support this task, they are working with the Welsh Government to create and import standardised LAEP outputs for aggregation into the DataMapWales platform (8) Energy Systems Catapult is also providing technical advisory support to the Welsh Government throughout the programme.

The LAEPs will also form the basis of the 'National Energy Plan' Welsh Government has committed to produce in 2024.

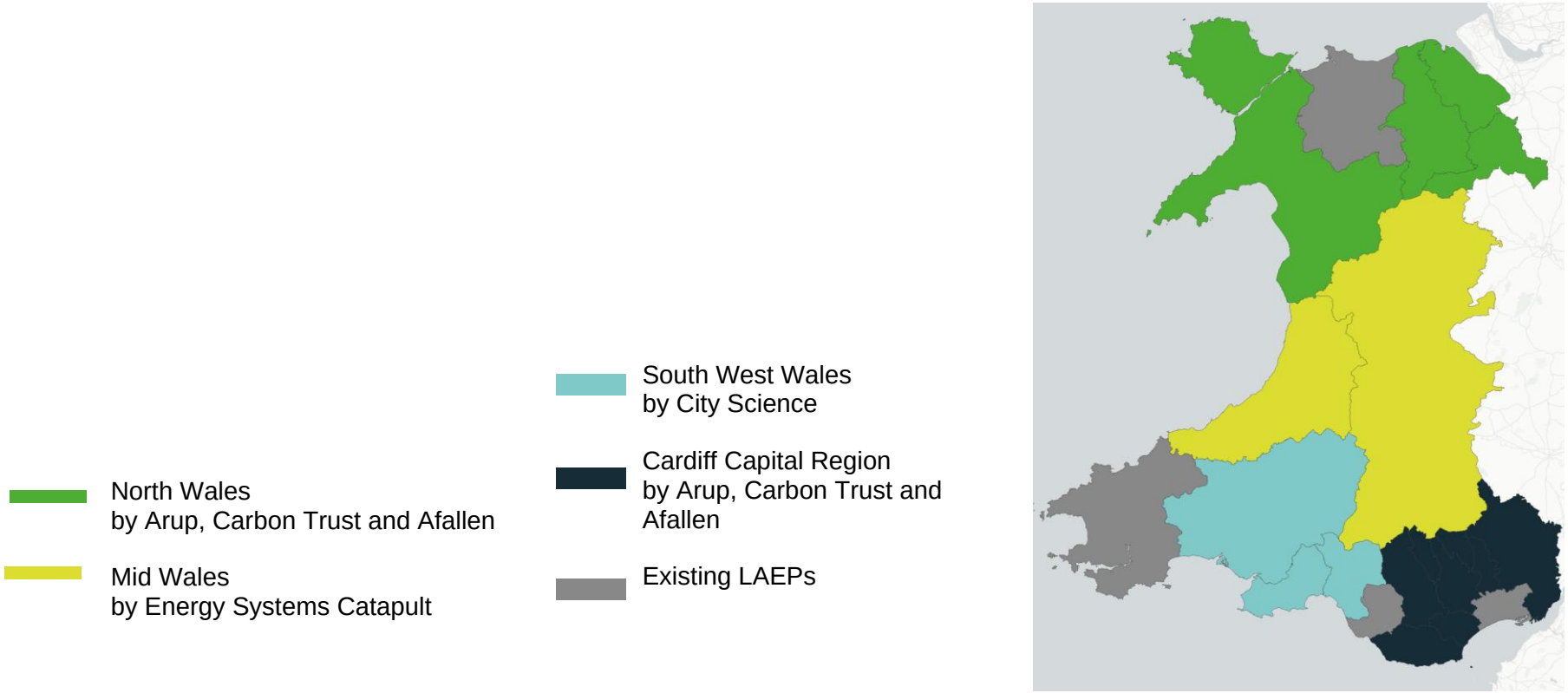


Figure 10 Progress made in the development of LAEPs across Wales

Boundary and Scope

A LAEP considers energy use, supply and generation within Denbighshire's county boundary.

There are three core parts to the local energy system:

- Infrastructure – The physical assets associated with the energy system such as electricity substations.
- Supply – Generation (renewable and non-renewable), storage and distribution of energy to local consumers for use in homes, businesses, industry and transport.

- Demand – The use of energy driven by human activity e.g. petrol/diesel used in vehicles, gas burned for heat in homes. required for the energy system to operate.

The whole energy system across all sectors is considered in the development of the LAEP to ensure that the interactions and dependencies between generation and use of different energy sources are fully considered. This identifies where different systems can work together to improve the overall resilience and flexibility of the energy system.

Local Area Energy System

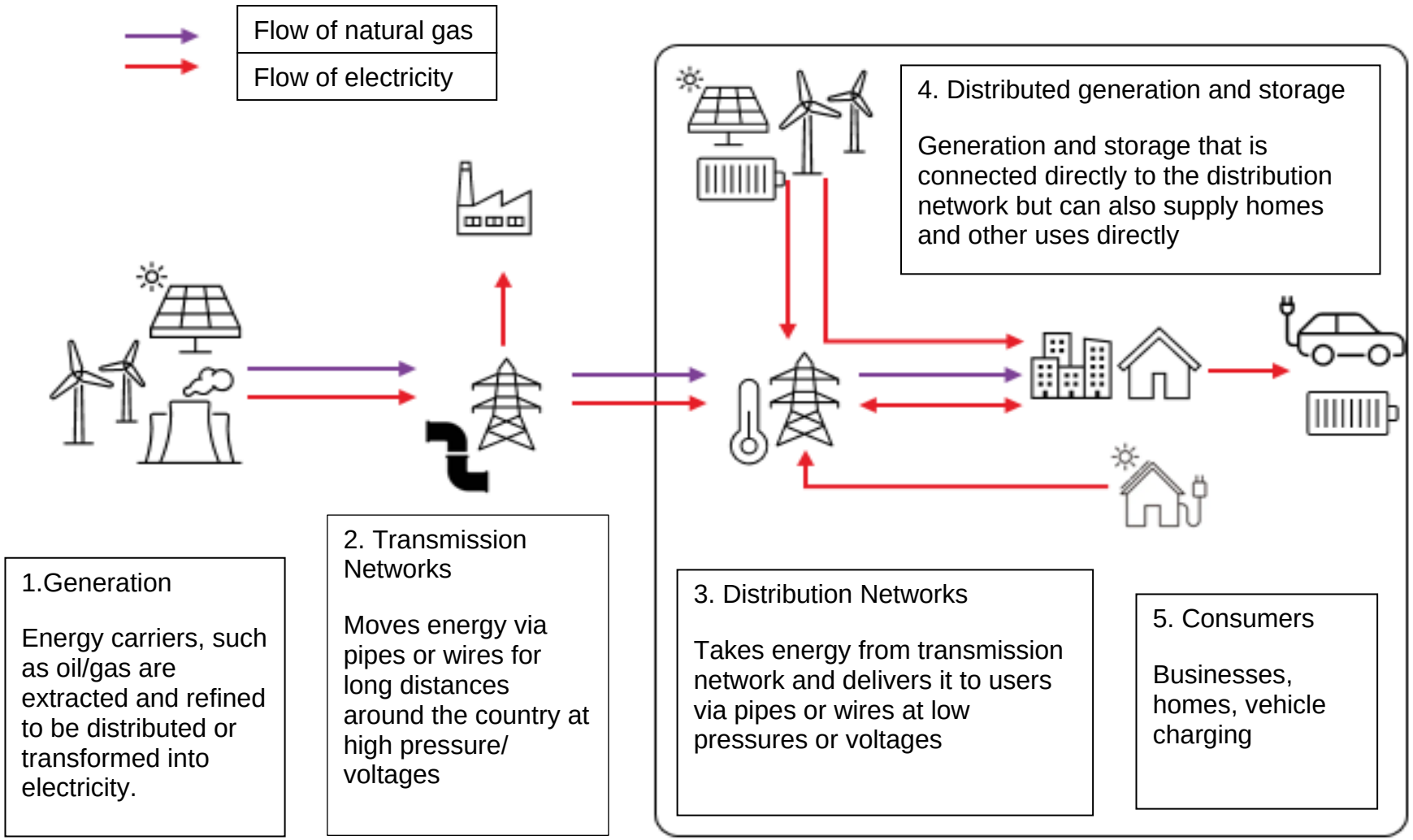


Figure 11 Illustration of transmission and distribution of gas and electricity from supply to consumer, and what parts of this system are included in the system boundary for LAEP

Geographic boundary

We used the geographic boundary for Denbighshire county to set the boundary for the LAEP, which meant that any energy generating assets, energy use and infrastructure in that boundary were considered for inclusion in the LAEP.

Scope for LAEPs in Wales

The diagram to the right indicate the parts of the local energy system which are in-scope for the LAEPs across Wales. This scope is defined by Energy Systems Catapult's LAEP Guidance (4)

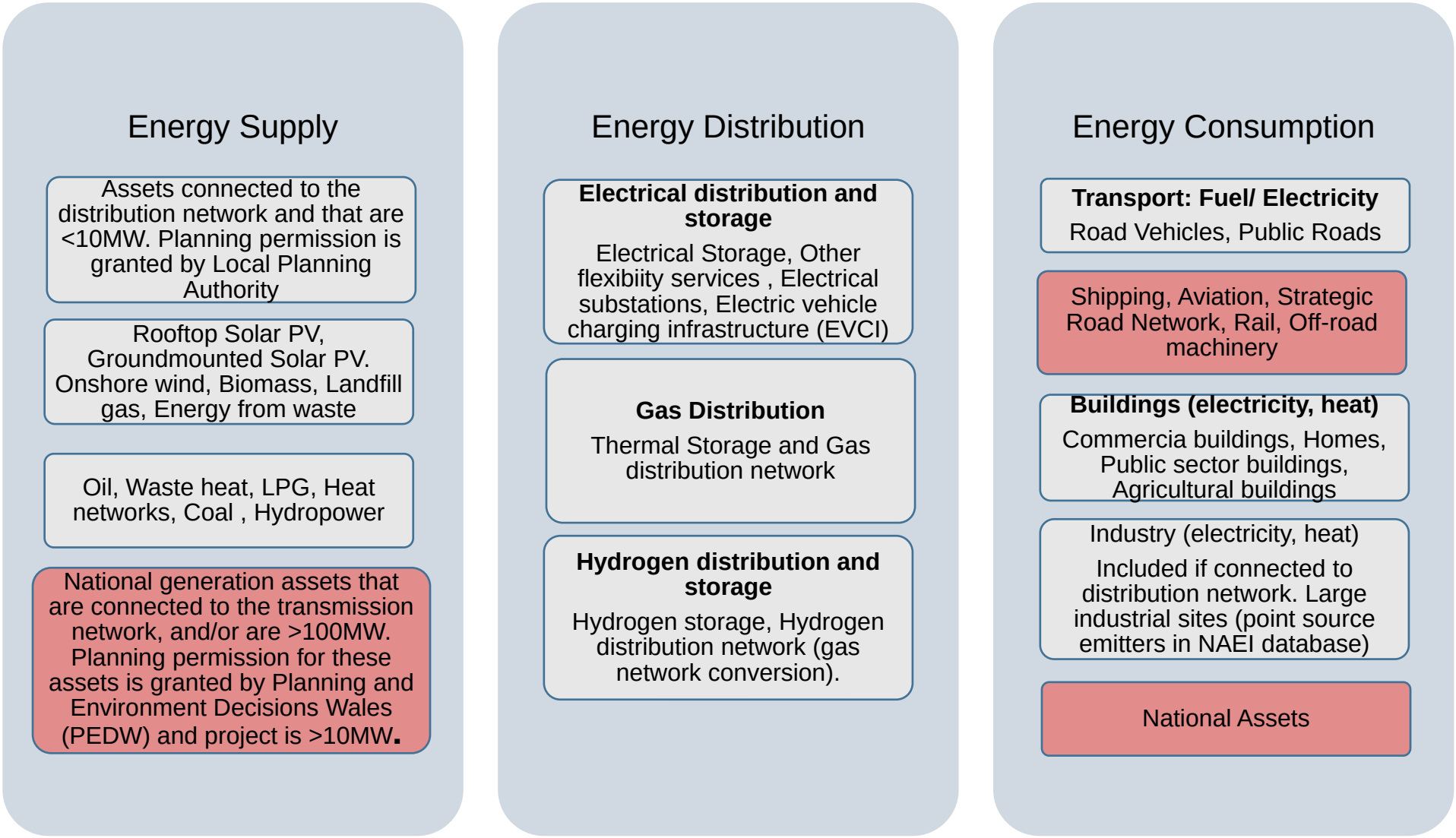


Figure 12 Schematic of the local system scope for LAEP, red boxes are outside of LAEP scope

Exclusions from the LAEP

The following parts of the energy system within Denbighshire county are excluded from the LAEP:

- any non-energy sources of greenhouse gas (GHG) emissions occurring within the Local Authority's governing boundary (for example, GHG emissions from industrial processes, agricultural land use and livestock are excluded)
- Existing and future energy assets that are likely to be overseen by central government e.g. offshore wind, grid scale batteries, hydrogen SMR
- Energy used for shipping, aviation and rail are excluded on the basis that they are not local uses of energy.
- Energy generators connected to the transmission network and/or are >100MW (such as offshore wind, grid scale batteries, hydrogen steam methane reformation (SMR)).

Due to the significant interaction between distribution and transmission networks, and local and national assets, LAEP must be considered in combination with other plans affecting these systems such as those from the National Energy Systems Operator and emerging Regional Energy Systems Planners (RESPs).

Future Energy System Vision and Energy Objectives

Denbighshire's energy system vision

Denbighshire County Council, along with stakeholders from across Denbighshire who have an interest and influence over the local energy system, came together to produce a vision statement that underpins the ambition for Denbighshire's future Net Zero energy system.

Energy objectives

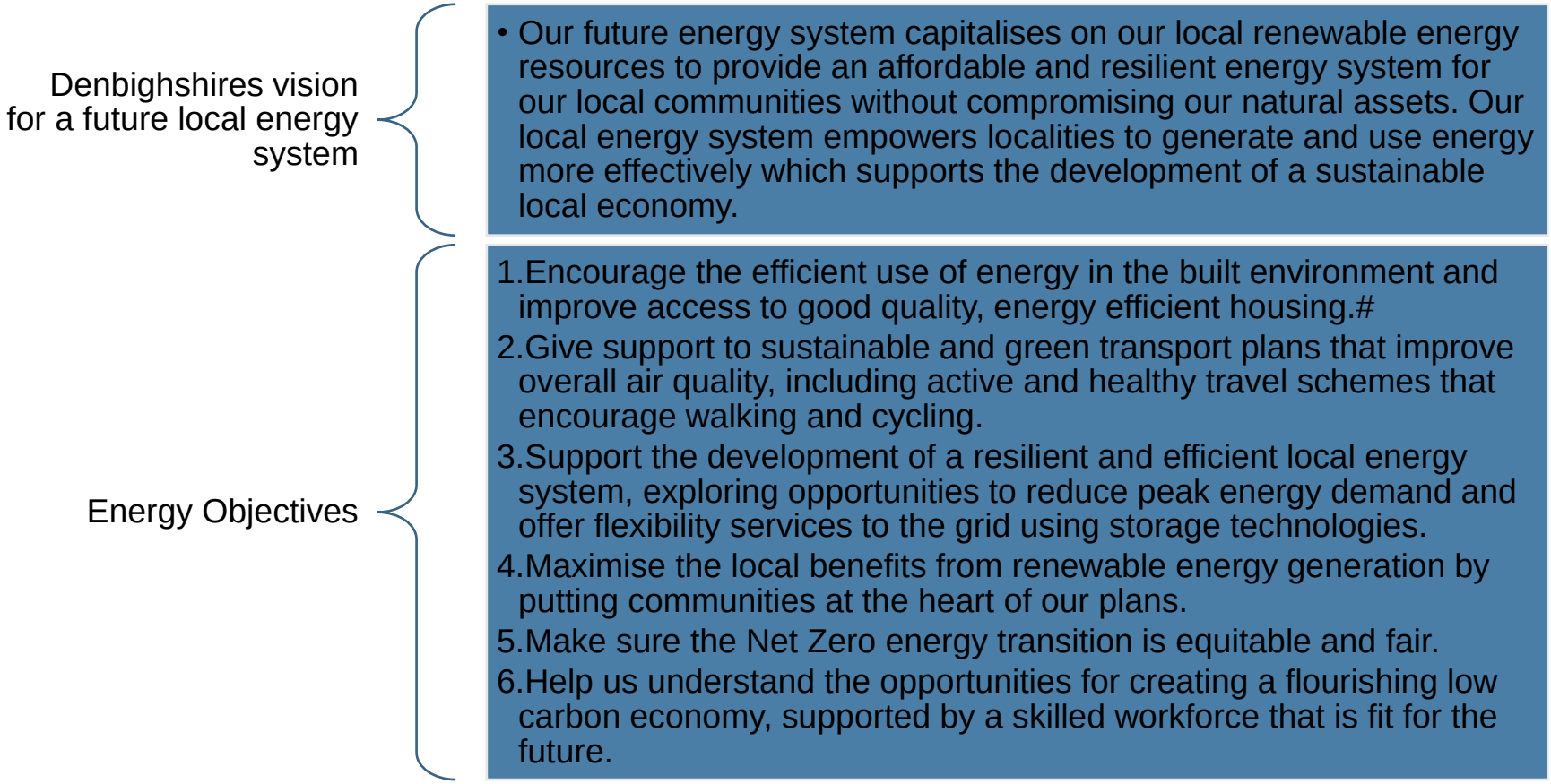


Figure 13 Denbighshire's vision for the future local energy system and its six energy objectives

This group of stakeholders collectively decided on the following specific energy system objectives for Denbighshire's LAEP that serve as important foundational principles by which the LAEP will be delivered, which also align closely to Denbighshire County Council's broader Council objectives. The proposed actions outlined in Chapter 4 are designed to implement changes that will help achieve these energy objectives

LAEP contents

This LAEP presents a vision for a Net Zero local energy system in Denbighshire, and a routemap of action needed to get there which brings together the support and commitment from critical energy system influencers such as Welsh Government, the energy sector and the local community.

This plan is structured into four main topic areas:

The current energy system (Chapter 2) - description of Denbighshire's existing energy system and relevant policies and objectives.

The future energy system (Chapter 3) - presentation of future scenarios for a Net Zero local energy system, including risks and "low regrets" measures, which are very likely to be part of the future energy system regardless of uncertainty around certain aspects of the future.

Action planning (Chapter 4) - a routemap and action plan for us to use to drive the local energy system transition in Denbighshire, including what needs to happen and what key energy system influencers will do.

Next steps (Chapter 5) – outlines immediate next steps and what is needed to create an enabling environment for the delivery of this plan, and a Net Zero local energy system

Figure 14 Geographic boundary of the LAEP

2. Chapter 2: The current energy system

Figure 15 Rooftop solar PV in Meliden, Denbighshire

2.1. Policy Context

Net Zero Wales (5) is the Welsh Government's emissions reduction plan for the current carbon budget period between 2021-2025. This is a statutory document required by the Environment (Wales) Act 2016 (9) which sets out policies and proposals to help Wales meet its carbon budget and be on track to meet its legally binding Net Zero target for 2050. The Well-Being of Future Generations (Wales) Act (9) is in place to ensure that this transition fosters greater equality and positive outcomes for all.

The Welsh Government's devolved powers vary across different parts of the local energy system, which means that policies and strategies at Welsh and UK level will influence how Wales transitions to a Net Zero energy system in the next 25-30 years.

Denbighshire County Council recognises that policy is one of our key levers for supporting the transition to Net Zero. So, using our own statutory powers, we, as a Local Authority, have also established plans and policies relating to decarbonising energy use across our own operations, and have started to look further to how we influence changes in our local communities through our place-making role.

Figure 16 summarises some key local, regional and national legislation, policies and strategies that will influence this LAEP.

