

Powys County Council
*Renewable & Low Carbon
Energy Assessment
(2022-2037)*



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Glossary

Acronym	Meaning
AD	Anaerobic Digestion
ASHP	Air Source Heat Pump
BEIS	Department of Business, Energy & Industrial Strategy
BIR	Building Integrated Renewables
CHP	Combined Heat & Power
COP	Coefficient of Performance
DHN	District Heat Network
DESNZ	Department for Business, Energy Security & Net Zero
FiT	Feed-in Tariff
GSHP	Ground Source Heat Pump
GW	Gigawatt
GWh	Gigawatt hours
MW	Megawatt
MWh	Megawatt hours
Ofgem	Office of Gas and Electricity Markets
PCC	Powys County Council
REGO	Renewable Guarantees of Origin
REPD	Renewable Energy Planning Database
RLCEA	Renewable & Low Carbon Energy Assessment
RLDP	Replacement Local Development Plan
RO	Renewable Obligation
SCOP	Seasonal Coefficient of Performance

1 Introduction

Chapter in Brief

This chapter provides a summary review of UK Government, Welsh Government and key regional and local policy within Powys relevant to renewable and low carbon energy, including discussion of the specific relevance for this assessment.

1.1 Study Purpose & Context

This interim report is an initial assessment of renewable targets to inform the preferred strategy of the Replacement Local Development Plan (2022-2037) for Powys County Council. These targets are based on previous work such as the existing Renewable & Low Carbon Energy Assessment (RLCEA) in 2017 and the ongoing Local Area Energy Plan (LAEP) being conducted by Energy Systems Catapult (ESC). Further work is to be carried out on modelling renewable resourcing potential post preferred strategy. This report therefore contains several sections which are to be completed post preferred strategy.

Powys County Council (PCC) have commissioned City Science to undertake a RLCEA for their Local Planning Authority (LPA) area (not including the area within the Bannau Brycheiniog (Brecon Beacons) National Park). The purpose of the study is to formulate robust renewable and low carbon energy evidence to inform the preparation of their Replacement Local Development Plan (RLDP) 2022-2037, which is in the early stages of preparation.

PCC are undertaking a RLCEA which reflects the Practice Guidance – Planning for Renewable & Low Carbon Energy: A toolkit for Planners (Welsh Government, 2015) and other relevant subsequent national policy and guidance. This commission comprises the following tasks:

- A policy review (see Section 1.2)
- An assessment of existing and potential future energy demand (see Section 2)
- An assessment of existing and proposed renewable energy generation (see Section 3)
- A county wide renewable energy assessment to quantify potential renewable resource (see Section 4)
- A building integrated renewables (BIR) assessment (see Section 5)
- An assessment of Heat network viability (Section 6)
- LDP target setting (Section 7)

This evidence base aims to estimate the scale of resource within the study area that is available for use, to provide focus for setting local policy and targets; therefore, assisting PCC in tackling key issues including climate change, fuel poverty and decarbonisation. It will also provide direction to the authority on how it can play its part in meeting the National and UK renewable energy targets.

This study provides details of existing and future demand, to provide context for resource-based targets.

1.2 Policy Context

A policy review of relevant UK, Welsh and local policies impacting renewable development is due to be provided after preferred strategy.

1.3 Method & Scope

1.3.1 Scope of Assessment

The geographic scope of this assessment is that of the administrative boundaries of Powys County Council (PCC), excluding the area administered by the Brecon Beacons National Park Authority which is a separate planning authority. Note: some data used in this report is provided only at County-wide level.

The emerging Powys Replacement Local Development Plan (RLDP) covers the period 2022-2037. This assessment therefore identifies renewable and low carbon targets for deployment by 2037 within the Powys LPA area.

The renewable energy technologies considered in this Interim Report, which is part of a larger study, include:

- Onshore Wind: generating electricity.
- Ground-Mount Solar PV: generating electricity.
- Anaerobic Digestion (AD): combustion of biogas generating heat and electricity simultaneously. Waste feedstocks considered: food waste, agricultural animal manure, agricultural poultry litter, sewage sludge and energy crops.
- Building Integrated Renewables (BIR): generation of heat or electricity utilising small scale, building integrated renewables such as rooftop solar PV, air source heat pumps, and ground source heat pumps.

Other low carbon opportunities considered include:

- Waste heat: e.g. from industrial processes or power stations.
- District Heating Networks (DHN): serving residential and/or non-residential heating loads.

Renewable and local carbon opportunities not explored in this study:

- Solar thermal hot water panels
- Biomass energy resource
- Energy from waste (waste incineration)
- Hydropower
- Liquid biofuels
- Geothermal energy
- Offshore wind.

1.3.2 Overarching Method

This study largely follows the method set out in the Welsh Government's guidance "Planning for Renewable and Low Carbon Energy - A Toolkit for Planners, 2015" (Welsh Government, 2015), referred to henceforth as the "Welsh Toolkit" or "Planning Toolkit". In some instances, the methodologies set out in the Toolkit reference superseded policies or financial incentive schemes which are no longer active. It uses an assessment of Pembrokeshire as an example for the Toolkit, with future forecasts and targets for 2020, which does not align with the target year in this study of 2037. It has therefore been deemed appropriate to deviate the Toolkit's suggested methodologies where they have been considered out of date, and where this has been done, it has been clearly stated in this report.

The overarching aim of this study is to identify potential renewable and low carbon energy resources and set targets for their deployment for the end of the RLDP period (2037). The results of this assessment are aimed at informing planning policy development for the RLDP. It is not meant as a tool for assessing planning applications.