Energy and climate change legislation, regulation and policy	Energy and climate change policy and strategy	Planning legislation, regulation, strategy and policy	Skills policies and plans
• Well-being of Future Generations (Wales) Act 2016 (3) • Environment (Wales) Act 2016 (9) • RIIO-GD2 (2021-2026) (10) • Corporate Joint Committees (CJCs) established (2021)(27) • RIIO-ED2 (2023-2028)(11) • Decision on future of local energy institutions and governance (2023)(12) • Decision on frameworks for future systems and network regulation (2023)(13) • Renting Homes (Wales) Act 2016 (2022)(14) • Energy Act (2023)(15)	• Prosperity for All: A Low Carbon Wales Plan (2019)(16) • Net Zero carbon status by 2030 (2021) (23) • Net Zero Wales Carbon Budget 2 (2021-2025) (5) • North Wales Energy Strategy (2021)(24) • Tackling fuel poverty 2021-2035 (2021) • Corporate Plan (2022-2027)(28) • Climate and Nature Strategy (2021-30)(29) • Heat Strategy for Wales (*in development*)(17) • Asset Management Strategy (2024-2029) *(in development)(30)*	• Adopted Local Development Plan (2006-2021)(31) • Planning (Wales) Act 2015) (21) • Replacement Local Development Plan (2018-2033)(32) • Future Wales: the national plan 2040 (2021) (20) • Local Well-being Plan (2023-2028)(33) • Update permitted development for heat pumps (noise levels) (2023) (21) • Planning Policy Wales Edition 12 (2024) (18)	• North Wales Regional Economic Framework (2022) (25) • Housing and Homelessness Strategy (2021-2026)(35) • North Wales Skills Action Plan 2023-2025 (2023) (26) • Stronger, fairer, greener Wales: a plan for Employability and Skills (2023) (19) • Economic Strategy (*in development*) (34) • Net Zero skills roadmaps (2024) (22)

Figure 16 Summary of cross-cutting regulation/policies at local, regional and national level that are likely to influence energy and climate issues (3) (9) (10) (11) (12) (13) (14) (15) (5) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35)

Buildings, regulation, strategy and policy	Transport legislation, regulation, strategy and policy	Renewable energy strategy and policy	Industry and hydrogen strategy and policy
• Update to min. energy performance requirements in Building Regulations (Part L) (2022)(36) • Boiler upgrade grant increased to £7,500 (2023) • Low carbon heat grant (£20 million) (2023) (37) • Update to Welsh Housing Quality Standard 2023 (2024) (38) • Clean Heat Market Mechanism (2024) (39)	• Active Travel (Wales) Act (2013) (40) • Electric Vehicle Charging Strategy and Action Plan (2021)(41) • Llwybr Newydd: Wales Transport Strategy to 2040 (2021)(2) • National Transport Delivery Plan 2022-2027 (2021)(42) • Consultation on reforming bus services in Wales (2023)(43) • Sustainable Travel Plan (2023-2028) (44) • Electric vehicle charging infrastructure: Welsh National Standards (2023) (45) • Regional Transport Plan (2024) (46) • Strategic Development Plan (*in development*) (47)	• Renewable Energy Assessment (2016) (48) • Contracts for difference (2023) (49) • Refresh of renewable energy targets (2023) (50) • Meet the equivalent of 100% of electricity needs from renewable sources by 2035 • 1.5GW of renewable capacity to be locally owned (exc. Heat pumps) • 5.5GW of renewable capacity to be produced by heat pumps by 2035 (subject to UKG support)	• Hydrogen Strategy (2021) (51) • Net Zero hydrogen fund (£240million) (2023) (52) • Sustainable Farming Scheme (2023) (53)

Figure 17 Summary of sector-specific regulation/ policy at local, national and regional levels (36) (37) (38) (39) (40) (41) (2) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53)

Stakeholder engagement approach

Delivering Denbighshire's LAEP calls for a collective effort from all types of organisations in and beyond the Local Authority boundary. The local energy system extends beyond Denbighshire County Council's sphere of influence which is why making sure we made stakeholder engagement the cornerstone for the development of Denbighshire's LAEP.

With support from our delivery partners, we prioritised stakeholders based on their level of local knowledge of and / or influence over specific elements of the local energy system and their role in the development of the LAEP. The importance of recognising the involvement of regional stakeholders emerged early in the development of the LAEP. They have a unique role, ensuring cohesion of action for specific element(s) of the energy system across neighbouring LAEPs in the same region and offering regional efficiencies where local objectives are aligned.

We engaged stakeholders at different stages of the development process to make sure stakeholders could help shape the plan and key development milestones. We held regional steering groups for North Wales, attended by the regional and Council project leads, as well as bi-weekly meetings with the Council project leads. Two workshops were held regionally and involved primary stakeholders from across each Local Authority in North Wales. These workshops were used at stages where it was important to agree a way forwards that was appropriate for the region, as well as each Local Authority.

Sector	Examples of stakeholders engaged
Buildings	Housing developers
Transport	Transport providers
Renewable energy generation	Energy project developers community energy groups, landowners
Industry and private sector	Local businesses, larger commercial organisations, Trade Associations
Community engagement	Charities, social enterprise,
Networks	Distribution Network Operators, gas distribution networks
Public sector	Public services board, public service providers, Welsh Government, educational institutions

7 workshops – 67 stakeholders attended at least one workshop – 28 organisations engaged – at least 168 hours of engagement with stakeholders (based on one 2.5 hour workshop)

Figure 18 Summary of stakeholder and key statistics

2.2. The Current Energy Baseline

Denbighshire's energy baseline

Overview

This section provides a detailed overview of the local energy system baseline, and describes the methodology and assumptions used to understand current energy infrastructure, what types of energy are used, what technologies are used to convert it from one form to another (e.g. heat) and how much is consumed.

The baseline presented is for 2023, the most recent and representative of the current energy system, but the availability of data for this year varied across sectors. Buildings data reflects energy consumption in 2023 but transport and industry data for North Wales uses data representative of activities in 2019. This has minimal impact on the results because transport and industry datasets are the least likely to be impacted by grid electrification between 2019-2023 and are likely to remain consistent. Transport energy demand will have been impacted by COVID-19, so 2019 is the most representative dataset for the energy system in 2023.

Some of the data collected that has locational characteristics is reported by "modelling zone". Figure 19 shows the geographic boundary of Denbighshire (black) which is also the boundary used for Denbighshire's LAEP. The primary substation service areas that supply energy within the geographic boundary are shown in red. Where primary substation service areas intersected one or more Local Authority boundaries, they were divided into **smaller modelling zones**. Most of the analysis, results, and maps in this report are presented in terms of these smaller modelling zones, which may also be called "substation zones" or simply "zones."

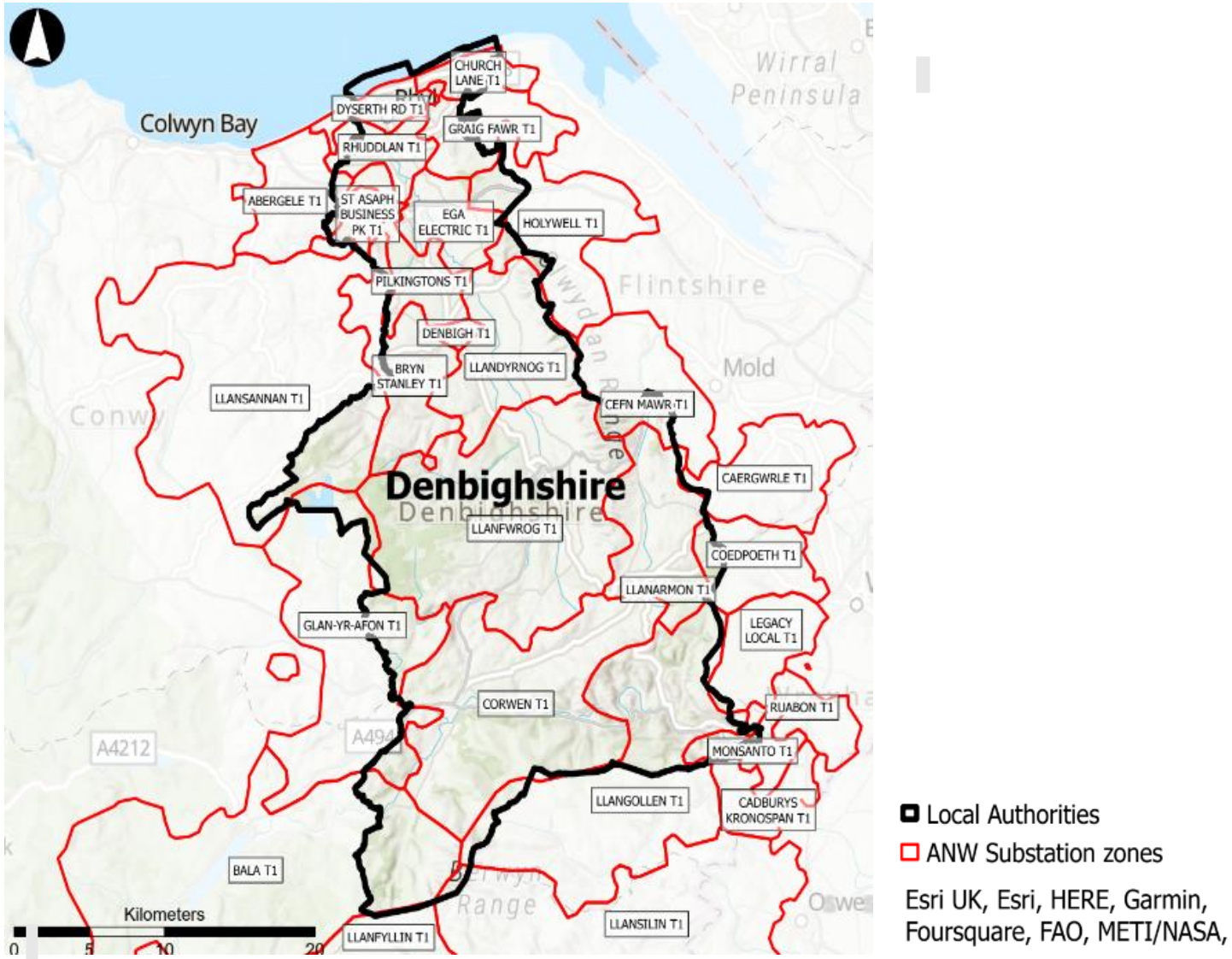
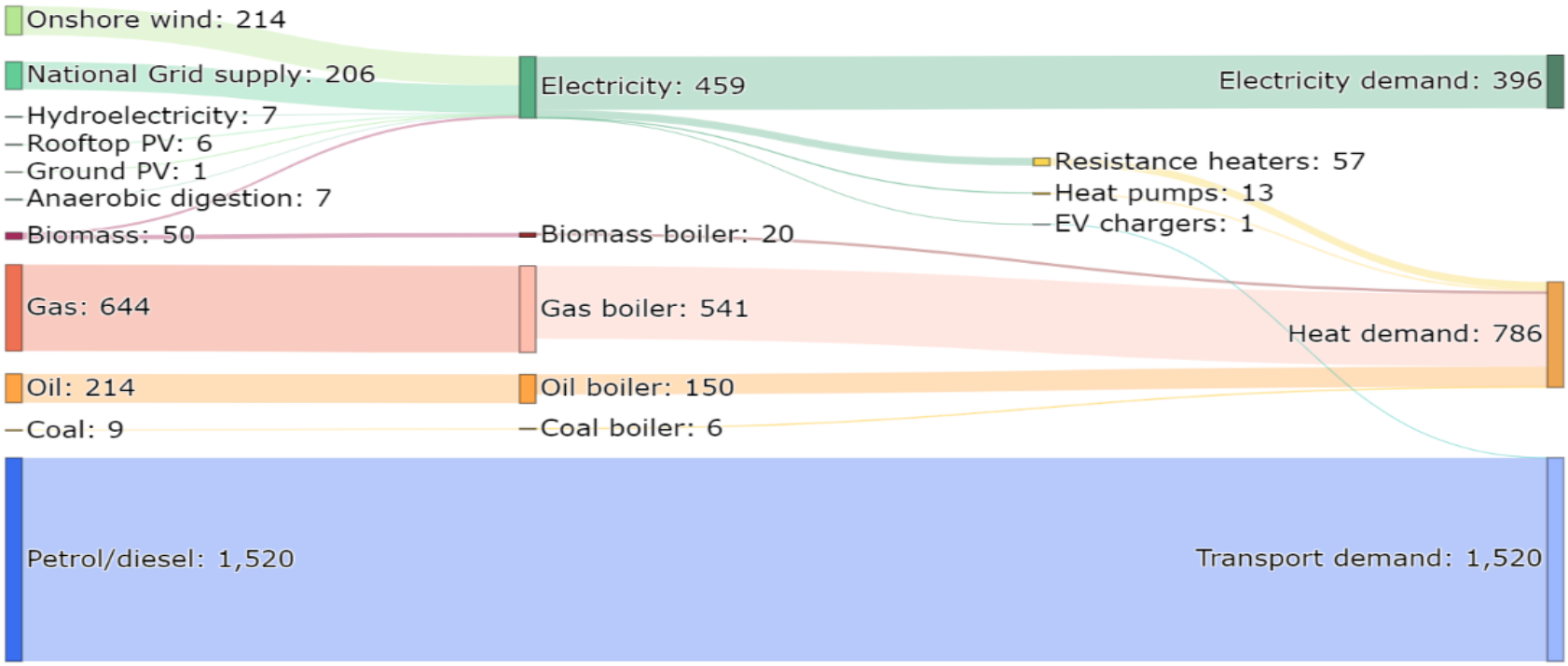


Figure 19 Geographic boundary of Denbighshire used to define the boundary for this LAEP and the associated modelling zones within the LAEP boundary

Overview

Sankey diagrams are a way of visualising energy transfer from energy sources to energy demands via different forms of energy (e.g. electricity, heat), and the technologies used to convert it from one form to another for different uses (e.g. gas boiler converts natural gas to heat energy through combustion). They are read from left to right and show a snapshot of the energy transfers in time e.g., 2050. Energy transfers are drawn to scale and so are helpful to identify the size of each transfer for comparison. Energy transfers are drawn to scale which helps to compare the relative amounts of energy across different energy transfers.

The Sankey diagram presents energy transfers in units of GWh per year. For example, the average Welsh home uses 3,300kWh per year of electricity, which is 0.003GWh for comparison with the scale on the Sankey. In terms of gas, a typical home uses 12,000kWh per year, which is 0.012GWh for comparison with scale on the Sankey (54)



1. Where the energy comes from

This side represents the different **energy sources**, including generation technologies and imports from the national grid

2. How the energy is being converted

3. Where the energy is being used

This side represents the **final demands** for each energy vector: heat demand, electricity, demand, transport demand.

Figure 20 How to read a Sankey diagram (units are GWh per year)

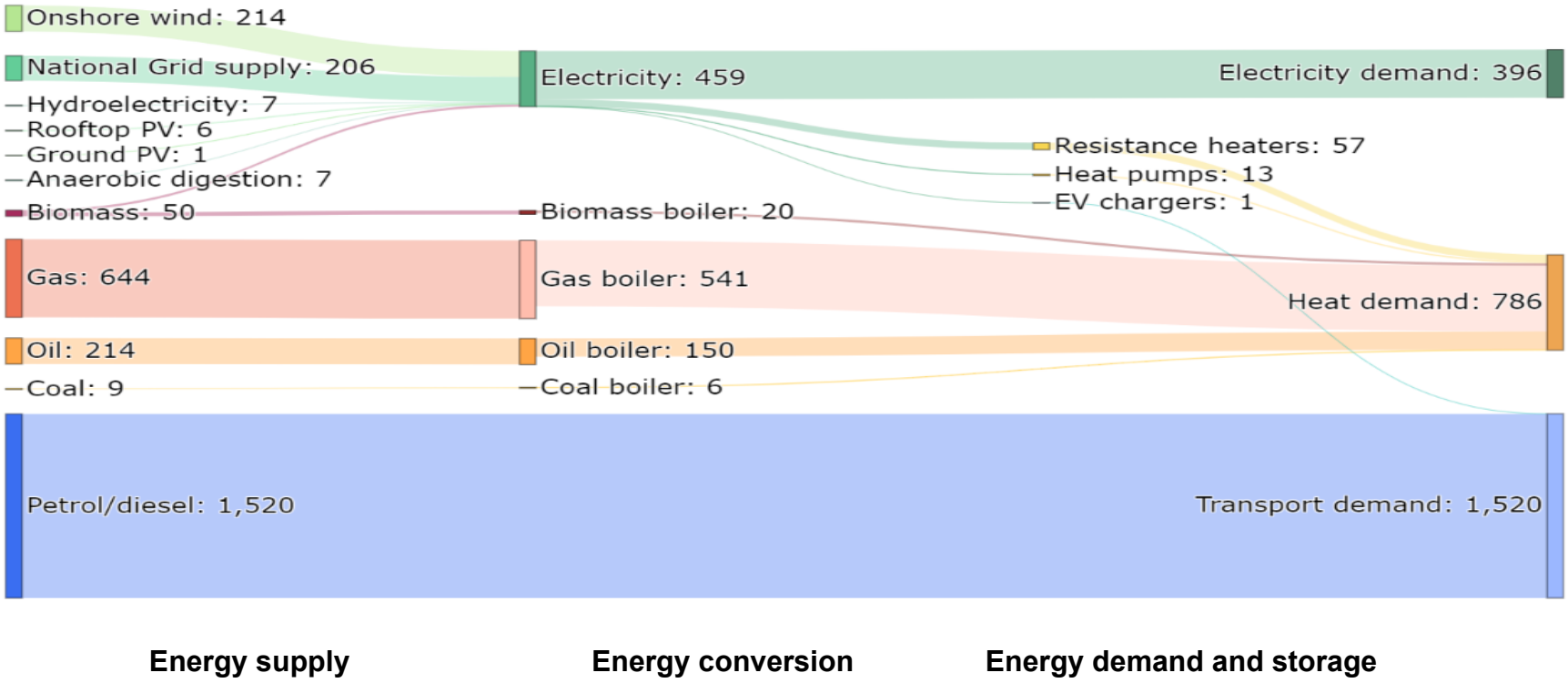


Figure 21 Sankey diagram showing energy input, conversion and output in Denbighshire (units in GWh per year (2023))

Heat

- 29% of total energy demand
- Main source of demand is heating in buildings

Transport

- 56% of total energy demand
- Dominant fuel type is petrol or diesel

Electricity

- Accounts for 15% of energy demand
- 55% of electricity is generated from renewable sources
- Denbighshire would need to produce 2 times the amount of energy it does today to meet local heat and electricity demand

Industry

- Accounts for 0% of total energy demand
- Major industries are agriculture and tourism
- Most light industry clustered around St Asaph.

Heat Demand in buildings and industry (MWh per year)

Heavy Industry

Denbighshire is not heavily industrialised, but some parts are more commercialised than others. Most people are employed in health and social care, retail, public services and construction in and around the larger towns such as Ruthin, Denbigh, Prestatyn, Rhyl and St. Asaph.

Larger businesses and industry are mainly based in St Asaph, where there is a large power station and potential for grid connection. Gas consumption (total domestic and non-domestic) is fairly uniform across the area, with slightly higher electricity

consumption in more densely populated areas such as along the A547 east-west corridor (Rhyl, Prestatyn), and much lower gas consumption in areas such as the Clwydian Range and Dee Valley National Landscape to the east of Denbighshire.

Buildings

Insulation: 30% with <100mm loft insulation, 17% with unfilled cavity walls. The main domestic archetype is that 75% of homes are semi- or detached.

Heating fuels: 75% of homes are connected to the gas grid. Most homes that are not connected to the gas network use oil for heating (13% of all homes).

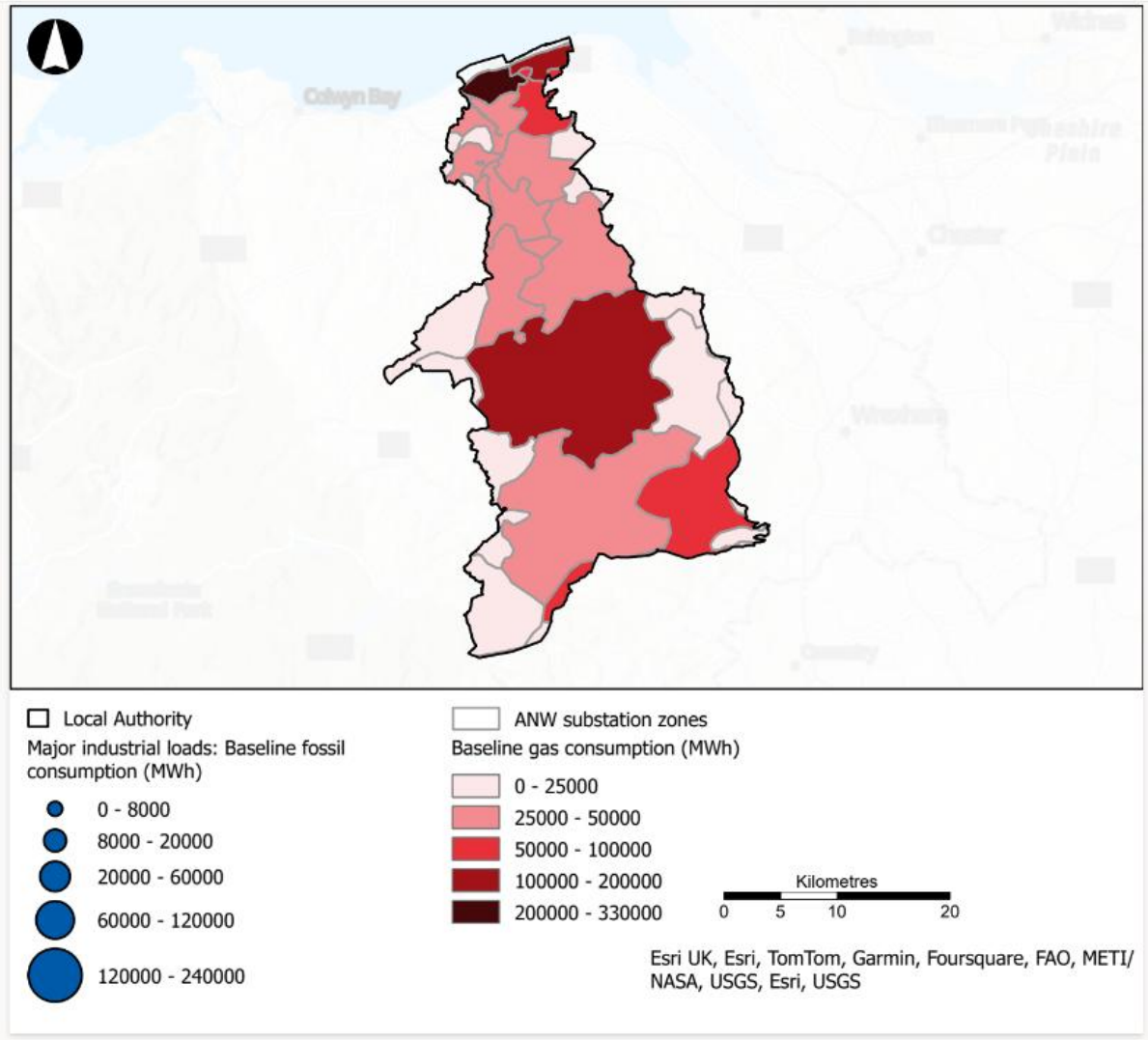


Figure 22 Major industrial loads (2019) and heat demand (2023) by substation zone across Denbighshire (units in MWh per year). The data is based on meter level gas consumption