The Welsh Toolkit outlines potential policy objectives for local planning authorities to consider with respect to renewable and low carbon energy, along with evidence bases which should inform each of the policies. For Powys, the overarching policy objective of the RLCEA is to develop renewable energy targets, inform site allocations for developments, and outline further actions for the local authority, public sector, and wider stakeholders to assist in the delivery of strategic opportunities for renewable or low carbon energy generation.

The report contains the following sections; those that are to be completed following the preferred strategy are highlighted as such.

- Introduction & Policy Context (to be completed post preferred strategy).
- Existing & Future Energy Demand Baseline.
- Existing & Proposed Low Carbon Technologies.
- Renewable Energy Resource Potential (to be completed post preferred strategy).
- Building Integrated Renewables (to be completed post preferred strategy).

- Heat Network Opportunities (to be completed post preferred strategy).
- LDP Target Setting (will be revisited post preferred strategy).

1.3.3 Notation Used

It is important to distinguish between energy generators that produce heat or electricity, or both (such as in CHP). Electrical capacity and electrical energy generation will be denoted with a subscript “e”, e.g. MW_e or MWh_e , and heat capacity and generation will be denoted with subscript “th”, e.g. MW_{th} and MWh_{th} .

2 Existing & Future Energy Demand Baseline

Chapter in Brief

This chapter provides a summary of the current energy use in Powys and makes a projection of energy demand to the end of RLDP period (2037). The energy demands shown here will be compared to the renewable energy potential in latter stages of this study.

PCC may wish to develop RLDP energy targets for a certain proportion of the county's energy demand being satisfied by renewable or low carbon energy. It is therefore useful to understand the current energy demands of the county and make a projection of what energy demands may be at the end of the RLDP period (in 2037). The Welsh Toolkit refers to an old UK Government projection of energy demand to develop this projection: the UK Renewable Energy Strategy, 2008 (HM Government, 2008). The methodology set out used in this study has instead used the latest DESNZ's Energy and Emissions projection 2019 to 2040 (DESNZ, 2023).

DESNZ publish the subnational final energy consumption dataset each year data for local authorities across Great Britain, accounting for various sectors and fuel types (DESNZ, 2023). The latest year of data available was 2021, which was significantly impacted by the Covid-19 pandemic. Most notably the road transport energy consumption which was significantly lower between 2020-2021. This was not considered representative of current energy demands, therefore the data for 2019 has been used.

The forecast of energy consumption in 2037 was determined by taking the percentage change in energy demand between 2019 and 2037 in DESNZ's energy and emissions projections publication, under their "Reference case" scenario in Annex F (DESNZ, 2023). This Reference case represents the expected final energy demand based on current policies that have been implemented or are planned to be implemented. It is not representative of a net zero scenario. The Reference case projection is for the UK energy system. This analysis therefore assumes that the national projection of energy demand can be considered representative of the expected changes in the Powys energy system.

The final energy demand categories in the DESNZ subnational dataset do not map exactly to that in the DESNZ energy projections. A mapping between these two datasets was therefore developed as part of this commission, which has been provided in Appendix A – Energy Projections Mapping.

As per the Welsh Toolkit, the energy demands have been simplified into Electricity, Heating fuels and Transport fuels. Aviation and shipping fuels are not included in the analysis as it is difficult to attribute such demands to a local authority.

The result of this analysis is shown in Table 2-1 below. The energy demand for electricity, heating fuels and transport (road and rail) fuels in 2019 has been estimated to be approximately 3,500 GWh. The percentage change in final demand in the DESNZ projections from 2019 to 2037 showed a 19% increase in electricity consumption, a 3% reduction in heating fuels, and a 25% decrease for transport fuels (most likely due to the electrification of vehicles).

Applying the trajectories in the DESNZ UK projections to the Powys energy demands results in an overall decrease from 2019 of 285 GWh.

Category	2019 demand (GWh)	DESNZ Energy & Emissions Projection	
		2037 increase from 2019	2037 Estimation (GWh)
Electricity	573	19%	680
Heating fuels	1,577	-3%	1,527
Transport fuels (road & rail)	1,345	-25%	1,003
Total	3,495	-8%	3,210

Table 2-1: Existing and Future Energy Demand for Powys

3 Existing & Proposed Low Carbon Technologies

Chapter in Brief

This chapter outlines the currently installed and proposed capacity of renewable and low carbon energy generation in Powys.

3.1 Methodology

Understanding Powys' existing and proposed renewable and low carbon technologies is a useful exercise in setting a baseline from which targets can be developed (Welsh Government, 2015).

There is no single comprehensive source of renewable installations, so this exercise involves searching through multiple datasets and performing corroboration where possible. The below method searches through multiple public datasets, cross references against PCC planning data, and then performs a final check against a Welsh Government publication which itself performed a corroboration of various renewable datasets.

Step 1: Review public renewables datasets: REPD, FiT, Ofgem Renewables and CHP Register.

Step 2: Cross reference schemes against renewable schemes in PCC planning data.

Step 3: Compare the total capacity estimates against the Energy Generation in Wales 2021 report (Regen, 2021) and the emerging Powys LAEP.

Step 4: Review REPD and PCC planning data for proposed schemes which are not yet built.

Step 5: Estimate the energy generation from existing and proposed capacity using the recommended capacity factors in the Toolkit (Welsh Government, 2015).

Figure 3-1: Methodology for Assessing Existing and Proposed Low Carbon Technologies

3.1.1 Public Datasets Used

The following public data sources have been reviewed to produce an estimate of the existing renewable and low carbon technologies:

- Renewable Energy Planning Database (REPD) (DESNZ, 2024).
- Ofgem Feed-in Tariff (FIT) register (Ofgem, 2024).
- Ofgem Renewables and CHP register (Ofgem, 2024) including registered stations under the Renewable Obligation (RO) and Renewable Guarantees of Origin (REGO).