Electricity demand in buildings (MWh per year)

Electricity consumption (total domestic and non-domestic) is fairly uniform across the area, with slightly higher electricity consumption in more densely populated areas such as along the A547 east-west corridor (Rhyl, Prestatyn), and much lower electricity consumption in areas such as the Clwydian Range and Dee Valley National Landscape to the east of Denbighshire County

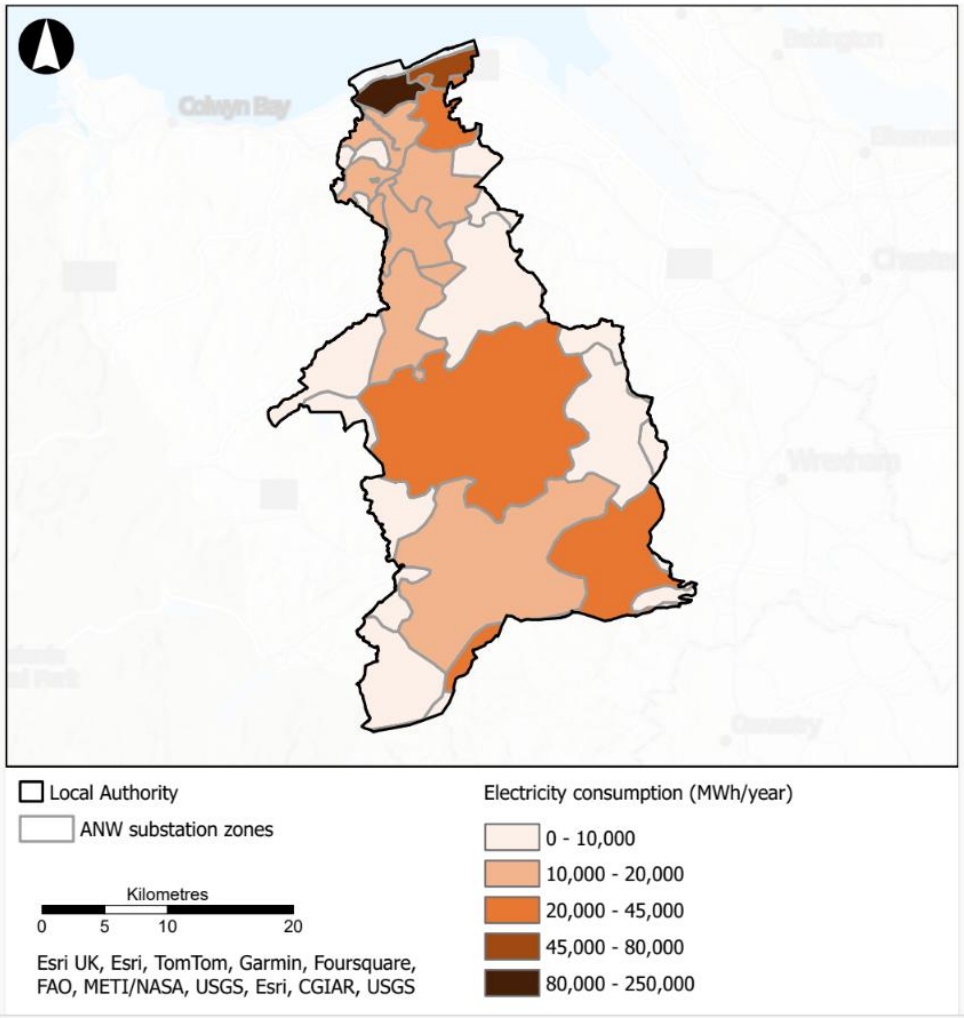
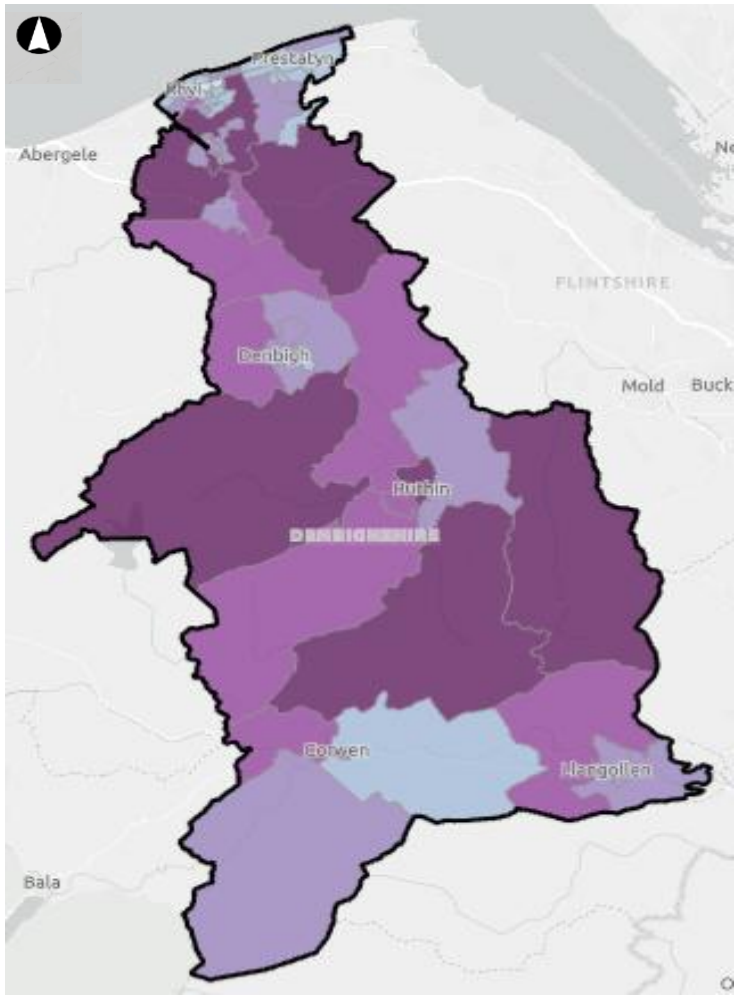


Figure 23 Electricity (domestic and non-domestic properties) by substation zone across Denbighshire (2023). Data is based on meter level electricity consumption data consumption (MWh per year)

Transport energy demand (GWh per year)



Annual fuel consumption per LSOA (GWh per year)
≤2.5
>2.5 – 5
>5 – 10
>10 – 15
>15 – 20
>20

Figure 24 Transport energy consumption (2019) (combined total across cars, light goods vehicles (LGV) and heavy goods vehicles (HGV) by Lower Super Output Area (Lower Super Output Area (LSOA)) (units in kWh per year)

Transport

Denbighshire is mostly rural, with most transport infrastructure concentrated on the following transport corridors:

- A525 connecting north to south
- A494 connecting west to east through Corwen and Ruthin to Mold
- A547 connecting the north of Denbighshire to the Deeside Valley and Isle of Anglesey
- A5 connecting Corwen and Llangollen in the South of Denbighshire.
- A55 (part of the Strategic Road Network) connecting north Denbighshire to the rest of North Wales and Cheshire.

This network has a significant impact on local employment, fostering economic growth and job opportunities.

77% of households own, on average, 1 car (55)

72 listed on the National Charge Point Registry (2023 data) (1).

Energy generation (MW) and rooftop solar PV capacity (MW) (2023)

Electricity generation

The county hosts several renewable energy generators across a broad range of technologies. This diversity improves the resilience of the local energy system and reduces dependency on one renewable energy source.

Total renewable energy capacity[a,b]:

84MW or 2% of total renewable energy capacity in Wales (Wales: 3,505MW in 2021) (56)

Largest contributor:

Onshore wind is the largest contributor with 69MW capacity in operation. The largest wind farm is located on Denbighshire's border with Conwy in the Clocaenog Forest where there are 27 turbines in total.

Heat Generation

Biomass/biogas:

3MW capacity biomass plant operated by Newbridge Energy Ltd near Ruthin. 1MW biogas plant operated by Ancala Bioenergy near Waen.

Natural gas:

2 gas-fired plants with a combined 3MW capacity

Gas connections:

75% of properties are connected to the gas grid, so most properties are heated using gas boilers. The remaining heat demand is provided by other fuels such as oil, biomass, coal and solid fuels.

[a]Capacity is the maximum amount of electricity that a generator can produce, also known as its maximum power outputs

[b]Renewable energy sources quoted also include energy from waste and biofuels

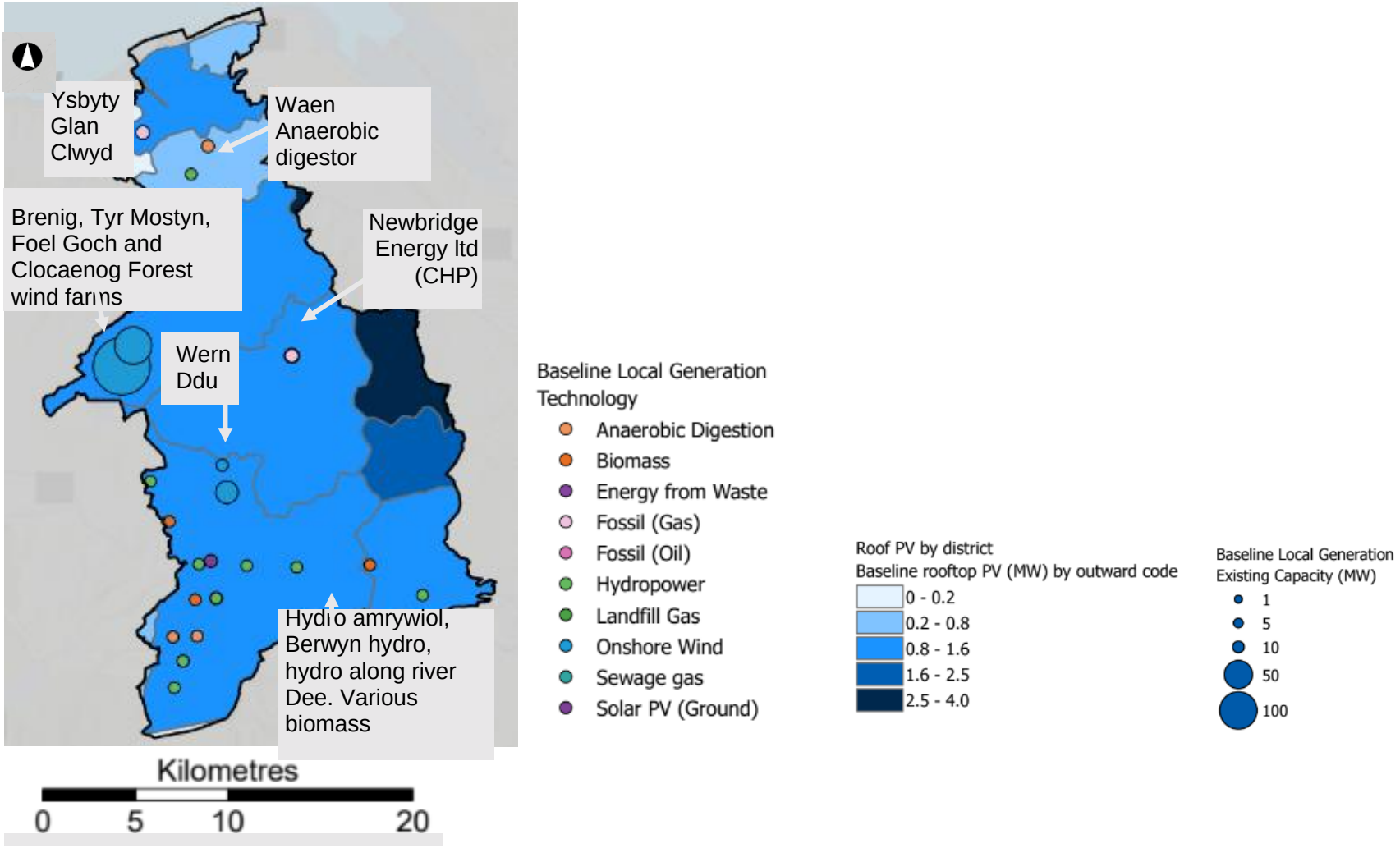


Figure 25 Capacity (MW) and location of energy generators in Denbighshire county and rooftop solar PV capacity (MW) by district. Data is based on Energy Generation Wales (2021) (56) and Renewable Energy Generation Database (2023) (57)

Networks and Infrastructure

Generation headroom

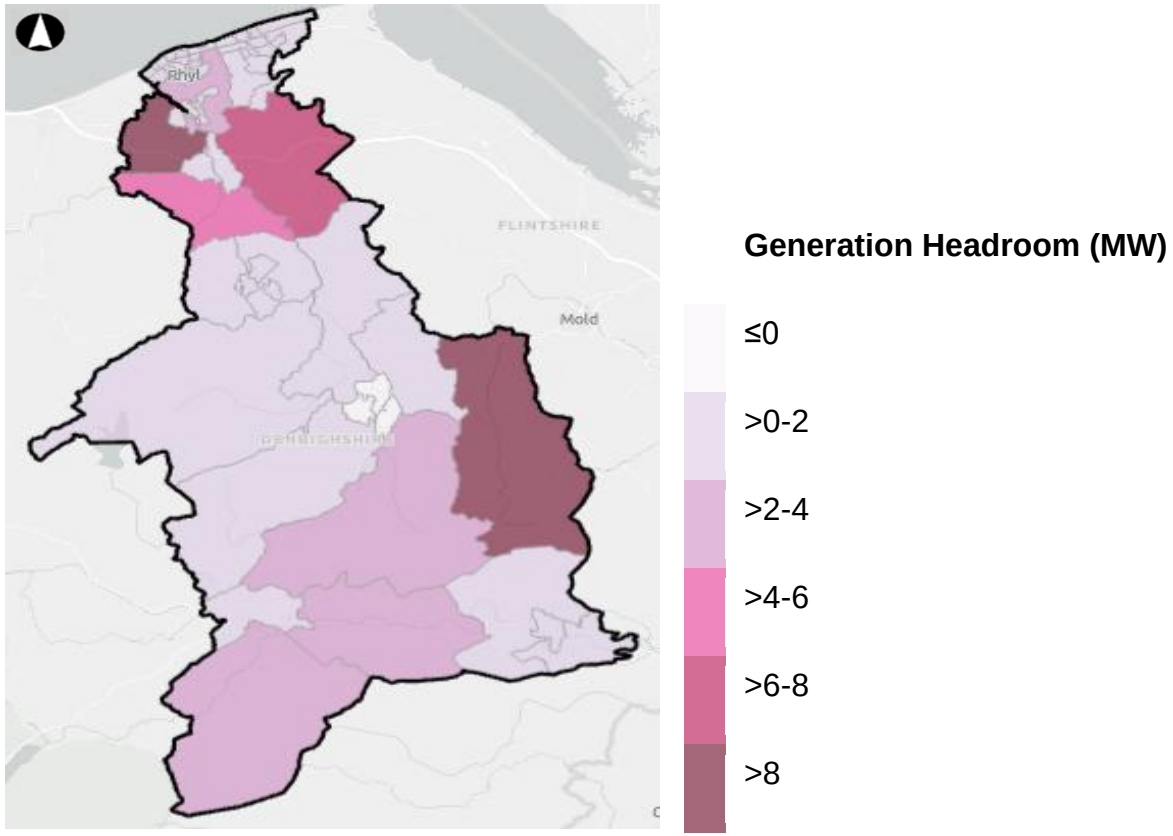
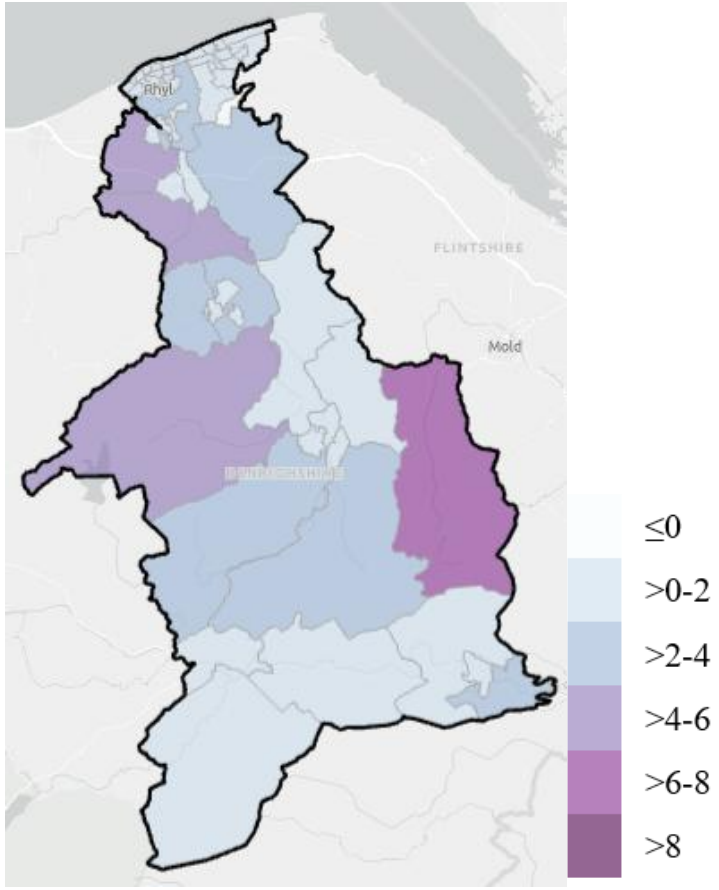


Figure 26 Electricity generation headroom (MW) by Lower Super Output Area (LSOA) (2023)

Presently, Denbighshire faces challenges with existing grid limitations, often leading to new connection delays and substantial expenses. These constraints impact the ability to develop new energy generation and infrastructure, highlighting the need for grid intervention. In simple terms, generation headroom is the amount of new generation that can be supported by an existing substation. For a more technical definition, see the Glossary. Generation headroom is relatively high in the Clwydian Range and

Dee Valley National Landscape. This is likely because this area has low housing density and therefore lower energy demands from housing, and there is only a small capacity being used by local renewable energy generators.

Demand headroom

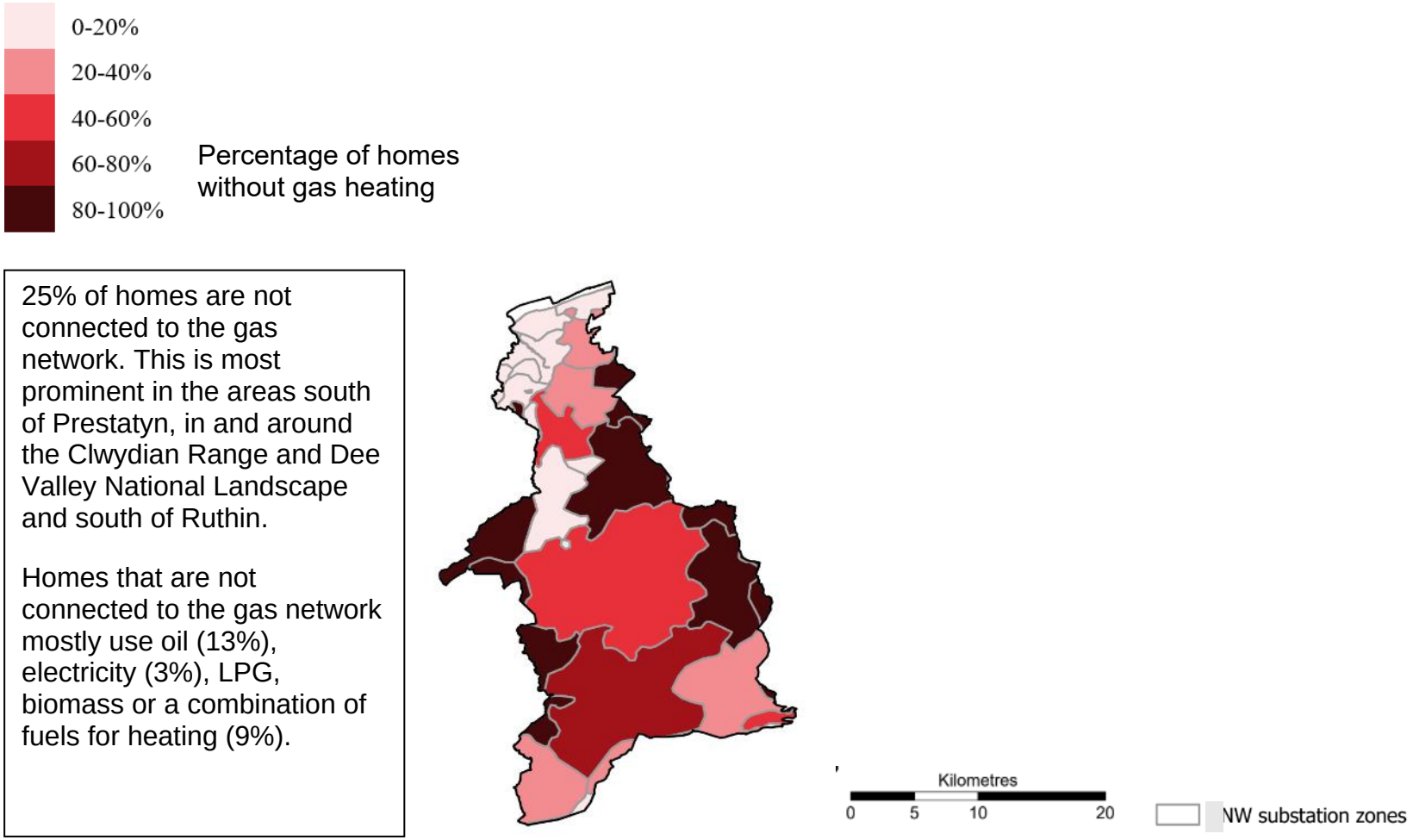


Demand headroom is the amount of energy demand that a substation can serve at a given point in time. For a more technical definition, see the Glossary.

Demand headroom in Denbighshire varies across the region, from near zero to 8MW per substation zone (median of 0-2MW).

Figure 27 Electricity demand headroom (MW) by Lower Super Output Area (LSOA) (2023)

Off-gas grid properties



25% of homes are not connected to the gas network. This is most prominent in the areas south of Prestatyn, in and around the Clwydian Range and Dee Valley National Landscape and south of Ruthin.

Homes that are not connected to the gas network mostly use oil (13%), electricity (3%), LPG, biomass or a combination of fuels for heating (9%).

Figure 28 Percentage of properties that are not connected to the gas distribution network (2023)

Local environmental, social and economic factors that influence energy

Area

Total land area:

844 km (58)

Land characteristics:

Majority of the area is rural, with main settlement clusters around St. Asaph, Prestatyn and Rhyl to the north.

Designations to note:

- Clwydian Range and Dee Valley National Landscape
- Pontcysyllte Aqueduct and Canal World Heritage Site and associated buffer zone

River Dee Special Area of Conservation (SAC).

Demographics

Population density:

115 persons per km^2 (Wales average 151 person per km^2). (59)(2022)

Population growth between 2011 – 2021:

2% (60) (94,000 to 96,000)

Socio-economic

Fuel poverty:

14% (Wales average: 14% (2021)) (61)

Commuting patterns:

Approximately 75% of residents work in the county, but out-commuting still exceeds in-commuting for work (ratio out:in is 1.3) (2022). (62)

Employment:

Top employment sectors were health and social work, retail, construction.

Emissions

Emissions per capita:

5 tCO_2e per capita per year (Wales average: 7tCO_2 per capita) (63)

Major emissions sources by fuel:

- Diesel used in vehicles (50%)
- Natural gas for heating (28%)
- Petrol used in vehicles (11%)

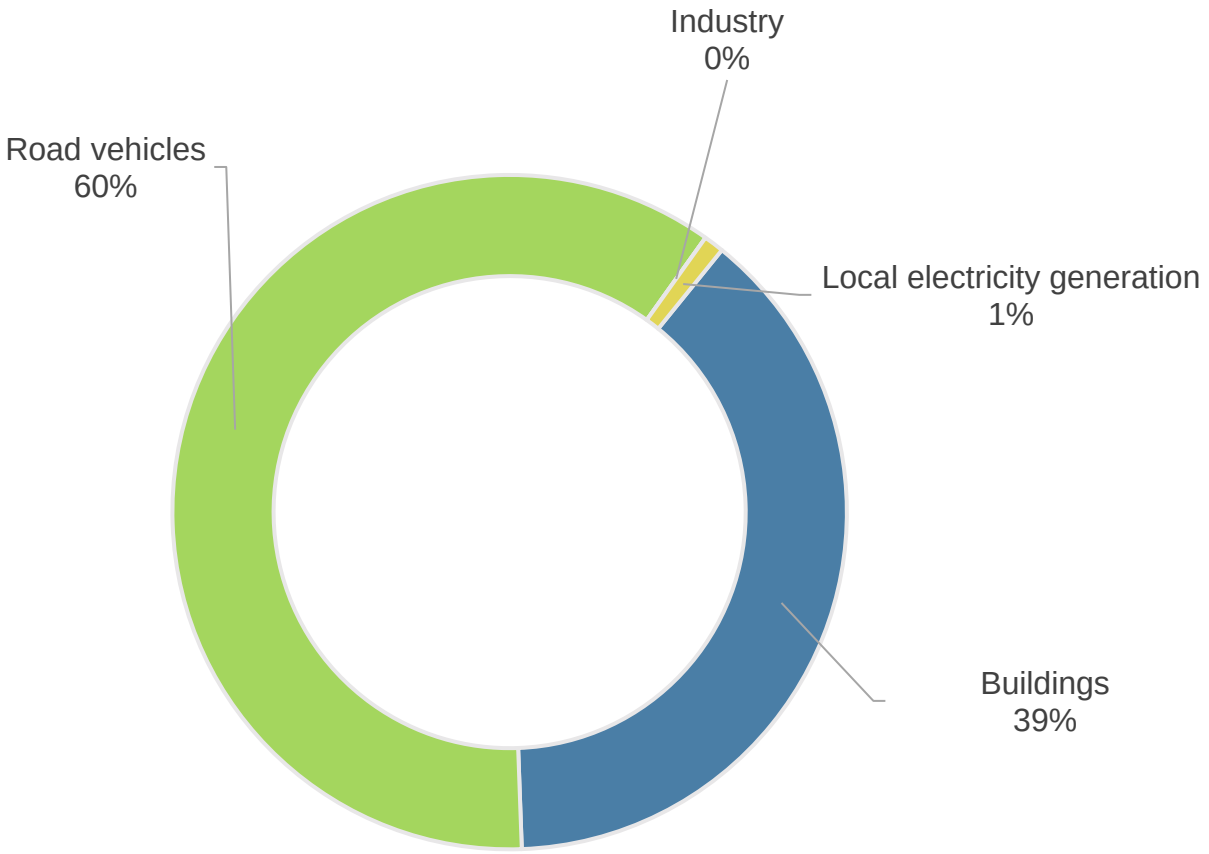


Figure 29 Denbighshire County's GHG emissions (2023)

Progress to date

Denbighshire County Council declared a Climate Change and Ecological Emergency in 2019 (64) and changed its constitution in 2020 for all decision-making to take account of tackling climate change and the nature emergency. It adopted a Climate and Nature Strategy in 2021 (29) which outlines its goals to achieve a Net Carbon Zero and Ecologically Positive Council and has since reinforced this commitment with its “greener Denbighshire” objective in its Corporate Plan (2022-2027) (28). This commitment to decarbonisation from the Council sets an example for others, recognising the importance of addressing the climate and nature emergency, and providing a supportive environment for others across the local area to do the same. The Strategy has recently been updated and will continue to be reviewed every three years. The Council’s Corporate Plan will be reviewed in 2028.

Since declaring a climate and ecological emergency, Denbighshire County Council has worked to reduce its organisational GHG emissions, and to encourage the wider community to do the same. Some important milestones achieved by the Council and across the County are summarised in Figure 30.

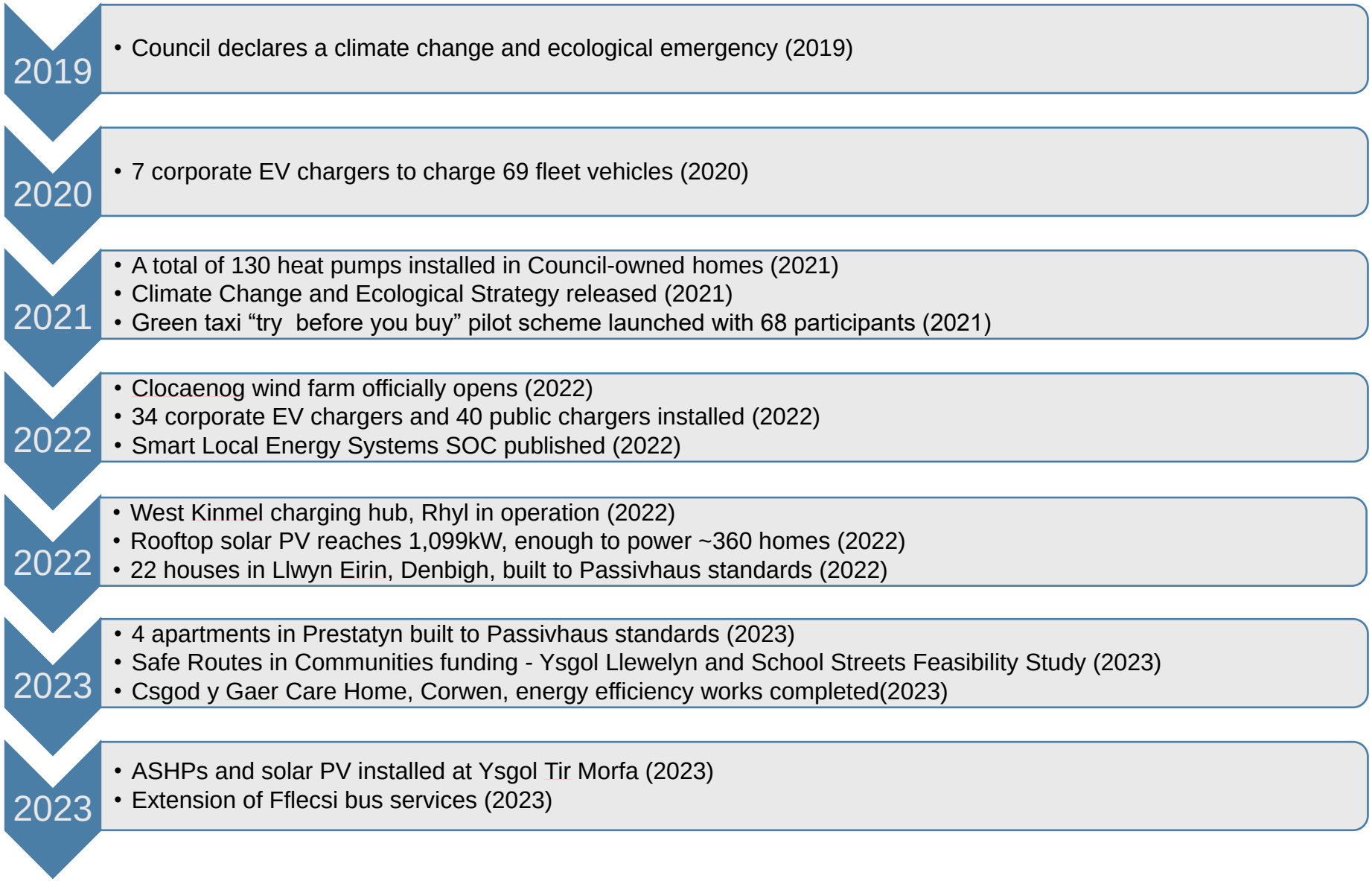


Figure 30 Summary of activities to date that have contributed to decarbonising the local energy system

Plans for the future

Grid interventions

Denbighshire County Council area is served by the section of network fed via the 240MVA 400/132kV super grid transformer (SGT) at St Asaph and the four 240MVA 400/132kV SGTs at the Legacy substation (Esclusham, Denbighshire County). These two network groups supply around 330,000 consumers in the North Wales area, which includes those in Denbighshire County Council.

Planned interventions to be delivered by 2028 will release up to 180MW of additional capacity and up to 120MW of flexibility services opportunities across both grid groups.

Various primary transformer and switchgear replacements and modernisations being delivered between 2024 and 2028 will provide shorter term deliverables throughout the RIIO-ED2 period and the full capacity release will become available following installation of an additional 132kV transformer by 2028.

Existing and further planned contracted flexibility services will mitigate low voltage issues in both groups whilst this planned replacement and modernisation work is being delivered, which will manage thermal constraints on the network during the RIIO-ED2 period.

SPEN are actively seeking further flexibility opportunities in this area and its partner, Piclo, are facilitating the procurement process with its Dynamic Purchasing Platform (65)

Renewable generation

There is significant potential for offshore renewables off the coast of Rhyl and Denbighshire, and as a result several national schemes for offshore wind energy off the coast of Rhyl are proposed and planned. These schemes require onshore connection to the grid. National Grid has been offering connection at the substation at St Asaph business park as it has had capacity. Nevertheless, National Grid has sought planning permission to extend the substation which is misleadingly named Bodelwyddan substation.

RWE is leading a consultation on proposals for a windfarm capable of generating power equivalent to 63,500 homes near the Alwen reservoir by 2028.

The Council is currently designing a district heating system in the village of Betws Gwerfil Goch to supply approximately 70 mixed tenure homes with low carbon heating to minimise its reliance on the grid. This project was awarded funding as part of the Optimised Retrofit Programme (66)and aims to address homes which are among some of the most poorly performing in energy performance in the area.

Transport

The Council is undergoing a fleet transition to electric vehicles, and currently uses 44 electric vehicles out of a fleet of approximately 350 vehicles. The Council is also working hard to make sure there is electric vehicle charging infrastructure fit for purpose to help us and the public play a part in tackling climate change. By the end of 2023, there were 80 charging points across the county.

The Council is also working with Sustrans Cymru (67) to understand how to make travelling actively in the area more accessible, safer and enjoyable to encourage more journeys on foot or cycle instead of by car. An additional three Clwyd West Levelling Up Fund Round 2 (UK Government fund) Projects will support this pledge to encourage more active travel, due to be completed in 2025.

Edeyrnion car club (68) near Corwen has been offering members use of an electric vehicle for the past four years. Originally funded by Big Lottery Wales, Cadwyn Clwyd (69) and Bus Services Support Grant, the club offers a transport option for those who don’t own a car and live in areas where public transport options are limited.

Community energy

- Prosperous Denbighshire (70) – A project aimed at boosting productivity, pay, jobs and living standards in Denbighshire with a focus on supporting micro and small enterprises. This includes encouraging adoption of productivity-enhancing, energy efficiency and low carbon technologies and techniques. Part of this is the Business Collaboration Fund, aiming to support and promote networking and collaboration across businesses in the area across the themes of innovation, entrepreneurship, business growth and Net Zero.

- Brenig Wind Ltd Community Benefit Grant (71) is administered by Cadwyn Clwyd and aims to provide benefits to the communities hosting and living with and around the wind farm. The wind farm is part of a larger area of the Clocaenog Forest where wind turbine are being installed, all of which will bring community benefit funds that will be invested back into the local communities.

- Corwen Electricity Cooperative (72) – Has developed two community-owned hydropower schemes (55kW and 100kW). One of these is part of an Energy Local Club providing electricity at lower tariffs to club members.

- Community Energy Wales (73), an organisation that promotes community-led renewable energy initiatives and support local ownership of energy projects.

Social and affordable housing

The Council's housing subsidiary, Denbighshire Housing, owns and maintains over 3,400 homes. Denbighshire Housing is participating in the Optimised Retrofit Programme which is funded by Welsh Government. As part of this, it has been working on reducing and decarbonising energy demand in their properties with new roofs, solar panels, external wall insulation and sensors in a range of locations: Rhydwen Drive, Rhyl, Canol Y Dre, Ruthin and Betws Gwerfil Goch. Phase 2 of the programme saw 96 homes on Rhydwen Drive receive energy efficiency improvements. The programme will continue through Phase 3 which runs from 2022-2025.

In 2023, the Council successfully completed the development of 4 new apartments in Prestatyn built to Passivhaus standards, following completion of 22 homes in Llwyn Eirin, Denbigh, also built to Passivhaus standards. Denbighshire Housing continues to progress other projects: Library site, Prestatyn and the old tax office on Churton Road, Rhyl, that are due to be completed in 2024.

3. The future energy system

Figure 31 Rooftop solar PV at Ysgol Dyffryn Iâl, Llandegla, Denbighshire

3.1. Overview

Vision and Objectives

Denbighshire's vision for the future local energy system and energy objectives were developed through consultation with our stakeholders. Further information on how they were developed can be found in the Technical Report (Chapter 1).

Vision

Our future energy system capitalises on our local renewable energy resources to provide an affordable and resilient energy system for our local communities without compromising our natural assets. Our local energy system empowers localities to generate and use energy more effectively which supports the development of a sustainable local economy.

Energy objectives

Denbighshire County Council worked with stakeholders to define the following objectives for the plan:

1. Encourage the efficient use of energy in the built environment and improve access to good quality, energy efficient housing.
2. Give support to sustainable and green transport plans that improve overall air quality, including active and healthy travel schemes that encourage walking and cycling.
3. Support the development of a resilient and efficient local energy system, exploring opportunities to reduce peak energy demand and offer flexibility services to the grid using storage technologies.
4. Maximise the local benefits from renewable energy generation by putting communities at the heart of our plans.
5. Make sure the Net Zero energy transition is equitable and fair.
6. Help us understand the opportunities for creating a flourishing low carbon economy, supported by a skilled workforce that is fit for the future.

Understanding the future energy system

We know that we need to transition our energy system in Denbighshire to Net Zero by 2050.

We also know that there are multiple plausible and attractive future energy systems for Denbighshire depending on a range of factors. This includes how innovation might impact on the cost of technologies over time, as well as wider policy decisions that will be made by Welsh and UK Governments. These factors will influence the uptake of hydrogen, for example.

Scenario analysis

To inform Denbighshire's plan, scenario analysis was used to explore what a Net Zero future energy system could look like under different future outcomes, including considering the potential for reduction measures and potential energy sources. Four future energy scenarios were optimised for the most cost- and carbon-effective way to meet demand in each one. Through doing this, technologies that played a significant role in all the future scenarios modelled were identified. These technologies represent low- and no-regrets options (meaning that they are likely to be most cost- and carbon-effective in the near-term) which are very likely to be important parts of the future energy system, regardless of the uncertainty of the future.

Deployment modelling

Aspects of each energy proposition and how they might be deployed between now and 2050 were modelled, creating deployment pathways. Deployment pathways indicate:

- the scale of change required over time,
- the sequencing of activity that needs to happen to achieve a Net Zero energy system.

Deployment pathways for different components were informed by broader plan objectives, local and regional strategic priorities, policies and national targets and using this context, helped us to define a suitable level of ambition, and bring all this evidence together into an action plan.

Method Overview

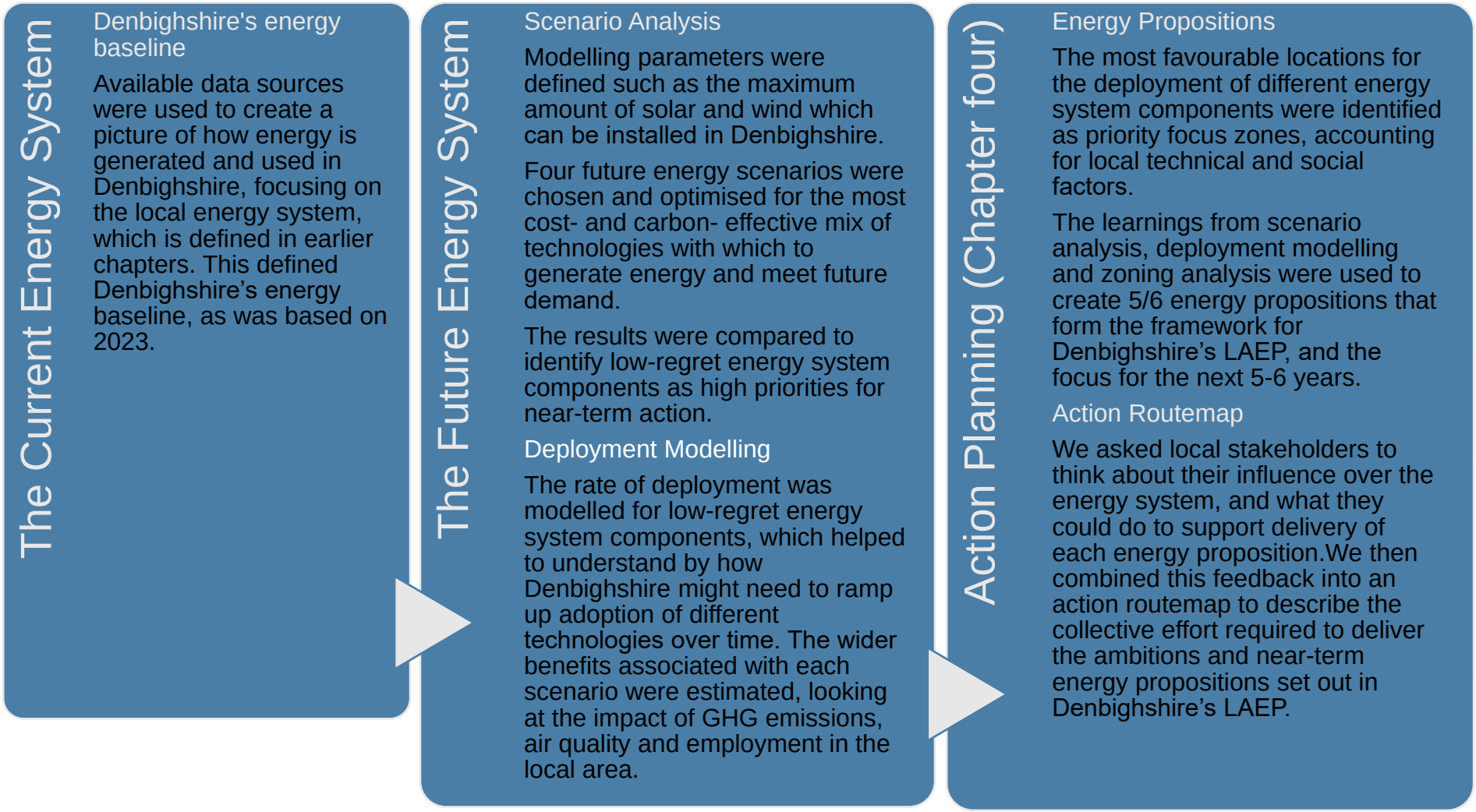


Figure 32 Summary of steps taken to produce the LAEP

3.2. Scenario Analysis

Do nothing

A scenario for comparison which considers committed activities and assumes that current and consulted upon policy goes forward and remains consistent.