The REPD began in 2014 (though it captures schemes developed prior to this year), capturing renewable schemes of 1 MW and above installed capacity, until 2021 when it began logging any schemes from 150 kW and above. Projects below 1 MW that went through the planning system before 2021 may therefore not be represented in the REPD.

The FiT register, published by Ofgem, provides details of any renewable schemes that applied for the FiT incentive between April 2010 and April 2019. Any schemes developed outside of that period, or that did not claim for the FiT incentive within that period, would not be included in the register.

The RO scheme was designed to encourage generation of electricity from larger renewable sources in the UK. The RO scheme came into effect in 2002 in Great Britain and the scheme closed to all new generating capacity 1 April 2017.

The REGO scheme provides certificates that evidence that electricity sold has come from a renewable source. The scheme came into effect in 2003 and is running up to the present day.

3.1.2 Corroboration of Datasets

The developments identified were then compared against all developments listed in PCC’s planning application data. There is overlap between the datasets, so where possible, renewable developments were corroborated against each other where a unique identifier could be found (e.g. a planning reference or a unique site name). Once corroborated, the sum total of all renewable energy generation capacities was then compared to the totals provided in the 2021 Regen study and to the emerging Powys LAEP. Further information on the corroboration of datasets, and check against the Regen and LAEP reports is provided in Appendix B – Details on Renewable Dataset Corroboration.

Notes on the estimation of renewable energy capacity:

The datasets were corroborated across datasets using the planning application reference (where available) and any duplicates removed. The cross referencing was not always possible due to lack of unique identifier (such as a planning application reference) and where cross referencing was possible, the capacities across the two datasets occasionally conflicted. Professional judgment was therefore used in circumstances of doubt and in determining operational capacities. Mapping of developments was also used to cross reference schemes across datasets where a unique identifier was not available (see Figure 3-2 below).

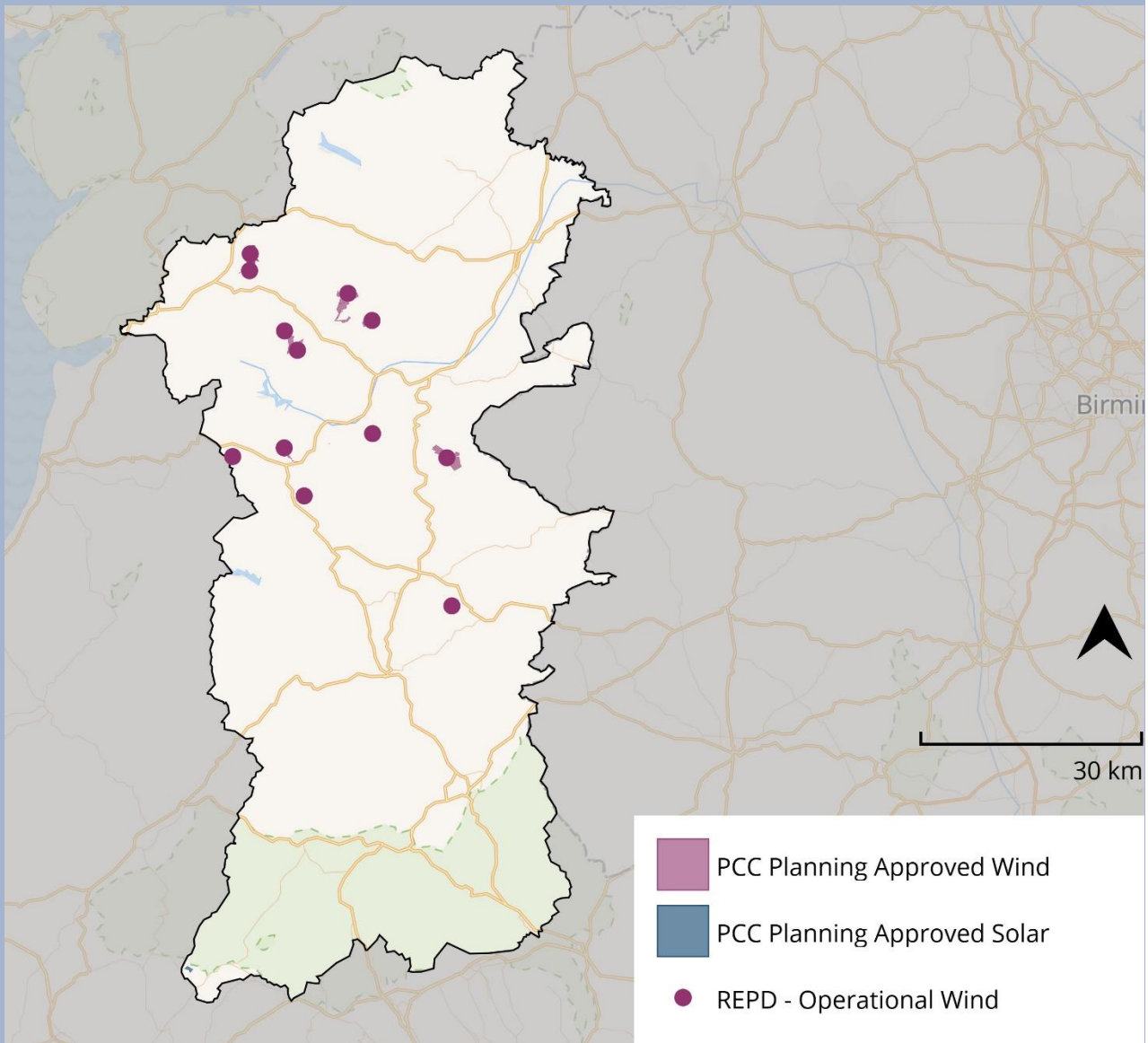


Figure 3-2: Operational and Approved Onshore Wind and Solar Developments from REPD and Approved Applications from PCC Planning Data