This scenario provides a cost counterfactual.

There is no decarbonisation target for this scenario, and we do not use it in optimisation modelling.

National Net Zero

Uses the lowest lifetime cost and carbon combination of technologies to meet Wales' 2050 net zero target.

Explores impact of energy-reducing initiatives such as home fabric improvements and uptake of active travel and public transport use and high reduction in car use.

Model is allowed to import and export to the electricity grid, this assumes that the electricity grid is decarbonised and reinforced to allow for the demands, likely to be a combination of offshore wind, hydrogen combined gas cycle turbine (CCGT), grid-level battery storage, nuclear (these are considered as national assets and outside the scope of the LAEP).

Low demand

Considers the lowest plausible future energy demand across different sectors, moderate roll-out of home fabric improvements and significant shifts to active travel and public transport/ reduction of car use. Model finds lowest lifetime cost and carbon combination of technologies to meet predicted future energy demand. Import and export of electricity as National Net Zero

High Demand

Considers the highest plausible future energy demand across all sectors. Considers significant roll-out of home fabric improvements. Considers a moderate shift to active travel and public transport and a reduction in car use. Model finds the lowest cost and carbon combination of technologies to meet predicted future energy demand. Import and export of electricity as National Net Zero.

Maximising Our Potential

Considers the highest plausible future energy demand across different sectors. Explores impact of low deployment of energy-reducing initiatives such as home fabric improvements. Explores impact of a significant shift to active travel and public transport use. Explores impact of restricting electricity imports and increasing reliance on local renewable generation. Considers hydrogen for heavy goods vehicles but not for home heating. Uses a lifetime cost- and carbon-optimal range of technologies to meet predicted future energy demand.

Figure 33 Summary of future energy scenarios

National Net Zero Scenario

Figure 34 shows the potential future energy system for Denbighshire in the National Net Zero scenario. This system was optimised for each three-hour interval that made up a period of one year. This system is a result from modelling a cost- and carbon-optimised system based on a set of pre-defined modelling parameter and assumptions about the future energy system in the local area. We have explored several future energy scenarios to help us create a strategic plan of action for decarbonising the local energy system. More details on the scenarios and results from the modelling can be found in the Technical Report (*Chapter 4*). There are an infinite number of potential energy futures, but this scenario has been used to explore what some of these futures could mean for the local energy system and understand the characteristics of these systems to inform the priorities of this LAEP, and our short-term action plan.

Potential 2050 energy system

- Annual electricity generation could be 4.6 times larger than the baseline.
- Significant increase in renewable energy generation, especially ground-mounted solar PV (900 times higher than baseline) and onshore wind (2.7 times higher than baseline).
- Hydrogen could be imported or generated from electrolysis to power Heavy Goods Vehicles (HGVs)
- Electricity could be supplied by the National Grid and could increase by 2.7 times compared to the baseline
- Smaller contributions from anaerobic digestion and hydroelectricity, which stay consistent to the baseline.
- Heat could be generated mostly by heat pumps (82%), with smaller contributions from resistance heaters (2%) and thermal storage (16%).
- Electricity could meet 89% of transport demand and hydrogen could meet 11% of transport demand.
- 21% of generated electricity could be exported when it’s not required to meet local demand.
- Thermal storage could help to meet heat demand where renewables are not available at time of demand (16% of heat generation).

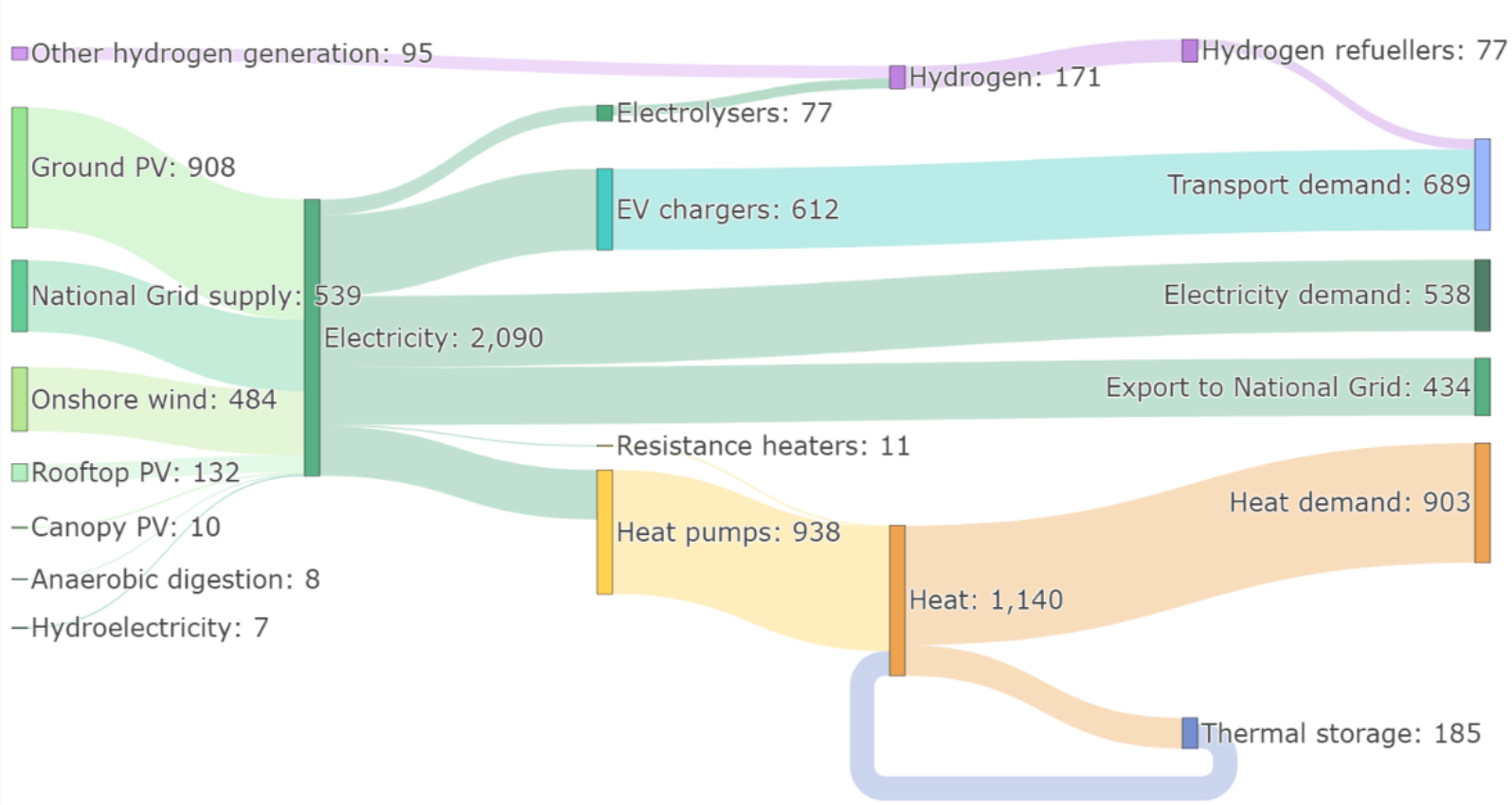


Figure 34 Sankey diagram for a potential future 2050 energy system – National Net Zero scenario (energy flows in GWh). Based on modelling energy demand and generation in three-hour intervals over the period of one year

Energy system components

Scenario analysis helped identify energy system components that the model selected in all scenarios. These components were defined as “low-regret, near-term components” and formed the basis of Denbighshire’s energy propositions. The system components that weren’t selected in every scenario were considered in the longer-term, and in conjunction with broader policy decisions. Table 1 and Table 2 (overleaf) shows what system components are recommended in each future energy scenario and on average, the amount of energy generated/converted/transferred by the energy system in one year, alongside Denbighshire’s energy baseline for 2023.

All scenarios suggest a transition to renewable energy sources, especially ground-mounted and rooftop solar PV and onshore wind. In contrast, the modelling indicates that electricity generated using biomass decreases across all scenarios, likely due to there being less need as renewable capacity from solar PV and wind increases.

Modelling indicates that hydrogen could be incorporated into the energy mix in all scenarios to meet transport demand. It’s only in the Maximising Our Potential scenario that hydrogen could act as a “dispatchable” energy source to produce electricity at short notice and at times where intermittent forms of energy (solar, wind) are not available to meet demand.

Table 1 Comparison of energy sources across the scenarios

Energy system components	Baseline (GWh)	National Net Zero (GWh)	High Demand (GWh)	Low Demand (GWh)	Maximising Our Potential (GWh)
Biomass	50	0	0	0	0
Coal	9	0	0	0	0
Hydroelectricity	7	7	7	7	7

Energy system components	Baseline (GWh)	National Net Zero (GWh)	High Demand (GWh)	Low Demand (GWh)	Maximising Our Potential (GWh)
Other hydrogen generation	0	95	93	90	812
Natural gas	644	0	0	0	0
Oil	214	0	0	0	0
Onshore wind	214	484	484	484	509
Rooftop/Canopy solar PV	6	142	142	142	142
Ground-mounted solar PV	1	908	908	908	865
Petrol/diesel	1,520	0	0	0	0

Table 2 suggests the different conversion and transfer technologies that the optimisation model has chosen. We see a significant uptake in EV chargers to meet the increased uptake of electric vehicles, and hydrogen refuellers used to supply hydrogen to heavy goods vehicles that service the area.

Heat pumps are the dominant conversion technology used for heat in buildings, and this is consistent across all scenarios. Hydrogen Combined Cycle Gas Turbine (CCGT) is only used in the Maximising Our Potential scenario where grid import is restricted. It is used to convert hydrogen into electricity to meet electricity demand when renewable generation is not available. Thermal storage is used to store excess heat generated and discharge it when it is needed.

In all scenarios, battery storage was allowed as a technology that the model could choose to optimise the future energy system to meet demand. This can happen simultaneously with grid export (i.e. it is not a true alternative). In most scenarios, building batteries is more expensive than grid import, and thus the model does not choose to build batteries. However, in the maximising our potential scenario, grid import is not allowed, so the model instead chooses to build batteries to meet the electricity demand. The balance between technologies (including the interaction between batteries and grid export, as discussed here) is determined in the optimisation model based on the carbon / cost inputs.

Table 2 Comparison of energy conversion (C), transfer (T) and storage (S) technologies across the scenarios

Energy system components	**Type**	**Baseline (GWh)**	**National Net Zero (GWh)**	**High Demand (GWh)**	**Low Demand (GWh)**	**Maximising Our Potential (GWh)**
Anaerobic digestor (plant)	C	7	6	8	8	9
Electrolyser	C	0	77	75	82	69
Heat pumps	C	0	938	938	643	939
Hydrogen CCGT[a]	C	0	0	0	0	376

Energy system components	Type	Baseline (GWh)	National Net Zero (GWh)	High Demand (GWh)	Low Demand (GWh)	Maximising Our Potential (GWh)
Resistance heaters	C	0	11	11	5	2
Biomass boiler	C	20	0	0	0	0
Coal/solid fuel/oil boiler	C	156	0	0	0	0
Battery storage	S	0	0	0	0	171
Thermal storage	S	0	185	185	136	144
EV chargers	T	0	612	629	612	612
Export to National Grid	T	0	434	429	509	243
Hydrogen refuellers	T	0	77	76	77	77
National Grid supply	T	206	539	549	401	0

[a]Combined Gas Cycle Turbine

Impact on energy demand

Deployment modelling estimates how quickly each energy component could be deployed in each future energy scenario. Figure 35 shows how the energy demand could change between 2023 and 2050 in each future energy scenario, accounting for innovation and supply chain development.

Total energy demand decreases between 2030 – 2042 in all scenarios driven by:

- a switch to more efficient electric vehicles and
- improving the energy performance of homes and commercial properties.

Total energy demand decreases to much lower levels in the Low Demand scenario compared to others, primarily driven by a more extensive roll-out of retrofit that achieves heat demands associated with EPC A ratings, rather than EPC C ratings, which is the assumption used in other scenarios. In 2042 and later, energy demand increases because the growth in housing and commercial property outweighs the energy reductions achieved through energy efficiency measures. The average heat demand decreases from approximately 13,000 to 11,000 kWh per home and commercial buildings 100 to 77 kWh per m^2. In 2042, the switch to electric vehicles slows down and we also see the introduction of hydrogen vehicles, which contribute to an increase in overall energy demand.

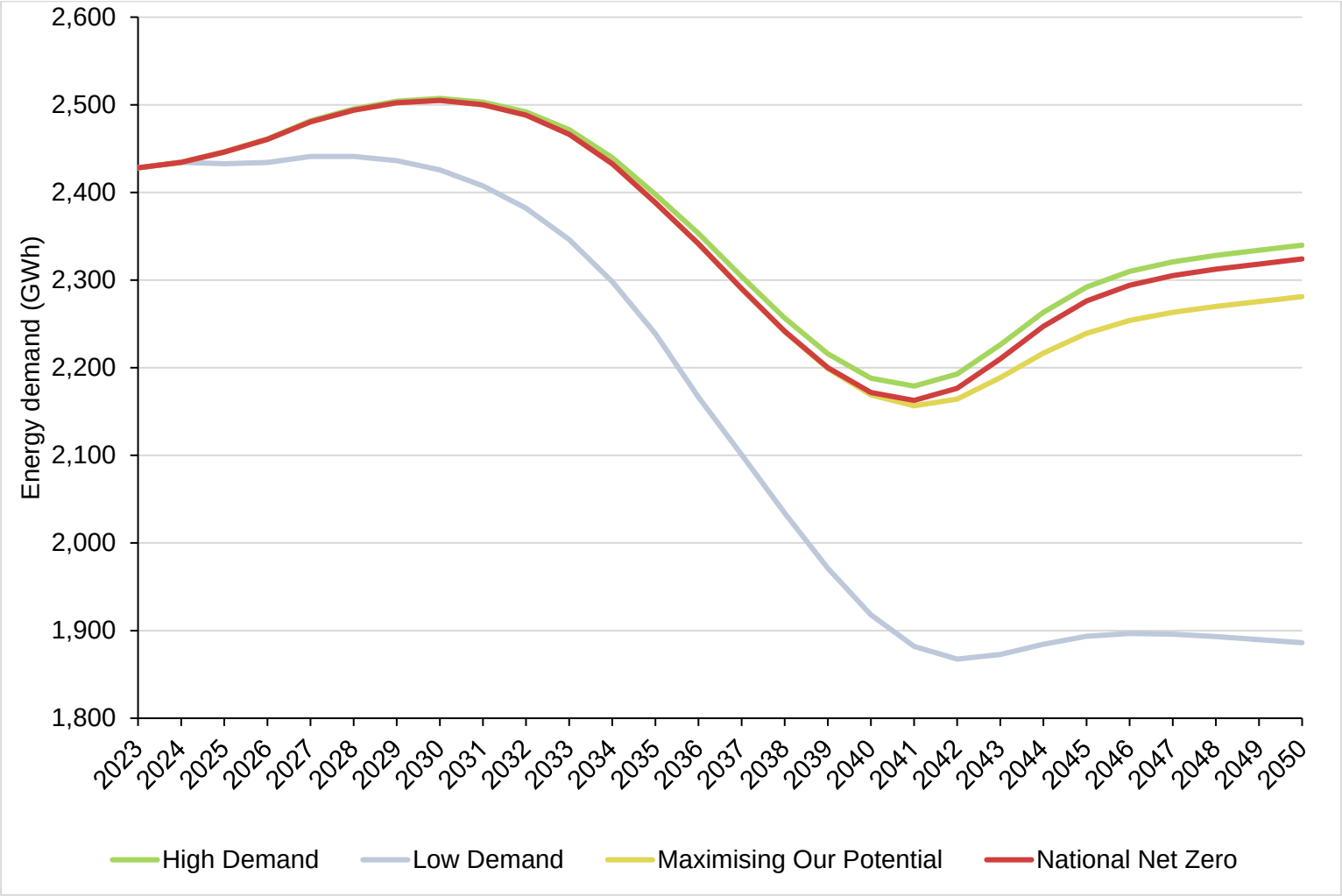


Figure 35 Change in total energy demand by scenario between 2023 and 2050 (GWh)

Impact on greenhouse gas (GHG) emissions

Figure 36 compares GHG emissions reductions between the Do Nothing scenario and the optimised scenarios. The deployment modelling provides evidence on the realism of delivering the changes suggested by the optimisation modelling. It helps us to determine the actions needed in the next five years to set Denbighshire on a pathway to Net Zero.

The deployment modelling also shows how these pathways contribute to the Welsh Government emissions reduction targets (shown in Figure 36). In 2023, Denbighshire's GHG emissions were 36% lower than 1990 levels, with reductions just below national 2050 target reductions in 2050. Pathways suggest a residual amount of GHG emissions remains in 2050 even with the ambitious changes set out in each scenario. This emphasizes the importance of exploring alternative ways to address hard-to-reduce GHG emissions through mechanisms such as offsetting.

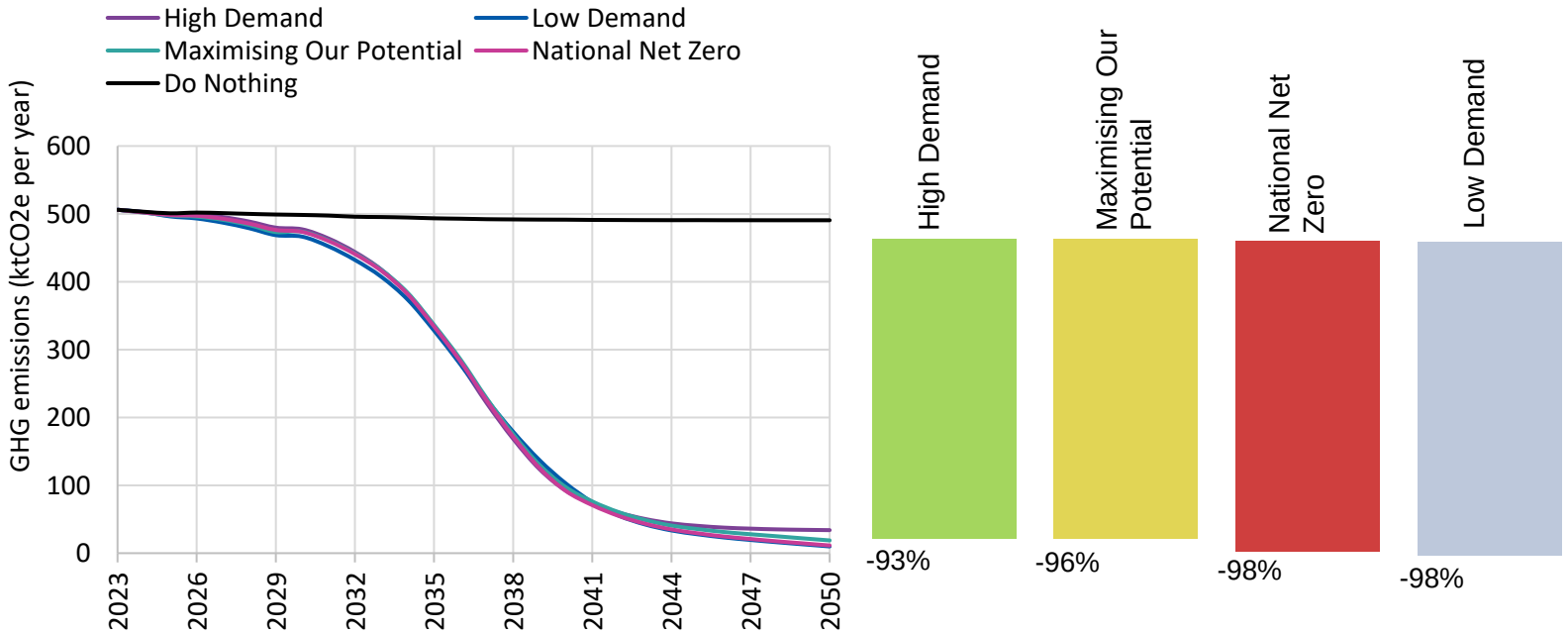


Figure 36 GHG emissions (ktCO2e) over time for each scenario compared to the Do Nothing scenario

Table 3 Percentage GHG emissions reduction for each scenario compared to the Welsh Government emissions reduction targets

Scenario	2030	2040	2050
Welsh Gov targets	**-63%**	**-89%**	**-100%**
National Net Zero	**-40%**	**-88%**	**-99%**
High Demand	**-39%**	**-88%**	**-96%**
Maximising Our Potential	**-40%**	**-88%**	**-98%**
Low Demand	**-40%**	**-88%**	**-99%**
Do Nothing	**-36%**	**-37%**	**-37%**

Socio-economic impacts

Reducing the amount of energy used in Denbighshire and using renewable energy sources for power generation can have wider environmental, social and economic benefits so it is important that they are fully understood to support decisions that impact the future of the energy system. For example, for every £1 invested in energy efficiency measures, the NHS can save £0.42 (amounting to annual savings of £1.4 billion in England alone) (74)

Employment impacts

Investments in local energy systems can be expected to have employment benefits by providing local, skilled jobs. These will include direct jobs from construction and operational phases of the development of new projects as well as associated jobs needed in the supply chain to bring the project to completion (also known as multiplier effects) (75)

Air Quality: It can also impact the quality of the air which in turn impacts: human health, productivity, wellbeing and the environment, which is why it is so important to understand when planning future policy or programmes of work. Activity costs presented in Table 3 shows estimates for the impact of air pollution per unit of fuel consumed in each future energy scenario and

estimates for the employment impacts associated with each future energy scenario, compared to the Do Nothing scenario. This analysis shows that the four future energy scenarios explored could improve air quality and minimise associated damage costs associated with poorer air quality. It also suggests that the four future energy scenarios would lead to a net increase in jobs available to the local community. More detailed analysis on deployment can be found in the Technical Report (*Chapter 4*).