Onshore wind developments were taken from the REPD and Ofgem Renewables Register, the datasets identified 12 existing sites and three developments which have received planning

permission. However, Bryn Blaen Wind Farm (14.1 MW) is listed as ‘Under Construction’ in the REPD but confirmed to be operational by PCC. Nine of the fifteen sites were corroborated against PCC data, with the remaining three sites included only in the REPD. The total capacity of existing and planned developments equalled 213.3 MW and 85.4 MW respectively. The total capacity for existing onshore wind sites reported in the Regen study equalled 199 MW. The discrepancy is due to the misreporting of Bryn Blaen Wind Farm in the REPD.

Ground PV developments were also taken from the REPD and Ofgem Renewables Register, the datasets reported no existing ground PV sites and six developments with approved planning permission. All six sites were corroborated in the PCC planning dataset which included an additional three planned ground PV developments. The FiT register which does not specify if an entry is ground or roof solar PV contained 18 existing sites which were assumed to be ground PV based on their large capacities. From these sources, the existing ground PV from the FiT register totalled 3.8 MW and the planned ground PV capacity from the REPD and PCC dataset equalled 18.9 MW

Rooftop PV developments were taken from the FiT register, the register included 3,745 sites which were determined to be rooftop installations. The FiT register will not capture all rooftop installations (potentially missing sites where electricity is used locally) but provides a reasonable estimate since these sites are not common. The total capacity of rooftop solar equalled 18.9 MW. It was not possible to corroborate these sites with the REPD or PCC database as both sources only included ground solar PV developments.

The total solar PV capacity estimated in this report is 2.2 MW smaller than the value stated in the 2021 Regen report. The Regen report is considered a more comprehensive source due to the use study’s access to additional data sources, the higher estimate in the Regen report has been used in this study to prevent an underestimation of capacity. Since the vast majority of solar PV sites reported are rooftop solar PV, the 2.2 MW has been included in this category.

A summary of the capacity of these existing sites and planned developments are shown in Table 3-1 and Table 3-2 respectively. Further information on the sites identified and corroboration between datasets is provided in Appendix B – Details on Renewable Dataset Corroboration.

3.2 Existing Installed Capacity

A summary of the existing renewable generation sites is presented in Table 3-1, only sites which were operational at the time of writing were included, with sites which have received planning permission or under constructed are presented in Section 3.3.

Technology (power)	Installed capacity (MW _e)	Assumed capacity factor	Estimated annual power generation (MWh _e /yr)
Wind (onshore)	213.3	27%	504,500
Solar PV (ground mounted)	3.8	10%	3,330
Solar PV (roof mounted)	21.1	10%	18,480
Anaerobic Digestion (electricity)	0.6	50%	2,630
Hydro	8.6	50%	37,670
Biomass (electricity)	1.0	90%	7,880
Landfill gas	2.1	60%	11,040
Totals	250.5	-	585,530
Technology (heat)	MW _{th}		
Anaerobic Digestion (CHP heat) *	0.7	50%	3,070
Totals	0.7	-	3,070

**For AD generation that is marked as CHP enabled (as determined from REPD), the potential heat recovery (MW_{th}) is estimated from the provided installed capacity (MW_e). It is assumed that the generation has a 35% electrical efficiency and 40% heat recovery.*

Table 3-1: Existing Renewable Generation Capacity in PCC (DESNZ, 2024)

3.3 Installed Capacity (Under Development)

The Welsh Toolkit suggests that only large sites that have received planning permission or under construction, should be included in the review of proposed technologies (Welsh Government, 2015). This means that if a planning application for a site has been submitted, but is yet to receive a decision, it will not be included in our results. It is also possible that some of the proposed sites included in the results will not be built. Only schemes with a proposed installed capacity of greater than 150 kW are included (as this is the minimum size reported in the REPD).

The proposed Llandinam Windfarm repowering and extension, with a proposed capacity of 102 MW, is located at the site of the existing Llandinam Windfarm. Constructed in 1993, the existing 31 MW windfarm is approaching the end of its lifetime. As a result, we assume that of the 102 MW proposed, 31 MW of which represents the replacement (often referred to as “repowering”) of the existing site and 71 MW the development of new onshore wind capacity. Consequently, the proposed installed capacity has been reduced to 71 MW.

Technology type	Site Name	Proposed Installed Capacity (MW)	Assumed capacity factor	Estimated annual energy generation (MWh/yr)
Onshore Wind	Hendy Wind Farm	14.4	27%	34,060
	Llandinam Windfarm Repowering and Extension (102 MW total)	71.0		167,930
Solar PV (ground mounted)	Bryn Henllys Solar Farm	20.0	10%	17,520
	Hope Solar Farm	8.5		7,450
	Refail Solar Farm	1.0		880
	Small Solar developments (55 total)	1.8		1,580
Solar PV (roof mounted)	Royal Welsh Showground	0.3		260
Hydro	Dolymynach	0.2	50%	880
AD electrical	Ystym Colwyn Farms	0.25	50%	1,100
AD heat	Ystym Colwyn Farms	0.3	50%	1,310
Total proposed power generation (MW_e)		117.8	-	232,970
Total proposed heat generation (MW_{th})		0.3		1,310

Table 3-2: Proposed Renewable and Low Carbon Energy Projects in PCC (DESNZ, 2024)

4 Renewable Energy Resource Potential

Chapter in Brief

This chapter determines the renewable energy potential for onshore wind, ground-mount PV and anaerobic digestion (AD).