Table 4 Summary of economic impacts for each scenario: employment impacts and air quality activity costs. Figures shown relate to the period 2023 – 2050. Air quality activity costs are presented using 2022 prices and are not discounted.

Metric	Do Nothing	National Net Zero	High Demand	Low Demand	Maximising Our Potential
Energy change (GWh, relative to 2023)	0	-142 (-4%)	-88 (-4%)	-542 (-22%)	-142 (-6%)
Change in GHG emissions ($ktCO_2e$, relative to 2023)	-15 (-3%)	-495 (-98%)	-472 (-93%)	-496 (-98%)	-487 (-96%)
Cumulative air quality activity costs between 2023-2050 (£'million) **(2022 prices)**	£609	£318	£292	£317	£320
Employment impacts between 2023-2050 relative to the Do Nothing scenario (net FTE)	0	3,400	3,400	4,600	6,400

In the table above, a negative number indicates a reduction and a positive number represents an increase or addition

Summary of deployment of critical energy components across Denbighshire

Figure 37 summarises the deployment rates for near-term system components, so we can better understand where we are now and where Denbighshire needs to get to, providing a starting point to frame the challenge for more detailed

analysis. It's important to note that there is still a high degree of uncertainty associated with this deployment modelling as there are many variable factors and unknowns. For example:

- Technological advance and innovation
- Supply chains and how they develop
- Large scale activity to decarbonise infrastructure at other levels: regional, UK and beyond.
- Whether practical application is actually feasible and deliverable.

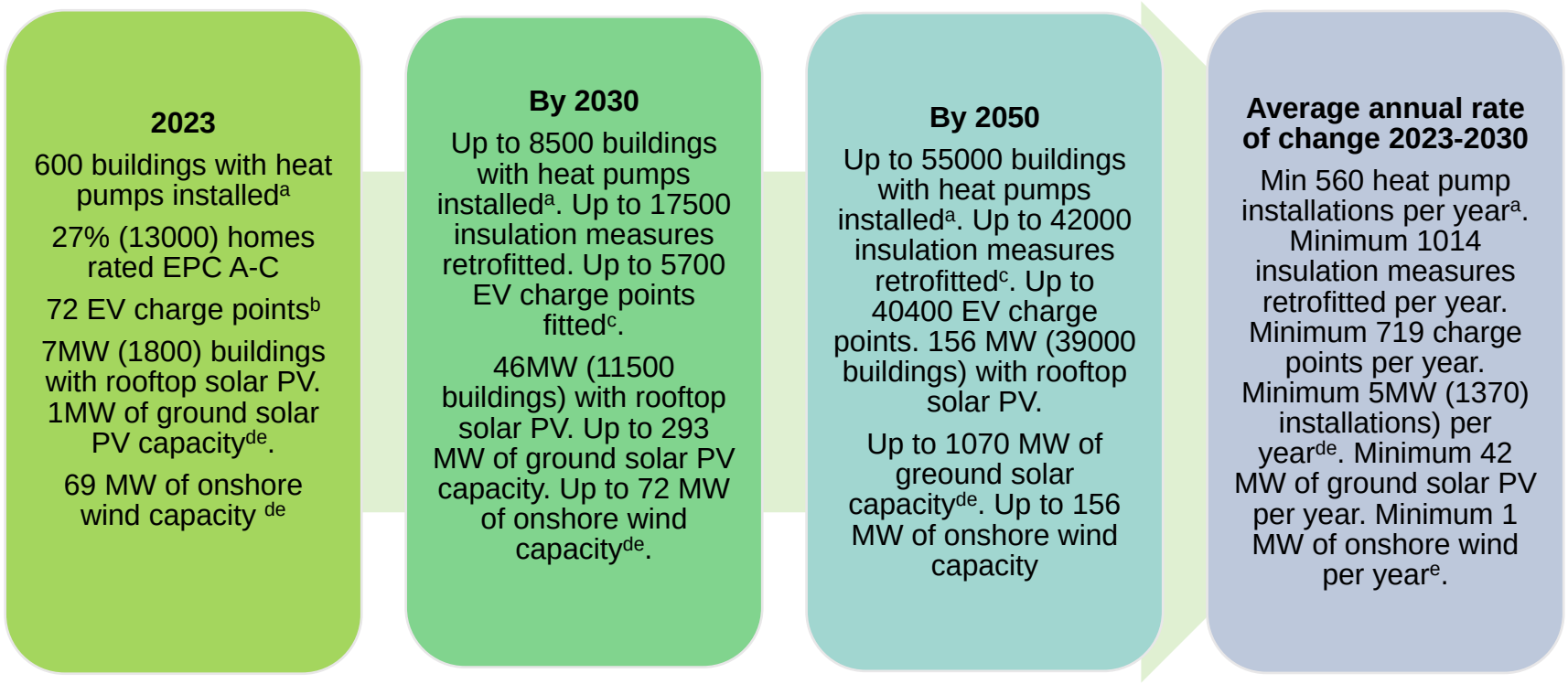


Figure 37 Summary of key deployment metrics from optimisation modelling a,b,c,d,e

[a]Assuming one heat pump is approximately 6kWp, [b]According to the National chargepoint Registry (1) as of May 2023. Refers to individual chargepoints

[c]Assuming 4kWp per chargepoint. Note that the power rating selected will be dependent on location and use case. E.g. Rapid chargers are more suitable at service stations due to the length of stay of customers. In Denbighshire most chargers (95%) are likely to be slow chargers (<7kW) with a small number of fast (7-22kW) and rapid (42-350kW) EV chargers (based on the Wales EV Charging Strategy).

[d]Assuming 4kWp per roof

[e]Renewable generation capacity is shown for technologies where current installed capacity is >5MW

4. Chapter 4: Action Planning

Figure 38 Llangollen, Denbighshire [Photo by Catrin Ellis on Unsplash]

4.1. Energy Propositions

We shared what we learnt from exploring different energy futures and deployment pathways with our stakeholders to discuss what key drivers will be critical for the transition to Net Zero. We then considered their feedback and our strategic vision and objectives and agreed energy propositions to act as the framework for Denbighshire's LAEP. There are numerous inter-dependencies and interactions between these propositions, as shown in Figure 39, and this highlights the importance of a whole system approach with a co-ordinated programme of delivery to meet the Net Zero target by 2050.

The following section describes each energy proposition in more detail, drawing together the evidence collected from baselining, scenario analysis and spatial modelling to propose priority focus zones to test critical, low-regrets system components that make up each energy proposition. It also summarises what scenario modelling tells us would be needed between now and 2030 to be on a trajectory towards meeting Net Zero by 2050.

Denbighshire's future energy system vision: Our future energy system capitalises on our local renewable energy resources to provide an affordable and resilient energy system for our local communities without compromising our natural assets. Our local energy system empowers localities to generate and use energy more effectively which supports the development of a sustainable local economy.

The level of reinforcement can be mitigated by appropriate placement of renewable generators.

Reducing car journeys reduces need for EVs – reduce electrical load onto network.

Electrolysers require electricity, from suitable electricity network.

Smart systems can reduce peak demands – reduce need for reinforcement.

1. Minimise heat demand, and support shift to low carbon, flexible heating systems in homes

2. Maximise local potential for onshore renewables

3. Decarbonise transport

4. Reinforce electricity and gas distribution networks

5. Explore opportunities for smart local energy systems

Reduction in demand lessens electricity requirements. Retrofit is key to ensure heat pumps can operate efficiently at low supply temperatures.

Heat pumps add electrical load onto network – network reinforcements could be required. EVs add electrical load onto network – network reinforcements required. Hydrogen distribution could supply heavy goods vehicles or industrial clusters. Creating or re-directing supply near demand can avoid need for grid reinforcement.

Figure 39 Summary of energy propositions and their inter-dependencies

Proposition 1: Minimise energy demand, and support shift to low carbon, flexible heating systems in homes	Proposition 2: Maximise local potential for onshore renewables without compromising natural assets	Proposition 3: Decarbonise transport
The priority is to reduce the amount of energy used to minimise emissions and cost to consumers. Most homes will need some form of retrofit in Denbighshire, and this is likely to become even more critical where energy prices have increased. Scenarios show heat pumps as the near-term, least regrets technology to decarbonise heating systems in home and areas where grid capacity (its maximum power output) would make this more favourable. Innovative business models should be explored to maximise local benefits, buy-in and confidence in low carbon heating systems.	Denbighshire currently has several onshore wind schemes with some further schemes proposed. These schemes meet local and broader energy needs. Theoretically they could be enhanced in the future. A large agricultural sector also presents opportunities to capitalise on unused waste resources for the generation of electricity. Consider storage technologies to minimise dependency and exposure to grid price volatility and connection challenges.	Develop EV charging infrastructure and support decarbonisation of heavy transport. Support a fair transition to ultra-low emissions (ULEV) vehicles and make it easier for people to choose public transport and active travel over other modes. EV charge point access should be considered across the borough, including more rural areas. Where car journeys can't be avoided, support a fair transition to ultra-low emissions vehicles (ULEV) which will include transitioning public service buses and taxis.

Figure 40 Summary of energy propositions (energy propositions 1-3)

Proposition 4: Reinforce the energy networks	Proposition 5: Promote smart local energy systems
There will be a significant increase in electricity demand between now and 2050, driven by the uptake of electric vehicles, and a shift to electricity for home heating. This means that reinforcement to meet up to a 95% increase in electricity generation capacity (its maximum power output) could be needed, based on scenario analysis. Even if hydrogen is not used for heating, the gas grid will need to be repurposed to provide hydrogen for uses that are not easily electrified such as industry, and to manage costs in a fair way as home heating transitions away from gas.	Smart systems bring together energy generation, storage, demand and infrastructure and connects them in a smart way. It presents an opportunity for energy resources to be used more efficiently, and opportunity to alleviate pressures on grid reinforcement and avoid delays for connection where it isn't needed.

Figure 41 Summary of energy propositions (energy propositions 4-5)

Identifying priority focus zones

Although the exact form of the decarbonised energy system in 2050 is uncertain, there are actions that local stakeholders can take now with relative certainty that will help Denbighshire maintain the ability to contribute to Wales' 2050 Net Zero ambition and capitalise on the associated opportunities.

Denbighshire's Plan on a Page (Figure 42) identifies priority focus zones with particularly favourable conditions for different low carbon technologies identified in Denbighshire's energy propositions: heat pumps, electric vehicles (EV) chargers, rooftop solar PV, ground-mounted solar PV, onshore wind, and insulation retrofits. The accompanying tables indicate what the modelling suggests could be developed in these priority focus zones to meet the future energy demand in the High Demand scenario.

We ranked the favourability of conditions in zones by ranking them against two or more criteria that reflect relevant characteristics of the area (e.g. Index of multiple deprivation, proportion of social housing, proportion of off-gas grid properties, electricity grid headroom) or the results from scenario modelling (e.g. Theoretical future renewable energy capacity requirements or EV chargers):

- **Off-gas homes** – prioritise zones with higher baseline proportion of off-gas housing. These homes will be the most challenging to transition to hydrogen and therefore are the most likely no-regrets targets for conversion to heat pumps.
- **Socioeconomics** - prioritise zones with higher baseline rates of deprivation (lower WIMD score).
- **Property ownership** - prioritise zones with the highest baseline percentage of social housing.
- **Substation generation headroom** – prioritise zones with the most baseline generation headroom available.
- **Listed buildings** – prioritise zones with the least number of currently listed buildings.
- **Domestic energy efficiency** – prioritise zones with the highest baseline percentage of homes with an EPC rating of D or below.
- **Built additional substation capacity** - prioritises zones where the least upgrades are required in the high demand scenario, since heat electrification is typically a major contributor to grid upgrade requirements (which may be back-logged by several years).
- **Built EV charging capacity** – prioritise zones with the most EV charging built in the high demand scenario.

- **Built additional capacity of each local generation technology** (rooftop PV, ground-mounted PV, or onshore wind) – prioritise zones where the most additional new capacity is built between the baseline and 2050 high demand scenario.

4.2. Executive Summary: Denbighshire's Plan on a Page

Reading the Plan on a Page

The Plan on a page is presented by "modelling zone", which was chosen as the smallest level of granularity used to present results in the LAEP. They are derived from primary substation service areas which are areas bounding the buildings or other electricity demands which are served by a primary substation or group of primary substations that act together. **They do not represent locations for specific projects.** This level of granularity has been chosen for several reasons:

- We needed to model for the most cost- and carbon- optimal generation profile using parameters that reflected the state of the current electricity grid.

- Presenting the results in this way helps Distribution Network Operators – who manage the operation, maintenance and interventions for primary substations - understand how future energy demand could change and how this might impact how investment in primary substation is prioritised.

In the map (overleaf), green areas show zones identified as a priority focus zone for at least one energy system component. The tables indicate the total scale of change that the modelling suggests is needed by 2030 and indicates either the total capacity (MW) to be installed or the number of homes requiring retrofit and the associated investment figures. Blue areas show "progress" zones where the conditions are ranked less favourably against the selected criteria compared to the green areas. Only tried and tested delivery models should be deployed in these modelling zones. A consistent level of deployment will still be required in these zones to transform the local energy system at the pace indicated by the deployment analysis.

Using the Plan on a Page

The Plan on a Page is a high level, theoretical assessment for the areas where different low carbon technologies could be deployed, considering the impacts of grid capacity, cost and greenhouse gas emissions. The plan is not a presumption in favour of development nor is it a material planning consideration.

To support the transition to a Net Zero energy system, pilot projects may be useful. The map below highlights areas that could provide a useful focus for these pilots

Figure 4.0.4 identifies zones with particularly favourable conditions for specific energy components, making them ideal locations for pilot studies. The summary tables (shown below) detail the (i) installed capacity opportunity, (ii) required investment for each component and (iii) total investment necessary for both energy component installation and electricity network infrastructure in each zone **by 2030**. Ranges have been calculated by taking the minimum and maximum results from each future energy scenarios modelled (see Chapter 3 for more detail). Note: intervention should still be carried out in 'progress' zones to transition the local area to Net Zero.

Area	i)	ii)	iii)
A, Insulation	1000-5000 homes	£28-500M	Total for zone (max): £550M
A, Rooftop PV	14MW	£15M	Total for zone (max): £550M
A, EV charger	0.4MW (100 EV chargers)	£0.3M	Total for zone (max): £550M
B, EV chargers	270 Chargers (1MW)	£0.8-0.9M	Total for zone (max): £73M
C, Heat pumps	0.1MW	£0.04-0.08M	Total for zone (max): £16M
C, Ground-mounted PV	23MW	£9.7M	Total for zone (max): £16M
D, Ground-mounted PV	96MW	£42M	Total for zone (max): £210M
D, Onshore wind	0.4MW	£0.4M	Total for zone (max): £210M
E, Heat Pumps	0.1-0.2MW (10-30 Heat pumps)	£0.06-0.1M	Total for zone (max): £38M
E, Onshore Wind	0.4MW	£0.5M	Total for zone (max): £38M

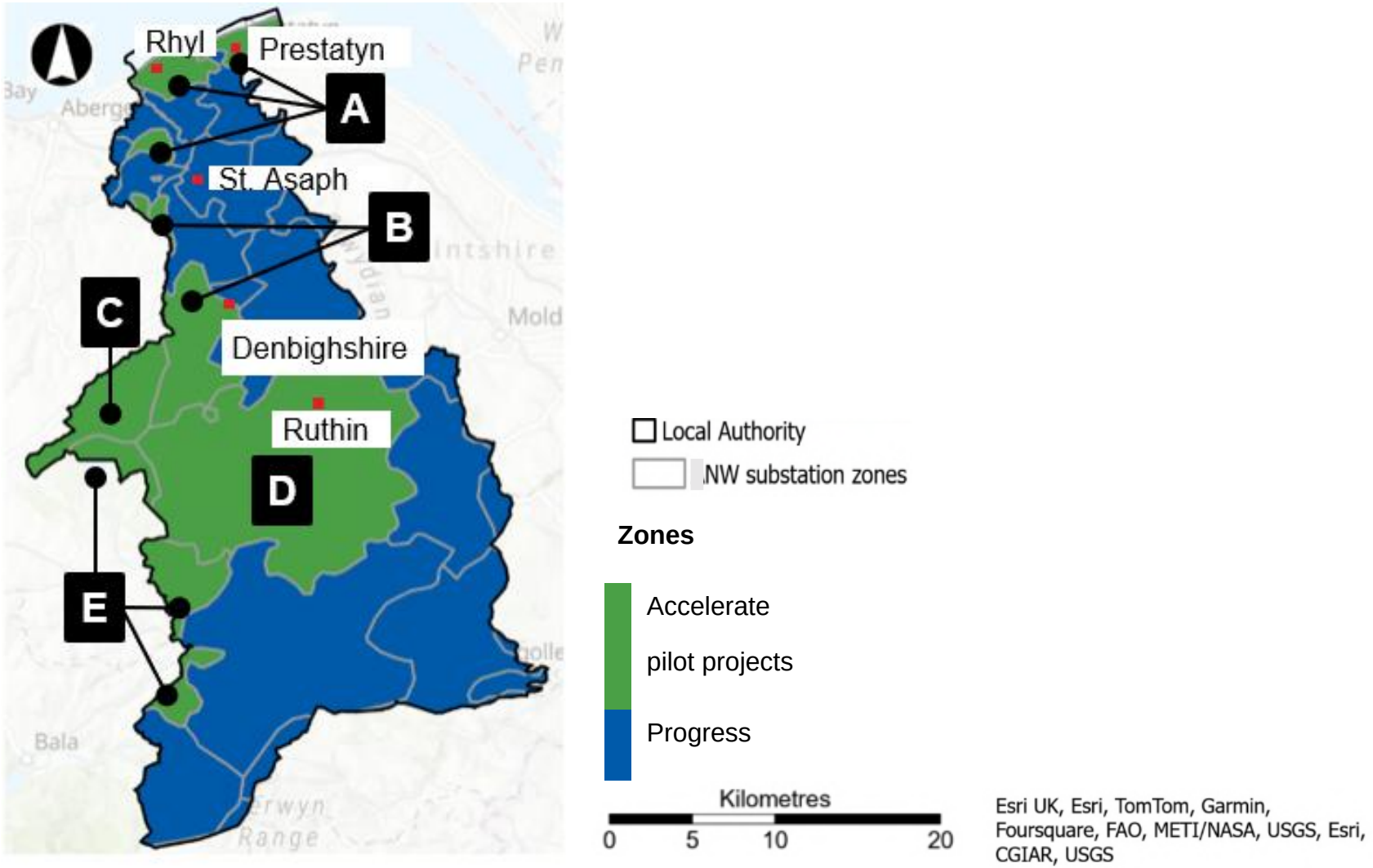


Figure 42 Denbighshire's spatial representation of opportunities, including 2030 ambition and investment (million £). Zone boundaries are defined by primary substation service areas

4.3. Creating an action routemap

Action routemap

Denbighshire's energy propositions describe where our priorities lie as a county borough based on the evidence presented thus far. Our **action routemap** takes each energy proposition and outlines critical, enabling actions that we will take collectively in the coming decade, with a particular focus on what we can achieve in the next five-seven years. Our action routemap has been developed as a dynamic plan that recognises the influence that wider contextual changes at national and local level will have on the way we choose to transition to a net zero energy system, such as national regulation, policy and strategic plans. As a result, we expect to regularly review and update our routemap based on these dependencies.

Each action will require four key elements to be successful:

- Mobilising finance
- Strong and consistent policy frameworks
- Identifying delivery owners
- Community engagement

As Denbighshire County Borough Council, our role in delivering each energy proposition will vary. Some actions call for council action in the material delivery of programmes, whilst others require the council to act as the facilitator for market-driven change.

Through the LAEP development process, we also identified that some of the actions are best delivered collaboratively through the regional partnership. This is because there are potential for economies of scale, and it would be more efficient to co-ordinate public resources. The regional actions will require detailed design work, to create projects and programmes, to progress them to implementation stage - with an initial focus on the tried and tested. The council will take an active role in supporting North Wales going forward.

Local ownership is a key focus throughout this plan, and where possible the action taken should build on the progress made through the Welsh Government's recent Co-operation Agreement with Plaid Cymru due to end in December 2024, which includes key goals on tackling climate change in a way that maximises local benefits.

The following section provides further detail on each of the actions that we will undertake under each energy proposition, as well as our key asks of others. Due to the relative uncertainty of longer-term actions, we have chosen not to focus on detailed scoping of these in this report and instead, focus on actions we intend to deliver in the short-term, subject to appropriate support. For more details on the action plan, please see the Technical Report.

Short-term: **Minimise energy demand, and support shift to low carbon, flexible heating systems in homes**

Action reference	Action	Timeline	Proposed Lead
1.1 (NEW-NCZ; EP A27)	Provide support and guidance on best practice energy management and low carbon heating systems for the community and local businesses.	2030	Denbighshire County Council
1.2 (NCZ A3 A5 A6i)	Capitalise on funding opportunities for energy efficiency and low carbon heating e.g. Wales Funding Programme. Utilise the available budget to undertake works to buildings to improve energy efficiency.	2030	Denbighshire County Council
1.3 (NEW (SS-PDA)	Support public sector to reach targets in the Heat Strategy for Wales.	2030	Denbighshire County Council
1.4 (NEW-EP)	Devise and implement a targeted energy pathway by 31/3/2027 to demonstrate how we will achieve SAP/EPC 75 by 31st March 2030, including estimated costs.	2030	Denbighshire County Council
1.5 (NEW-NCZ)	Promote and administer the ECO4 scheme via Flintshire County Council – energy efficiency in private sector dwellings by 2030.	2030	Denbighshire County Council

Action reference	Action	Timeline	Proposed Lead
1.6 (NCZ-A42)	Continue to support households living in Denbighshire who are most likely to experience fuel poverty and those vulnerable to the effects of a cold home through promoting Welsh Governments fuel poverty scheme and administrating Denbighshire's own criteria.	2030	Denbighshire County Council
1.6 (NEW (SS_PDA))	Implement minimum energy standards for non-domestic rented out property (EPC by 2027 on new leases) by 2030.	2030	Denbighshire County Council
1.7 (NEW-NCZ)	Complete a funding options analysis in anticipation of the cessation of Retrofit Grant funding post 2025.	2025	Denbighshire County Council
1.8 (NEW-NCZ)	Work collaboratively with partners across the housing sector, through initiatives such as the Low Carbon Hub and Net Zero Group, towards decarbonisation goals.	2030	Denbighshire County Council
1.9 (5C)	Explore development of support mechanisms for small to medium-sized enterprises (SMEs) to encourage uptake of energy efficiency improvements to commercial buildings.	2030	Business Wales; M-Sparc; North Wales Mersey Dee Business Council

Action reference	Action	Timeline	Proposed Lead
1.10 (3A)	Provide support and incentives for households to install energy efficiency measures and low-carbon heating systems, ensuring such support is targeted at those in fuel poverty and/or in most need.	2030	Registered Social Landlords
1.11 (3C)	Ensure PAS 2035 surveys and a clear plan for retrofit measures are prepared for individual social homes, in accordance with the Welsh Housing Quality Standard (WHQS).	2030	Local Authorities; Registered Social Landlords
1.12 (B.1.2; 3B)	Develop and agree an approach and delivery plan for tackling owner-occupied retrofit. Review existing and explore new potential financial mechanisms to support owner-occupiers and building owners seeking to undertake energy efficiency retrofit works.	2025	Welsh Government
1.13 (B.1.7)	Work with local authorities and regional bodies to determine an approach to coordinated, street-by-street approach to retrofit and the mechanisms for delivery (e.g. governance, resource, finance, policy). Co-ordinate a retrofit plan for all housing tenures which expands on the Optimised Retrofit Programme.	2050	Welsh Government
1.14 (B.5.2)	Consider tighter building regulations to support delivery of net zero ready buildings including a consultation on Part L regulations in 2024.	2025	Welsh Government

Action reference	Action	Timeline	Proposed Lead
1.15 (3D)	Review current support provision to tenants and landlords in the private-rented sector to ensure minimum energy efficiency standards are met. Review enforcement provisions to ensure minimum statutory standards within the sector are achieved.	2026	Welsh Government; Local Authorities
1.16 (B.5.1; 3E)	Identify specific local planning constraints (e.g. permitted developments i.e. 3 metre rule for heat pumps, permissive planning for listed buildings, new build regulations) limiting progress to net zero and delivering the LAEPs and work with Welsh Government to resolve these.	2050	Welsh Government; Local Authorities
1.17 (E.4.1)	Identify procurement frameworks for renewable technologies which consider local and ethical sourcing of goods and services. Develop national procurement framework, learning from previous ECO4 roll out and the Optimised Retrofit Programme, to deliver street-by-street retrofit.	2025	Welsh Government
1.18 (B.1.8)	Apply lessons learnt from Optimised Retrofit Programme to retrofitting the privately rented and owner-occupied sectors through Welsh Zero Carbon Hwb.	2050	Welsh Government

Action reference	Action	Timeline	Proposed Lead
1.19 (B.2.1)	Using the learning from other information hubs to develop an information service that provides a trusted source of retrofit and energy efficiency information for consumers. Explore the potential of establishing an advice hub to support regional decarbonisation / low carbon energy initiatives.	2025	Welsh Government
1.20 (R1.4)	Work with Community Interest Companies (CIC) to provide a regional service of wrap around support for residents covering education, behaviour change, energy advice and support.	2028	Warm Wales

Maximise local potential for onshore renewables without compromising natural assets

Action reference	Action	Timeline	Proposed lead(s)
2.1	Engage with National Grid, SPEN, and other utilities to develop a pipeline of viable projects and prepare for future funding opportunities.	2030	Denbighshire County Council
2.2 (NEW (SS-PDA))	Review the Agricultural Estate Strategy and explore options around environmental improvement, nature recovery and carbon zero emissions.	2024	Denbighshire County Council
2.3	Disseminate learnings from small-scale renewables trials to community groups, small businesses and landowners.	2027	Denbighshire County Council
2.4 (NCZ)	Engage with local tenants on land use and sustainable farming scheme, informed by workshops with services and a review of the agricultural estate.	2027	Denbighshire County Council

Action reference	Action	Timeline	Proposed lead(s)
2.5 (NEW-NCZ)	Ensure a minimum requirement for on-site renewable energy generation for new building development where possible.	2030	Denbighshire County Council
2.6 (EP P14)	Work with the Local Planning Authority (LPA) and Planning Policy to ensure clear guidance is provided to prospective developers around carbon reduction and biodiversity within developments. Use the LPA validation process, where reasonable, to ensure compliance (following update to Planning & Policy Wales – Section 6).	2030	Denbighshire County Council
2.7 (NEW (finance))	Explore funding models for investment in renewable energy products/schemes.	2030	Denbighshire County Council
2.8 (NCZ A37)	Delivery of Supplementary Planning Guidance resulting from the new Local Development Plan will support the climate change and biodiversity agenda.	2030	Denbighshire County Council
2.9 (NCZ A43)	Support the delivery of projects under Ambition North Wales' Low Carbon Energy Programme.	2030	Denbighshire County Council

2.10	Engage with communities and landowners to identify opportunities for small-scale renewables and collaborative opportunities.	2027	Denbighshire County Council ;Clwydian Range and Dee Valley National Landscape
2.11	Create policies that facilitate development of renewable energy projects.	2027	Welsh Government
2.12	Improve signposting and communication of renewable project design and feasibility for Wales.	2027	Welsh Government
2.13	Publish guidance on use of public land for renewables.	2025	Welsh Government
2.14 (2A)	Engage with Welsh Government to identify and build on opportunities that Ynni Cymru could provide to North Wales.	2030	Ynni Cymru; Ambition North Wales
2.15 (2D)	Support workstreams in increasing local ownership of energy projects to be delivered in line with proposed guidance on local and shared ownership in Wales.	2030	Ynni Cymru; Ambition North Wales

2.16 (2B)	Explore how to improve communication of available funding sources for the development and delivery of a range of low-carbon power generation projects (e.g. onshore and offshore wind, solar PV, nuclear, and tidal and marine energy).	2025	Ambition North Wales
2.17 (2F)	Maximise opportunities for public procurement to support the acceleration of renewable energy generation and secure local economic and social value. - Ensure that public procurement strengthens local supply chains / local jobs (social value). - Ask the supply chain to deliver against public sector carbon ambitions through procurement frameworks.	2030	Ambition North Wales
2.18 (2G)	Maximise opportunities for community benefits funds from energy infrastructure projects (on the distribution network) to support local and regional decarbonisation initiatives, recognising the need to target those communities and areas most impacted by such developments.	2030	Ambition North Wales
2.19 (R2.1)	Explore the opportunities that Power Purchasing Agreements could provide to energy generation across the region.	2026	Ambition North Wales

2.20 (R2.2)	Continue to explore the opportunities presented by solar canopies in car parking spaces and the enablers to scale the technology across the region.	2027	Ambition North Wales; Welsh Government Energy Service
2.21 (RN.4.1)	Identify and explore opportunities for the development of renewables on public sector owned land.	2050	Welsh Government; Trydan Gwyrdd Cymru
2.22 (2E)	Explore the potential of establishing an advice hub to support regional decarbonisation / low carbon energy initiatives.	2026	Ambition North Wales
2.23 (G)	Explore the development of an investment prospectus for renewable developments currently in the pipeline.	2025	Ambition North Wales
2.23 (G)	Explore the development of an investment prospectus for renewable developments currently in the pipeline.	2025	Ambition North Wales
2.22 (2E)	Explore the potential of establishing an advice hub to support regional decarbonisation / low carbon energy initiatives.	2026	Ambition North Wales
2.23 (G)	Explore the development of an investment prospectus for renewable developments currently in the pipeline.	2025	Ambition North Wales

Decarbonise Transport

Action reference	Action	Timeline	Proposed lead(s)
3.1 (PR006055)	Develop a Sustainable Transport Plan.	20265	Denbighshire County Council
3.2 (NCZ P19)	Carry out education, training and publicity programmes in schools to build confidence in cycling and walking to/from school.	2050	Denbighshire County Council
3.3 (NCZ P19)	Ensure the new Active Travel Plan 2021 onwards, which maps current routes and plans for the future delivery of active travel routes in the county, aligns with the Council's ambitions to tackle climate and ecological change by 2030.	2030	Denbighshire County Council
3.4	Focus on implementing active travel routes for utility journeys of <3km in line with Active Travel (Wales) Act.	2050	Denbighshire County Council
3.5 (NEW-NCZ)	Continue to deliver school streets across the county i.e. a school street outside of a school that is closed to private vehicles for a time period before and after school times.	2030	Denbighshire County Council
3.6 (NEW-NCZ)	When reviewing the Learner Transport Policy, consider improving opportunities for learners to walk	2030	Denbighshire County Council

Action reference	Action	Timeline	Proposed lead(s)
	to school and reviewing routes to school to enable this by 2030.		
3.7	Use the Local Development Plan (LDP) to direct development to sustainable locations to encourage use of active travel and public transport.	2030	Denbighshire County Council
3.8 (NEW-NCZ)	Ensure that Officers from School Transport and active travel are engaged in the Strategic Planning and Development Management process by consulting them on new policies, land allocations and development proposals.	2027	Denbighshire County Council
3.9 (NCZ A14)	Install electric vehicle charging infrastructure into Council buildings, including offices, depots, libraries, and tourist attractions by 2027.	2027	Denbighshire County Council
3.10 (NEW-NCZ)	Explore options regarding electric vehicle charging for Council Housing.	2030	Denbighshire County Council
3.11 (NCZ P5)	Continue to implement the electric vehicle first vehicle replacement policy by 2030.	2030	Denbighshire County Council
3.12 (NEW-NCZ)	Continue to expand the public electric vehicle charging network as opportunities arise and guidance is provided by Welsh Government.	2030	Denbighshire County Council

Action reference	Action	Timeline	Proposed lead(s)
3.13 (NEW-NCZ)	Research funding opportunities and viable business models for electric vehicle charging, including joint procurement with other Councils.	2027	Denbighshire County Council
3.14 (NEW-NCZ; NCZ A17; NZC A18; C&ES)	Convert the majority of Denbighshire County Council-owned larger sized vehicles to Ultra Low Emission options. -Trial large vehicles which are powered by low and ultra-low carbon technologies (e.g. bin lorries) by 2030. -Look to trial/introduce low emission buses (electric vehicle, Hydrotreated vegetable oil (HVO), hydrogen or plug-in hybrid).	2030	Denbighshire County Council
3.15 (NCZ A13)	Convert all of Denbighshire County Council owned light commercials (up to 3.5 tonnes) vehicles to electric vehicles (EV).	2030	Denbighshire County Council
3.16 (NEW-NCZ)	Explore the opportunity of in-house provision of low carbon school transport vehicles (to approach fleet first as opposed to tender).	2030	Denbighshire County Council
3.17 (C&ES)	To consider long-term issues such as EV charging across sites as part of the Sustainable Communities for Learning and the requirement for new-build / refurbishment of schools to be Net Carbon Zero by 2030.	2030	Denbighshire County Council

Action reference	Action	Timeline	Proposed lead(s)
3.18	Expand Fflecsi services.	2050	Denbighshire County Council
3.19	Continue to encourage volunteer and car share schemes.	2050	Denbighshire County Council
3.20 (NCZ A41)	Support Ambition North Wales in developing and publishing a new Regional Transport Plan and encouraging alignment with Denbighshire's climate and ecological change agenda.	2025	Denbighshire County Council ; Ambition North Wales
3.21 (4C)	Collaborate on opportunities to decarbonise public sector fleet, service vehicles, and commercial fleets and the co-ordination of associated infrastructure design and development across local authority boundaries.	2050	Denbighshire County Council; Ambition North Wales; Welsh Government Energy Service
3.22 (NCZ A14)	Complete strategic assessment for electric vehicle charge points at council buildings, including offices, depots, libraries and tourist attractions.	2026	Denbighshire County Council ;Clwydian Range and Dee Valley National Landscape

Action reference	Action	Timeline	Proposed lead(s)
3.23 (R4.1)	Establish a Regional Transport Officer's Group that provides a forum for collaboration and alignment between local and national government in addition to Transport for Wales.	2025	Ambition North Wales
3.24 (R4.2)	Explore opportunities around bus franchising across the region.	2026	Ambition North Wales
3.25 (R4.3)	Produce the first Regional Transport Plan (RTP) in line with that Welsh Government statutory guidance.	2025	Ambition North Wales
3.26 (4F)	Support greater awareness raising of UK Government funding for development of electric vehicle charging infrastructure such as the on-street residential charging scheme.	2028	Ambition North Wales
3.27 (4G)	Continue to support organisations such as local community car clubs to deliver community-oriented, low-carbon transport infrastructure and services.	2050	Ambition North Wales; Welsh Government Energy Service
3.28 (4D)	Work together to deliver the most appropriate electric vehicle public charging infrastructure across the region, aligning with national work being undertaken through Transport for Wales.	2050	Ambition North Wales; Transport for Wales; SPEN

Action reference	Action	Timeline	Proposed lead(s)
3.29 (T.2.4)	Develop a national procurement framework for EV charging infrastructure.	2024	Welsh Government
3.30	Release pilot EV charge point locator and costing tool for EV charge points that to help Local Authorities select locations that can be supported by the network.	2025	SPEN

Reinforce and transition the energy networks

Action reference	Action	Timeline	Proposed lead(s)
4.1 (N.2.2;N3.3)	Provide data about energy demand and growth to Distribution Network Operator (DNO) and Gas Distribution network (GDN) to inform Distribution Future Energy Scenarios (DFES)[MN70] and future grid investment. One way of doing this will be to respond to consultations in support of required investment for upcoming business plans for RIIO-ED3 and RIIO-GD3.	2026	Denbighshire County Council
4.2	Map out and engage key stakeholders to identify where network enforcement is needed.	2030	Denbighshire County Council
4.3	Encourage investment in low-carbon technologies through incentives and public finance mechanisms.	2028	Welsh Government
4.4 (N.3.4)	Publish LAEP outputs onto Datamap Wales.	2026	Welsh Government
4.5 (N.1.2)	Organise regular engagement meetings between Denbighshire County Council, SPEN and WWU.	2050	SPEN; WWU

Action reference	Action	Timeline	Proposed lead(s)
4.6 (N.2.5)	Co-ordinate Net Zero clinics for Local Authorities to discuss decarbonisation of heat, transport and renewables strategies, and willingly contribute to workshops organised by the Local Authorities for local small-medium enterprises (SMEs).	2025	SPEN; WWU
4.7 (N.2.6)	Discuss and agree any strategic optimisation opportunities with each local authority to continue progressing decarbonisation and economic growth plans.	2050	SPEN; WWU
4.8 (N.1.3)	Plan a method to consolidate the pipelines for all energy-related projects across the electricity and gas/hydrogen networks. This will consolidate all actions planned by electricity and gas/hydrogen networks within an area into one common database. As a starting point, set up ongoing engagement meetings with DataMapWales, NGED SPEN, and WWU to coordinate if and how DataMapWales may be an appropriate platform to consolidate this information.	2050	SPEN; WWU
4.9 (N.2.1)	Inform local authorities about available data resources by providing access to the Distribution Future Energy Scenarios (DFES)MN70 report and the resulting Network Development Plan (NDP) via SPEN's Open Data PortalMN69 as well as other datasets such as heat maps, network infrastructure	2050	SPEN

Action reference	Action	Timeline	Proposed lead(s)
	& usage. Requests for additional, bespoke reports can also be made via the portal.		
4.10 (N.2.4)	Provide low carbon technology (LCT) optioneering services to Local Authorities to support them with site optioneering (cost and timescale) for EV charging, heat pump rollout and renewable generation infrastructure planning.	2029	SPEN
4.11 (N.2.3)	Use all relevant outputs from the LAEPs to inform SPEN's Distribution Future Energy Scenario (DFES) ReportMN70 and at the transmission network level.	2025	SPEN
4.12	Publish findings from North Wales Conceptual Plan for hydrogen infrastructure.	2025	WWU
4.13 (N.3.1)	Highlight gas infrastructure opportunities. Support Local Authorities in exploring new opportunities to develop the existing gas networks in advance of 100% transition to existing hydrogen network.	2050	WWU
4.14 (N.3.2)	Include new projects from the LAEP in strategic planning process.	2050	WWU

Action reference	Action	Timeline	Proposed lead(s)
4.15 (N.3.5)	Make the network hydrogen ready. Deliver programme to convert remainder of gas network not covered by the REPEX programme to enable a 100% hydrogen conversion, WWU's sustainability strategy from 2023 identifies a desire to complete this between 2035-2040.	2040	WWU
4.16 (N.4.5)	Develop a more detailed understanding of potential hydrogen transport demand and incorporate this demand within existing network demands. This action will be supported by WWU's innovation project HyDrive.MN71	2024	WWU
4.17 (N.4.4)	Develop hydrogen and bio-methane projects.	2050	WWU
4.18 (N.4.4)	Publish a Welsh Government carbon intensity standard for hydrogen production based on that of UK Government. This standard can be used as a basis for future permitting by Natural Resources Wales.	2026	Welsh Government; Natural Resources Wales
4.19 (E)	Support the emerging hydrogen economy, taking account of proposed hydrogen projects across the region. This should:	2030	Welsh Government; Ambition North Wales

Action reference	Action	Timeline	Proposed lead(s)
	- Provide a clear vision on the role of hydrogen in the future regional energy system. - Consider opportunities for industrial decarbonisation, transport uses and domestic energy. - Support the development of the hydrogen hubs by Menter Môn in Holyhead and Ambition North Wales. - Explore the role of Carbon Capture, Utilisation and Storage (CCUS), especially in the context of cross border projects such as Hynet.		