Section to be completed post preferred strategy.

5 Building Integrated Renewables

Chapter in Brief

This chapter determines the energy potential for renewables that can be “building integrated” across the building stock in Powys.

Section to be completed post preferred strategy.

6 Heat Network Opportunities

Chapter in Brief

This chapter maps out various datasets which could inform the identification of heat network viability.

Section to be completed post preferred strategy.

7 LDP Target Setting

Chapter in Brief

This chapter sets targets for renewable and low carbon energy uptake in Powys over the LDP period. The intention is for these targets to influence PCC's planning policies; progress against these targets will be assessed in future annual LDP monitoring reports.

Note that this section is showing indicative targets only, and future work post-preferred strategy will conduct a renewable resource assessment to develop new, refined targets. Targets have been set for ground mount PV, rooftop PV, AD, onshore wind and heat pumps. Other technologies such as hydro and biomass are out of scope of further potential resource modelling, so no targets have been set for these technologies.

The complete renewable resource assessment will be developed after the preferred strategy, the indicative LDP targets in this report have therefore been developed using existing and ongoing studies, and via engagement with PCC. The existing RLCEA (Aecom, 2017), set a target for 181% of Powys projected 2026 electricity demand to be met by renewable sources (i.e. Powys generates more renewable electricity than it consumes). This target has been carried forward to 2037 in this assessment, which has a significantly higher electricity demand than the previous 2026 target. For renewable heating technologies, targets have been set based on an uptake of heat pumps in new buildings.

For each renewable technology, average build out rates have been set based on the expected resource available, and our professional judgement in reasonable deployment rates. The future work post-preferred strategy will update the expected resource available, but for the purposes of this study, existing sources have been used. The most appropriate source used was based on our judgement of the robustness of the methodology, with respect to the date when the work was carried out. For example, the 2017 RLCEA is now seven years old; some of the methodologies used in this study are now outdated due to changes in policy, but some are still considered reliable. The rationale behind each technology's target deployment rate is outlined below.

Ground Mount PV: The 2017 RLCEA identified 220 MW of potential installed capacity of ground mount PV in Powys. Of this, 45 MW was targeted to be delivered by 2026 based on an assumed build out rate of 5 MW per year. This development rate of 5 MW per year has been projected forward to 2037, bringing the total capacity in 2037 to 100 MW.

Rooftop PV: The emerging Powys LAEP being delivered by ESC identifies a potential of 506 MW of rooftop solar PV by 2050, which would be the total capacity if all suitable roofs – existing and new build – were fitted. This includes 19,500 domestic households (62 MW) and 444 MW of public and commercial buildings. This is equal to a generation potential of 443 GWh per year.

The installation of rooftop PV on new buildings can be influenced by PCC planning policies, such as a requirement for developers to assess the potential for rooftop PV on any proposed developments. In most cases, the installation of rooftop PV on existing buildings (retrofit) will fall under permitted development, so PCC have limited influence on uptake. As such, no indicative target has been set for retrofit on existing buildings; this will however be reevaluated following the preferred strategy.

For new buildings, it has been assumed that 85% of domestic properties may have a rooftop suitable for PV deployment (this makes an allowance for 15% of new builds to have an unsuitable orientation or construction), and 80% suitability is assumed on non-domestic buildings (commercial and industrial). Assuming that not every new development with suitable rooftops comes forward, the target for rooftop PV has been set at 75% of new domestic properties and 60% of new non-domestic roof space (i.e. 88% of suitable domestic properties and 75% of suitable new non-domestic roof space).

An indicative number of new dwellings and employment land to be developed over the LDP period has been provided by PCC. The LDP period has a new dwelling requirement of 3,975, and an allocation

of 32 ha of new employment land. Assuming a 40% building to plot ratio, this equates to a floorspace of 128,000 m². Note that the roof space may be lower than the floorspace due to some buildings having multiple floors; the reduced target of 60% intends to account for this.

Table 7-1 shows the uptake target setting based on the number and floor area of new buildings over the LDP period. The assumed domestic rooftop PV installation size (kW) is calculated using the average existing domestic installation from the FiT data.

LDP Plan Period New Dwellings (Dwelling Requirement)	3,975
LDP New Domestic Rooftop PV Uptake: 75% target	2,981
Assumed Domestic Rooftop PV Installation Size (kW)	4.0
New Domestic Rooftop PV Capacity (MW)	11.9
Non-Domestic Buildings	
LDP Planned Period New Employment Floorspace (m ²)	128,000
LDP New Non-Domestic Rooftop PV Uptake (m ²): 60% target	76,800
Assumed Non-Domestic Rooftop PV Density (kW/m ²)	0.2
New Non-Domestic Rooftop PV Capacity (MW)	15.4
Total Capacity	
LDP Total Rooftop PV Capacity on New Buildings (MW)	27.3
LDP Annual Rooftop PV Development Rate (MW/year), 2022-2037	1.8

Table 7-1: Powys Rooftop PV Target

As the existing installed rooftop PV capacity in Powys is 19 MW, an annual development rate up to 2037 of 1.8 MW per year is seen as a reasonable target.

Note that the suggested uptake rate of rooftop PV in the LAEP, and the target as calculated above are higher than that in the previous RLCEA, which identified a potential of 1.2 MW of additional BIR capacity over the entire LDP period (up to 2026). This is however considered to be highly conservative; the previous work used an outdated methodology and so the outcomes of the existing study have been replaced for a new target here.

Anaerobic Digestion: The 2017 RLCEA identified a maximum potential of 1.7 MW_e and 1.7 MW_{th}, equal to 7,446 MW_e and 7,446 MWh_{th} of AD with CHP by 2026. This was calculated based on the available animal slurry in Powys (cattle and pigs). All other sources of AD were deemed to be of insufficient resource, or would conflict with recycling targets. It is assumed that the feedstock circumstances are unlikely to have changed significantly, so these targets have been projected forward to 2037. Our analysis post preferred strategy will also explore the potential for energy crops for use in AD, meaning the energy potential will likely increase.

Onshore Wind: As outlined in Appendix C – Review of Existing Resource Assessments, the existing 2017 RLCEA found no areas outside of the TAN 8 Strategic Search Areas (SSAs) for onshore wind development. The TAN 8 SSAs have now been superseded by the Future Wales Pre-Assessed Areas (PAAs) for wind. If the PAAs were fully built out with wind turbines, this would equate to capacity of 6,670 MW, and a generation potential of 15,800 GWh. It is not expected however that these areas are fully built out for onshore wind, instead these are areas in which the Welsh Government have stated a presumption in favour of large-scale developments where landscape change may be acceptable. This potential also significantly exceeds that required to meet Powys' electricity demand.

As there is a large potential capacity of onshore wind, the onshore wind deployment target has been set to balance out the energy difference between the generation from other renewable sources and the 181% generation target projected forward from the existing RLCEA. Using the above targets for ground mount PV, rooftop PV and anaerobic digestion, and the existing renewable electricity generation capacities, the sum of renewable electricity generation (excluding onshore wind) would be 193 GWh (see Table 7-4), meaning that onshore wind is to account for the remaining 1,038 GWh to meet the 181% target. Table 7-2 outlines the required onshore wind capacity to meet this generation.

LDP Onshore Wind Generation Target (GWh)	1,038
LDP Onshore Wind Capacity Target (MW)	439
Powys Existing and Planned Onshore Wind Capacity (MW)	298.4
LDP Annual Onshore Wind Development Rate 2022 – 2037 (MW/year)	10.8*

Table 7-2: Powys Onshore Wind Target

*as there has been no new wind developments in the first two years of the plan period, the development rate is increased to represent that required from 2024 (the remaining 13 years).

Heat Pumps: The emerging Powys LAEP National Net Zero scenario modelled 56,500 heat pumps to be installed in homes, equal to 84% of all existing buildings (not including new developments up to 2050), and 2.4 million m² of non-domestic floorspace decarbonised via heat pumps by 2050.

As outlined above, the influence of PCC over new buildings and existing buildings varies significantly, therefore, only new buildings are considered for these indicative targets.

It is assumed that a high proportion of new developments will be suitable for heat pumps. Electrified heating via heat pumps is seen as the most likely technology for new builds, particularly with the incoming Future Homes Standard (taking effect in 2025) which sets stringent energy efficiency requirements on new builds and bans the installation of new fossil fuel boilers. A high target of 85% of new dwellings and non-domestic floorspace to be heated by heat pumps has therefore been set.

To estimate the energy capacity for domestic heat pumps, a typical heat pump size of 10 kW is assumed. For non-domestic, an approximate heating benchmark has been derived from the total floorspace of non-domestic properties in Powys in the Non-domestic National Energy Efficiency Data-Framework (ND-NEED) (DESNZ, 2023) and the 2019 fuel consumption in DESNZ subnational data. This figure has then been reduced by 40% to represent the increased energy efficiency of new builds compared to existing. A capacity factor for heat pumps of 20% is assumed, based on the 2015 Welsh Toolkit.

LDP Plan Period New Dwellings	3,975
LDP New Domestic Heat Pump Uptake (85% target)	3,379
Assumed Domestic Heat Pump Size (kW _{th})	10
New Domestic Heat Pump Capacity (MW _{th})	33.8
LDP Planned Period New Employment Floorspace (m²)	
LDP Planned Period New Employment Floorspace (m ²)	128,000
LDP New Non-Domestic Heat Pump Uptake (m ²) (85% target)	108,800
ND-NEED Total Existing Floorspace (m ²)	1,984,348
Powys 2019 Non-Domestic Combustion Fuel Demand (GWh)	356
Powys Non-Domestic Heating Benchmark for Existing Buildings (kWh/m ²)*	152.5
Powys Non-Domestic Heating Benchmark for New Buildings (kWh/m ²)**	91.5
New Non-Domestic Heat Pump Generation (GWh _{th})	10
New Non-Domestic Heat Pump Capacity (MW _{th})	5.7
LDP Total Heat Pump Capacity in New Buildings (MW_{th})	
LDP Total Heat Pump Capacity in New Buildings (MW _{th})	39.5
LDP Annual Heat Pump Development Rate 2022-2037 (MW _{th} /year)	2.6

Table 7-3: Powys Heat Pumps Target

*A typical boiler efficiency of 85% is assumed to convert from fuel to heating.

**A space heating reduction factor of 40% is applied to account for increased energy efficiency in new buildings, based on past project experience.

Energy Technology	Existing and Under Development Capacity (MW)	Existing and Under Development Generation (GWh)	2037 Target Capacity (MW)	Average Annual Deployment to Achieve 2037 Target (MW)	2037 Target Potential Generation (GWh)
Onshore Wind	298.4	471	439	10.8	1,038
Ground Mount PV	35.1	30.7	100.1	5	87.7
Rooftop PV (New Buildings)	-	-	27.3	1.8	23.9
Rooftop PV (Existing Buildings)	19.2	16.8	19.2	-	16.8
Anaerobic Digestion	0.85	3.7	1.7	N/A*	7.4
Hydro	8.8	38.5	8.8	-	38.5
Biomass	1	7.8	1	-	7.8
Landfill Gas	2.1	11.1	2.1	-	11.1
2037 Renewable Electricity Generation (GWh)					1,231
2037 Electricity Demand (GWh)					680
% Renewable Electricity Contribution					181%

Table 7-4: Resource summary table for renewable electricity in 2037

Note that no target on retrofitting existing properties with rooftop PV has been included due to Powys' limited influence over those buildings. Any deployment of rooftop PV on existing buildings would reduce the required development of other sources; notably onshore wind.