Promote smart local energy systems

Action reference	Action	Timeline	Proposed lead(s)
5.1 (NEW)	Trial potential Council-owned projects as demonstrators e.g. Council depots.	2027	Denbighshire County Council
5.2	Stay up-to-date on funding opportunities and develop a pipeline of smart local energy system projects "ready to go”.	2027	Denbighshire County Council
5.3	Engage with local communities to assess appetite for smart local energy systems.	2027	Welsh Government
5.4 (I.1.3; F)	Continue to explore and support opportunities for smart local energy systems in the region. Using outputs from the LAEP, map smart local energy system opportunities and identify feasibility/demonstrator projects collaboratively with organisations across the region and engage with key stakeholders including community energy groups and general public. Explore/identify relevant revenue and capital funding resources to support.	2026	Ambition North Wales; Ynni Cymru; Welsh Government

Action reference	Action	Timeline	Proposed lead(s)
5.5	Raise awareness of SPEN's Flexibility Service procurement to support a smarter system.	2027	SPEN

Routemap

Action reference	Action	Timeline	Proposed lead(s)
0.1 (E.3.1; C)	Deliver actions set out in Employment and Skills Plan (2023-2025)[MN33], working alongside organisations in the low carbon sector e.g. developers, suppliers, installers, retailers etc. - Review the current skills capabilities and capacity to deliver decarbonisation as proposed in Net Zero Wales plan. - Develop a strategy to raise awareness of regional capabilities (including offshore and onshore wind, marine energy, nuclear and solar PV). - Ensuring the local supply chains are visible to developers operating within the region.	2025	North Wales Regional Skills Partnership; Welsh Government

Action reference	Action	Timeline	Proposed lead(s)
	- Provide appropriate training and education to enable people to access green jobs should be embedded across the learning cycle and opportunities for adapting existing jobs should be integrated into career pathways.		
0.2 (E.3.2)	Review existing and develop educational programmes and technical qualifications to meet need identified for retrofit and low carbon builds, renewables, transport and business / industry (to include upskilling and apprentice training).	2025	North Wales Regional Skills Partnership; Welsh Government
0.3 (A)	Ensure effective alignment between local, regional and national energy strategies, plans and initiatives. -The transition should be led by consistent policies at a national level which filter down to regional and local levels. The development of local development plans and strategic development plans should all consider the relevant aspects of the Energy Strategy.	2030	Ambition North Wales
0.4 (D)	Provide regional support in the delivery of commitments made in the Climate Action Wales public engagement strategyML38 to help citizens take action to reduce demand, improve energy efficiency and use energy in a way which supports our vision.	2025	Ambition North Wales

Action reference	Action	Timeline	Proposed lead(s)
0.5 (H)	Strengthen the link between research, development and innovation with regards to current and emerging technology and the North Wales Energy StrategyMN31 priorities.	2030	Bangor University / M-Sparc; Wrexham University; Ambition North Wales
0.6 (R1.1)	Ensure alignment between the scope and function of the new Regional Energy Strategic Planners (RESPs)ML39 with Ofgem's policy design. Consultation of the policy design will be published in the summer of 2024 with the RESPs in operation by late 2025/early 2026.	2026	Ofgem; National Grid ESO
0.7 (R1.2)	Ambition North Wales to support the Race to Zero campaign and provide oversight on carbon emissions across the region.	2030	Ambition North Wales
0.8 (R1.3)	Develop the first regional Strategic Development Plan (SDP). Include policies in the plan that support low carbon building practices and low carbon new builds.	2028	Ambition North Wales
0.9 (R1.5)	Work with Welsh Government to create a governance structure and performance management framework for the LAEPs to facilitate monitoring of progress and performance of the LAEPs across the Region.	2025	Ambition North Wales; Welsh Government Energy Service

Action reference	Action	Timeline	Proposed lead(s)
0.10 (E.3.3)	Develop a communication strategy to educate, promote skills, training and the need for a supply chain.	2024	Welsh Government
0.11 (E.2.2)	Using the outputs from the LAEPs and four Regional Energy Strategies, create a national plan which covers the gaps such as national and regional assets.	2024	Welsh Government

National and UK-related targets and policy

Action	Timeline	UK wide/ Wales only
-37% GHG emissions by 2025 (rel. to 1990) (76)	2025	Wales only
-63% GHG emissions by 2030 (rel. 1990) (76)	2030	Wales only
Net zero public sector by 2030 (23)	2030	Wales only
Up to 1GW of electrolytic hydrogen secured (77) (2025)	2025	UK-wide

Action	Timeline	UK wide/ Wales only
Decision on hydrogen in buildings (78) (2026)	2026	UK-wide
Up to 10GW hydrogen capacity in the UK (50% electrolytic) (77)	2030	UK-wide
Up to 50GW of offshore wind capacity in the UK, including up to 5GW of innovative floating wind (2030) (77)	2030	UK-wide
1.5GW of renewable capacity to be locally owned (exc. Heat pumps) (50)(2035)	2035	Wales only
580,000 heat pumps to be installed in Wales by 2035, contingent on scaled up support from the UK Government and reductions in the cost of technology (50)(2035)	2035	Wales only
All new social homes built to Welsh Development Quality Requirements (WDQR) 2021 without fossil fuel heating (79) (from 2025)	2025	Wales only
All existing social homes to have a plan for minimising environmental impact and improving energy performance (80)(2027)	2030	Wales only

Action	Timeline	UK wide/ Wales only
Minimum EPC E to rent out any property (from 2023 onwards) and EPC C from 2030 (81) (UK)	2050	Wales only
1 public EV chargepoint for every 7 to 11 electric vehicles (2) (2025)	2025	Wales only
Rapid EV charging available every 20 miles on the strategic trunk road (2) (2025)	2025	Wales only
-10% car miles travelled/person (5) (2030)	2030	Wales only
80% new cars and 70% new vans sold to be zero emissions (2030) (Zero Emissions Vehicles mandate) (82)	2030	UK-wide
100% new cars and vans sold to be zero emissions (2035) (Zero Emissions Vehicles mandate) (82)	2035	UK-wide

5. Chapter 5: Next Steps

Figure 43 View of Little Orme, Llandudno [credit: Denise Barnes, Getty Images]

5.1. Enabling conditions for success

Governance

Progressing energy propositions

Denbighshire's LAEP provides a good understanding of the current state of our local energy system, and what it could take to decarbonise it. We have set out a plan of action alongside our stakeholder for the next five-six years and will aim to deliver this collectively subject to sufficient political, and financial support. We recognise that this will involve building on the opportunities identified in this LAEP to scope viable projects and programmes that take us closer to our Net Zero energy system vision. For each prioritised proposition, we will encourage the relevant organisations and/or groups to undertake a series of development activities to progress towards delivery (such as feasibility studies, detailed technical and commercial development, business case, commercialisation and procurement).

Governance

We want to make sure that there is a well-defined governance structure for managing the delivery of the LAEP. As an area-wide plan it is the responsibility of all who live and operate in the area to support its delivery, and the chosen governance framework will need to reflect this. We, as a Council, will seek to bring the delivery of our LAEP into alignment with our plans for delivering our decarbonisation plan, where activities are mutually beneficial for addressing the climate and ecological emergency and meeting our climate change targets.

We intend to align governance arrangements for the LAEP with those for our Climate Change and Nature Strategy. The proposal is for The Greener Denbighshire Board to be responsible for approving the LAEP and overseeing its delivery in line with the Council's corporate priorities. Political steer has been provided by the Lead Member for Environment and Transport to date and this is likely to continue in line with the governance set out to deliver Denbighshire's Climate Change and Nature Strategy. The Board may be responsible for monitoring progress of individual projects in the climate change and nature work programme. As the LAEP has some relevance to the planning activities of the Council, the Strategic Planning Group will also have oversight of delivery of the LAEP through the receipt of information reports.

Roles and responsibilities

As a Council, our priority is to decarbonise assets within our direct control, such as Council buildings and the Council vehicle fleet. We recognise the importance of tackling the climate and nature emergency across the county and our role as convener, co-ordinator to influence the transition more broadly across the county:

As a Planning Authority:

- Preparing planning policies and allocating land in our Local Development Plan
- Development management – taking decisions on planning applications submitted to the local planning authority for development; as well as preparing Local Impact Assessments for schemes which are determined by Planning and Environment Decisions Wales (PEDW).

As a place-maker:

- Taking action at a Council-wide level to achieve a low carbon economy.
- Taking forward wider community action and communicating the need to increase the uptake of renewable energy.

Our Climate Change and Nature Strategy (2021/22-2029/30) (29)provides a summary of the county-wide actions we'll take over the next few years to address the climate and nature emergencies.

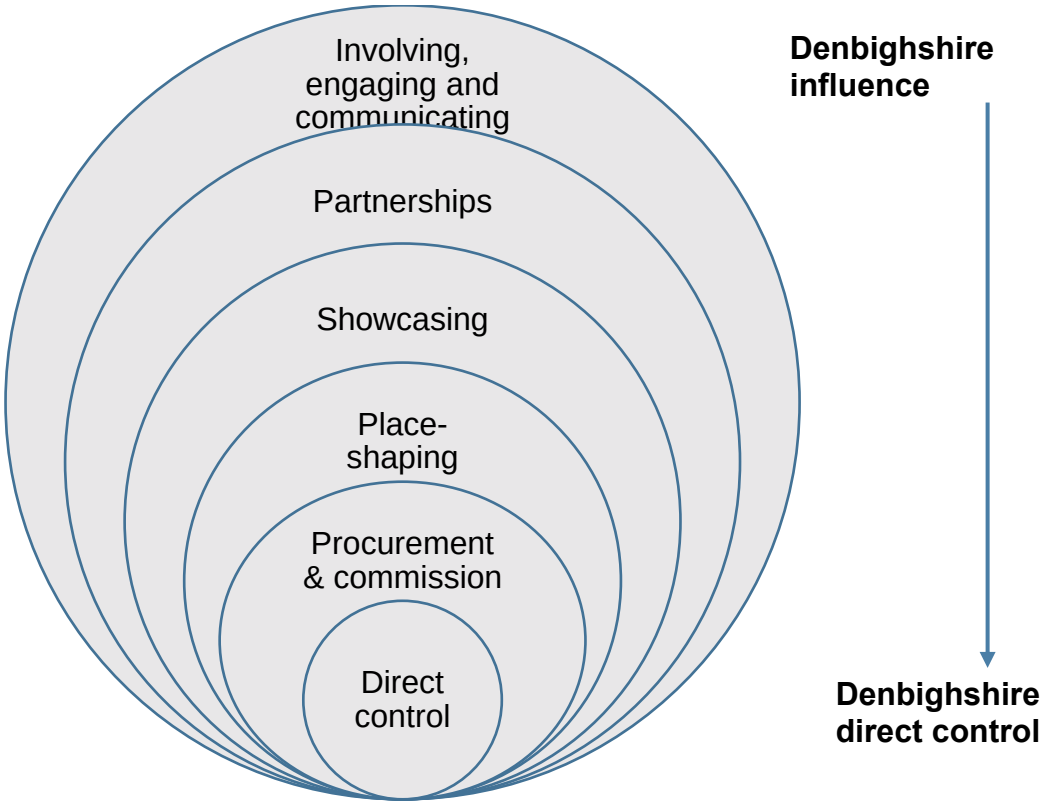


Figure 44 Local Authority roles and level of influence

For this delivery of the LAEP and our own decarbonisation plan to be successful, we will require a collective, co-ordinated effort from many different stakeholders, which means closer collaboration between the Council and our partners and building relationships with key stakeholders that hold influence over different parts of the energy system. We will leverage existing local forums to do this, such as the Public Sector Board (PSB), Public Sector Decarbonisation Group and others.

Regional perspective

Developing this LAEP in close collaboration with other local authorities in Wales recognises that a consistent, co-ordinated plan for creating a net zero energy system in North Wales can bring wider economic and social benefits and capitalise on the unique potential in each local area. This regional approach to energy planning recognises the environmental, economic and social dependencies between different local areas and local energy systems. Ambition North Wales, a regional representative in national discussions on energy, as well as responsible for co-ordinating North Wales' Energy Action Plan and managing the North Wales Growth Deal, recognises its critical role in endorsing this way of working, and how it might support this approach where it is most effective. It has committed to actions that are within its influence to lead and/or co-ordinate in the action routemap.

National perspective

Welsh Government has committed to achieving net zero emissions in Wales by 2050 and recognises that a significant part of this will depend on a low carbon energy system. As such, it committed to providing the resource and funding for each Local Authority to develop a Local Area Energy Plan (LAEP). Having Local Area Energy Plans (LAEP) for every Local Authority in Wales provides an opportunity for Welsh Government to aggregate the findings into a national energy plan that is coherent with local energy priorities and needs and identifies large-scale opportunities to accelerate the transition at pace and scale.

Welsh Government is well-placed to:

- Develop a national energy plan using the outputs of the LAEPs and Future Grid for Wales project [E2.2].
- Utilise the findings from LAEP to influence national energy infrastructure planning so that it supports local energy ambitions.
- Understand what policy and/or institutional support might be needed to empower Local Authorities and regional public bodies to drive energy innovation at a local level.
- Work with local and regional bodies to establish an effective local-national governance framework to enable co-ordinated decision-making and monitoring.
- Scale-up local energy plans to identify gaps to enable us to plan for a system that is flexible and smart – matching local renewable energy generation with energy demand.

Monitoring and review

This plan sets out key actions that will be taken by various stakeholders across Denbighshire for the first five-six years to set the local area on a journey to achieve a net zero energy system. The plan needs to be flexible to adapt to changes in the future.We will work with regional and national partners to develop a monitoring framework which builds on existing data and processes and helps us understand the progress Denbighshire is making towards its committed actions and ambitions set out in this plan.

We will make use of publicly available datasets such as the Energy Performance Certificate Register (65) the Micro Generation Certification Scheme (84), the Renewable Energy Planning Database and publications such as Renewable Generation in Wales report (56). We will also track GHG emissions reduction, building on our existing submissions to Welsh Government for Public Sector Reporting as a starting point. We recognise that available data will lag a few years behind.

Our action routemap has been developed as a dynamic plan that recognises the influence that wider contextual changes at national and local level will have on the way we choose to transition to a net zero energy system, such as national regulation, policy and strategic plans. As a result, we expect to regularly review and update our routemap based on these dependencies.

The whole plan will be updated at least every five years to take account of key factors, including policy changes at a UK and Welsh Government level, changes in costs and the effectiveness of technologies.

Finance

We will develop a plan for funding arrangements to support the delivery of local authority programme of works to enable the delivery of the LAEP. This may be from usual capital markets or through more innovative financing mechanisms such as community municipal investments, Pay as you Save or net-metering. Innovative finance options to be explored for individual energy consumers such as green mortgages.

6. Glossary

Term	Definition or Meaning
Action	The process of doing something – a specific action assigned to a responsible person preferably with a date to be completed.
Active travel	A term used to describe walking and cycling for purposeful journeys to a destination, or in combination with public transport.
Anaerobic digestion	Processes biomass (plant material) into biogas (methane) that can be used for heating and generating electricity.
Baseline	The baseline is the data showing the current energy system, containing the 2019 data sets provided by the LA and publicly available data.
Batteries	Devices that store electrical energy to be used at a later time.
Biomass boiler	A boiler which burns wood-based fuel (e.g. logs, pellets, chippings) to generate heat and electricity.
Capita	Also referred to as “per person”, it is a term used to describe an average of a measure per head or per person.
Carbon Capture and Storage (CCS)	The process of capturing and then storing carbon emissions before they enter the atmosphere.

Term	Definition or Meaning
Certainties	A fact that is definitely true or an event that is definitely going to take place. In terms of a local energy system, certainties include funded projects, etc.
Decarbonisation	Actions needed to cut greenhouse gas emissions and transition to a low carbon economy. The Welsh Government is committed to achieving net zero GHG emissions by 2050.
Demand	Local energy demand that the local energy system needs to meet.
Demand headroom	The difference between the electrical capacity of a substation, and the electricity demand at the substation at the time of peak demand.
Deployment modelling	A model investigating rates by which to deploy specific technologies between the baseline year and 2050 to achieve the end state developed by the optimisation model for each scenario. The model considers broader plan objectives and local, regional, and national strategic priorities, policies, and targets to help us to define a suitable level of ambition and inform an action plan.
Dispatchable energy generation	Energy generation that can turn on and off (i.e. isn't controlled by the weather) – this is likely to be gas turbines of some sort.
Distribution network	Takes energy from transmission network and delivers it to users via pipes or wires at low pressure / voltages.

Term	Definition or Meaning
Electricity network	Interconnected infrastructure which consists of power stations, electrical substations, distribution lines and transmission lines. The network delivers electricity from the producers to consumers.
Electrolyser	A piece of equipment that uses electricity to split water into hydrogen and oxygen.
Energy proposition	A proposition is an energy component with a scale and a timescale. For instance, wind turbines with [#]MW capacity to be built in 5 years, 10,000 buildings to retrofit with XX by 2030, or a pilot project such as hydrogen storage innovation. These are typically near term, low regrets energy components that are needed in future energy systems (it is likely that these appear in all scenarios).
Focus zone	A modelling zone which has been identified as an area in which to target near-term installation, upgrade, retrofit, or other activities related to a specific energy system component.
Generation	Local generation – size below 100MW.
Grid electricity	Electricity that is supplied by the electricity network.
Heat network	A distribution system of insulated pipes that takes heat from a central source and delivers it to a number of domestic or non-domestic buildings.

Term	Definition or Meaning
Heat pump	A piece of equipment that uses a heat exchange system to take heat from air, ground or water and increases the temperature to heat buildings.
Hydrogen	A flammable gas that can be burned, like natural gas, to generate heat or power vehicles. The by-product is water only, no carbon.
Hydrogen Combined Cycle Gas Turbine (CCGT)	Combined cycle gas turbines are found in combined cycle power plants where a gas-driven turbine and steam-driven turbine are used in sequence to improve the efficiency of the process. Hydrogen (or another combustible fuel such as natural gas) is burnt which turns the first turbine and any waste heat produced from this is recovered and used to turn a second turbine.
Infrastructure	Local energy distribution infrastructure, includes storage assets if these are at grid level.
Landfill gas	Gases such as methane that are produced by micro-organisms in a landfill site that can be used as a source of energy.
Lever	We use the term policy levers to refer to the 'governing instruments' which the state has at its disposal to direct, manage and shape change in public services.
Local energy system	The distribution level energy system, excludes the transmission and national assets.
Longer-term options	The likely outcome of these is less certain and dependent upon actions and decisions being made that are not under

Term	Definition or Meaning
	our control, e.g. a national policy or the capability / availability of a technology.
Low-regret	Options which are common to all scenarios, cost-effective, provide relatively large benefits, and are very likely to be important parts of the future energy system, regardless of future uncertainty.
Major industrial load	The power demand of industrial sites in the 2019 NAEI Point Sources data are large enough to be classified as major industrial loads. Sites that aren't included in this database are likely too small to have a significant impact on the energy system singlehandedly.
Methane reformation	Process of producing hydrogen by heating methane from natural gas and steam, usually with a catalyst. Produces carbon dioxide as a by product.
Modelling zone	A specified area in our modelling which is the smallest level of granularity for analysis. The zones are used through energy modelling, deployment modelling, and mapping. Zones were created by intersecting the local authority boundary with the primary substation service area boundary, as described in the "Methodology - electricity and gas network infrastructure" section of the Technical Report. *May also be called "zone" or "substation zone" in the reports.*
National asset	National infrastructure (can be supply or demand and the accompanying transmission / distribution infrastructure) – defined as over 100MW, unless it produces heat which

Term	Definition or Meaning
	can only be used locally this is generally excluded from LAEP particularly the modelling.
National grid	A generic term used in the reports referring to the electricity network serving Wales, including both the transmission and distribution networks and facilitating the flow of electricity between neighbouring areas or regions. *May also be called generically "grid" in the reports.*
National Net Zero	Name of a future energy scenario modelled as part of developing the LAEP. Details of assumptions are in Chapter 3: the future energy system.
Net Zero	Net zero when used in this LAEP refers to achieving net zero emissions produced by the local energy system. The boundary and scope of emissions associated with the local energy system are defined in Chapter 1: Introduction.
Optimisation modelling	Modelling to create the most cost and carbon optimal energy system.
Outward code	The first part of a postcode i.e. BS1.
Pathway	A pathway is how we get from the current energy system, to the most likely net zero end point. The pathway will consider what is needed from across the scenarios, the supply chain, number of installers etc. The propositions will make up the more certain part of the pathway, whereas the longer-term energy components will need further definition in the future.

Term	Definition or Meaning
Power purchase agreement (PPA)	A contract between two parties where one produces and sells electricity and the other purchases electricity.
Primary substation	The physical equipment comprising a substation with a 33kV-11kV transformer(s) connecting the primary-level, high voltage electricity lines to the consumer-level, low voltage electricity lines.
Primary substation service area	The area bounding the buildings or other electricity demands which are served by a primary substation (or, in ANW, a group of primary substations acting together to serve one area).
Programme	A series of projects, usually with a theme, that is run collectively.
Project	Strategic scale projects being implemented or planned for implementation in the local energy system that will significantly affect local demand or local supply.
Resistance heating/ heater	Generate heat by passing electrical currents through wires.
Scenario	A scenario is a set of assumptions for a particular end point (usually 2050) which are modelled in our optimisation model. We modelled 5 different scenarios to see what was common across the scenarios and therefore is a “no regrets” measure, and what changed between the modelled scenarios.
Sensitivities	Sensitivities of a specific scenario can be tested – for instance to test the impact of increasing

Term	Definition or Meaning
	electricity/hydrogen prices on the scenario. Testing a sensitivity is when you change one thing multiple times to assess the impact on the cost/carbon.
Sewage gas	A mixture of gases generated in sewer systems, used in a reciprocating gas engine to produce heat and electricity.
Solar Photovoltaic (PV)	Convert solar radiation into electricity using photovoltaic (PV) cells.
Strategic energy objective	Strategic objectives are purpose statements that help create an overall vision and set goals and measurable steps to achieve the desired outcome. A strategic objective is most effective when it is quantifiable either by statistical results or observable data. Strategic objectives further the vision, align goals and drive decisions that impact change.
Substation upgrades	Interventions at an existing primary substation designed to increase the capacity of the substation, such as upgrading an existing primary substation or installing a new primary substation. *May also be called 'substation interventions' in the reports.*
Supply	Energy supply options – this is how energy is delivered from the point of source. E.g. a supply option could be solar PV.
Supply/generation headroom	The difference between the electrical capacity of a substation, and the power being supplied to the substation at a given time.

Term	Definition or Meaning
Sustainable travel	A term used to generally describe transport modes that reduce GHG emissions, and feature at the top of the “sustainable transport hierarchy” (Planning Policy Wales 12) such as cycling, walking and the use of public transport.
Transmission network	Move energy via pipes or wires for long distances around the country at high pressure/ voltages.
Ultra-low emissions vehicles	Vehicles that emit very few greenhouse gases – technically 75gCO_2 per km or less. The vehicles could be electric, hydrogen or hybrid.
Uncertainties	Uncertainty results from lack of information or from disagreement about what is known or even knowable.
We	The collective of people and organisations in Denbighshire who have helped create and shape the LAEP, and those who will support its delivery.
Wind power	Harnessing the kinetic energy of wind to turn a turbine to generate electricity.

Unit	Definition or Meaning
GWh	Gigawatt hour(s) – a unit of energy representing 1 billion watt-hours.
$kgCO_2e$	Kilogram(s) of carbon dioxide equivalents – a unit of measurement for greenhouse gas warming potential, expressing the equivalent weight of carbon dioxide with the same global warming potential.
$ktCO_2e$	Kilotonne(s) of carbon dioxide equivalents - a unit of measurement for greenhouse gas warming potential, expressing the equivalent weight of carbon dioxide with the same global warming potential. Represents 1 million kgCO2e.
kV	Kilovolt(s) – a unit of potential energy of a unit charge in a point of a circuit relative to a reference (ground) representing 1000 volts.
kW	Kilowatt(s) – a metric unit of power measuring rate of energy consumption or production representing 1000 watts.
kWh	Kilowatt hour(s) - a unit of energy representing 1000 watt-hours.
kWp	Peak kilowatt(s) – the maximum power rating possible produced by an energy generation source (i.e., amount of power produced in ideal generation conditions).

Unit	Definition or Meaning
MW	Megawatt(s) – a metric unit of power measuring rate of energy consumption or production representing 1 million watts.
MWh	Megawatt hour(s) - a unit of energy representing 1 million watt-hours.
tCO_2e per capita	Tonne(s) of carbon dioxide equivalents per capita – a unit of mass of carbon dioxide emitted per member of a population per year. Represents 1000 $kgCO_2$ per capita.

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