The targets for renewable heat have been set on an individual technology basis. For heat pumps, the target is for 85% of new build domestic and non-domestic heat to be met by heat pumps, equating to 39.5 MW_{th} of heat pump capacity by 2037. The AD target is based on the previous work, projecting forward the 1.7 MW_{th} target to 2037.

Energy Technology	Existing and Under Development Capacity (MW _{th})	Existing and Under Development Generation (GWh _{th})	2037 Target Capacity (MW _{th})	Average Annual Deployment to Achieve 2037 Target (MW _{th})	2037 Target Potential Generation (GWh _{th})
Heat Pumps (New Buildings)	-	-	39.5	2.6	69.2
Anaerobic Digestion	1	4.4	1.7	N/A*	7.4

Table 7-5: Resource summary table for renewable heat in 2037

*Increase in AD would occur over a single year due to small increase in capacity.

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9 Appendices

9.1 Appendix A – Energy Projections Mapping

Energy Category	DESNZ Subnational Final Energy	DESNZ Energy & Emission Projections
Electricity	Electricity: Domestic Electricity: Industrial, Commercial and other	Residential: Electricity Commercial Services: Electricity Public Services: Electricity Agriculture: Electricity Iron & Steel: Electricity Other Industry sectors: Electricity Transport: Electricity
Heating fuels	Coal: Domestic Coal: Industrial Coal: Commercial Coal: Public Sector Coal: Agriculture Manufactured fuels: Domestic Manufactured fuels: Industrial Petroleum: Industrial Petroleum: Commercial Petroleum: Domestic Petroleum: Public sector Petroleum: Agriculture Gas: Industrial, Commercial & other Gas: Domestic Bioenergy & wastes: Domestic Bioenergy & wastes: Industrial and Commercial	Residential: Natural gas Residential: Petroleum products Residential: Renewables Residential: Solid/manufactured fuels Commercial Services: Natural gas Commercial Services: Petroleum products Commercial Services: Renewables Commercial Services: Solid/manufactured fuels Public Services: Natural gas Public Services: Petroleum products Public Services: Renewables Public Services: Solid/manufactured fuels Agriculture: Natural gas Agriculture: Petroleum products Agriculture: Renewables Agriculture: Solid/manufactured fuels Iron & Steel: Natural gas Iron & Steel: Petroleum products Iron & Steel: Renewables Iron & Steel: Solid/manufactured fuels Other Industry sectors: Natural gas Other Industry sectors: Petroleum products Other Industry sectors: Renewables Other Industry sectors: Solid/manufactured fuels
Transport fuels (road and rail)	Coal: Rail Petroleum products: Road transport Petroleum products: Rail Bioenergy and wastes: Road transport	Transport: Natural gas Transport: Petroleum products (rail) Transport: Petroleum products (road transport) Transport: Renewables Transport: Solid/manufactured fuels

Table 9-1: Mapping of DESNZ subnational energy data to energy projections

9.2 Appendix B – Details on Renewable Dataset Corroboration

- **Onshore Wind:** The REPD and Ofgem Renewable Register contained 15 sites between them which were either existing sites or developments under construction but not yet operational. Nine of these sites were corroborated against PCC data. In four cases the capacity reported in the PCC dataset were larger when compared to the capacity in the REPD. For those four sites, the capacity reported in the REPD was consistent with the capacity reported in the CHP & Renewables Register and it has been assumed that the built capacity of these three sites was lower than the capacity stated during the corresponding planning applications. The PCC planning dataset contained an additional site with a capacity of 69 MW which is listed as having received planning permission in 2009, this site was identified in the REPD and listed as “Planning Application Submitted”, a visual inspection of the site using satellite imagery suggests some preliminary construction work was started but the project later abandoned. As a result, this site had not been included in this assessment.
- **Ground Solar PV:** The PCC planning data had a total of 64 ground solar PV schemes with a combined capacity of 34.3 MW, all sites were listed with “Planning Permission Granted”. The REPD showed six schemes with a combined capacity of 23 MW, which were all corroborated between the two datasets using the planning reference number. The discrepancy between the two total capacities was attributed to 55 sites with individual capacities below the 200 kW REPD threshold which had a total capacity of 1.8 MW and two additional sites with a capacity of 9.5 MW which received planning permission after the most recent REPD publication
- **Rooftop Solar PV:** Rooftop PV installations are likely to fall under permitted development, and so would not be included in the PCC planning data. The REPD also only includes schemes above 150 kW and so will not include small rooftop installations. The FiT register does not explicitly state whether a scheme is rooftop or ground mounted and so an estimate of small-scale rooftop PV capacity was determined by assuming that anything 50 kW or below is rooftop, anything above is ground mount. Out of the 4,067 schemes listed, only 18 sites had a capacity greater than 50 kW (all of which were non-domestic sites), and 3,745 sites (3,645 domestic and 100 non-domestic) had capacities less than 5 kW, suggesting that most schemes in this register are rooftop PV. The sum of schemes below 50 kW in the FiT register amounted to 18.9 MW, with 15.2 MW of that being listed as domestic applications.
- **Corroboration against Regen, 2021:** Regen was commissioned by Welsh Government to produce a series of reports exploring the extent of renewable capacities across Wales, the latest of which is representative of the capacities in 2021 (Regen, 2021). In doing this, they performed a corroboration of all public renewable datasets, gaining access to some non-public datasets, and held engagements with utilities, installers and industry organisations. This study is therefore considered a comprehensive source of renewable capacities, but it was published in 2021 and so will be missing any renewable projects developed between the publication and the time of writing this study (2024). Despite this, the capacity of existing onshore wind estimated in this study matched the value reported in the Regen report (199 MW). The Regen reported a higher solar PV capacity of 24.8 MW which may be due to missing data in the FiT register. To avoid underestimation of the renewable capacity in PCC, the higher capacity of the Regen report was used in our results.
- **Corroboration against emerging LAEP, 2024:** Energy Systems Catapult were commissioned by PCC to produce a LAEP for the county in 2023. The study used the REPD to assess the existing renewable energy technologies within the area. This study states an onshore wind capacity of 313 MW and a solar PV capacity of 22.3 MW. These figures were similar to the total wind and solar capacity reported in the REPD, 329 MW and 23 MW respectively (including operational and proposed developments). The additional 16 MW of onshore wind capacity not reported in the LAEP, was attributed to the Carno Wind Farm site; the REPD has three entries for the site “Carno A” (16.8 MW), “Carno B” (16.8 MW) and “Carno A & B Extension (15.6 MW)”. These sites were corroborated by PCC planning data with two entries, one representing Carno A and Carno B with a capacity of 33.6 MW and the other representing the Carno Extension with a capacity of 15.6 MW.

Site Name	Capacity (kW)	Source of Information	Assumptions and Corroboration Performed
BDCR Vestas V17	75	Ofgem Renewables Register	No corroboration possible, not listed in REPD or PCC
Bryn Blaen Wind Farm	13,800	REPD	Corroborated by Ofgem Renewables Register, PCC data reported 15 MW. 13.8 MW assumed correct
Bryn Du	16,400	REPD	Corroborated by Renewables Register and PCC data
Bryn titli Windfarm	9,900	REPD	
Carno 'A' Wind Farm	16,800	REPD	Corroborated by Ofgem Renewables Register, PCC data reported 33.6 MW as a combined capacity for Carno 'A' & Carno 'B'.
Carno 'A'and 'B' Wind Farm, (Extension)	15,600	REPD	Corroborated by Renewables Register and PCC data
Carno 'B' Wind Farm	16,800	REPD	Corroborated by Ofgem Renewables Register, PCC data reported 33.6 MW as a combined capacity for Carno 'A' & Carno 'B'.
Cemmaes 'B' Wind Farm	3,400	REPD	No corroboration possible, not listed in Ofgem Renewables Register or PCC
Cemmaes 'C' Wind Farm	15,300	REPD	Corroborated by PCC, Ofgem Renewables Register reported 11.9 MW. 15.3 MW assumed correct
Garreg Lwyd	34,000	REPD	Corroborated by Ofgem Renewables Register, PCC data reported 46 MW. 34 MW assumed correct
Hendy Wind Farm	14,400	REPD	PCC data reported 17.5 MW. 14.4 MW assumed correct
Llandinam Windfarm	31,800	Ofgem Renewables Register	Corroborated by REPD, no capacity reported in PCC, approaching decommissioning
Llandinam Windfarm Repowering and Extension	71,200	REPD	No corroboration possible, not listed in REPD or PCC since planning permission was granted by DECC for 102 MW. 31.8 MW of capacity to replace the existing site reaching end of life, with an additional 71.2 MW of new capacity
Mynydd Clogau Wind Farm	14,500	REPD	Corroborated by Renewables Register and PCC data
Tirgwynt	24,600	REPD	Corroborated by Ofgem Renewables Register, PCC data reported 28 MW. 24.6 MW assumed correct

Table 9-2: Corroboration of Onshore Wind Developments

Site Name	Type of Array	Capacity (kW)	Source of Information	Assumptions and Corroboration Performed
Bryn Henllys	Ground PV	20,000	REPD	Corroborated by PCC, no capacity reported in Ofgem Renewables Register
Buttington Old Hall, Buttington	Ground PV	200	REPD	
Coppice Farm, Pen-Rhos	Ground PV	1,150	REPD	
Glandulas Mawr Farm	Ground PV	240	REPD	
Heartsease Farm	Ground PV	1,200	REPD	
Hope	Ground PV	8,500	PCC	No corroboration possible, not listed in REPD or Ofgem Renewables Register
Rallt Carno	Ground PV	220	REPD	Corroborated by PCC, no capacity reported in Ofgem Renewables Register
Refail	Ground PV	1,000	PCC	No corroboration possible, not listed in REPD or Ofgem Renewables Register
Royal Welsh Showground, Llanelwedd	Roof PV	290	REPD	Corroborated by PCC, no capacity reported in Ofgem Renewables Register
Small developments (From PCC data all sites below 200 kW)	Ground PV	1,800	PCC	No corroboration possible, not listed in REPD or Ofgem Renewables Register

Table 9-3: Corroboration of Solar PV Developments

9.3 Appendix C – Review of Existing Resource Assessments

9.3.1 Onshore Wind

Current analysis is of the Future Wales Pre-Assessed Areas for wind energy. City Science analysis to be completed for final report, which will predominantly focus on areas outside of the PAAs.

The 2017 RLCEA did not find any suitable land parcels of sufficient area for schemes in Powys in the installed capacity range of 5-25 MW, outside of the TAN 8 strategic search areas (SSAs). TAN 8 has now been superseded in favour of the Future Wales Policy 17 Pre-assessed areas (PAAs) for wind energy (Welsh Government, 2021). A comparison between these areas is shown on Figure 9-1 below.

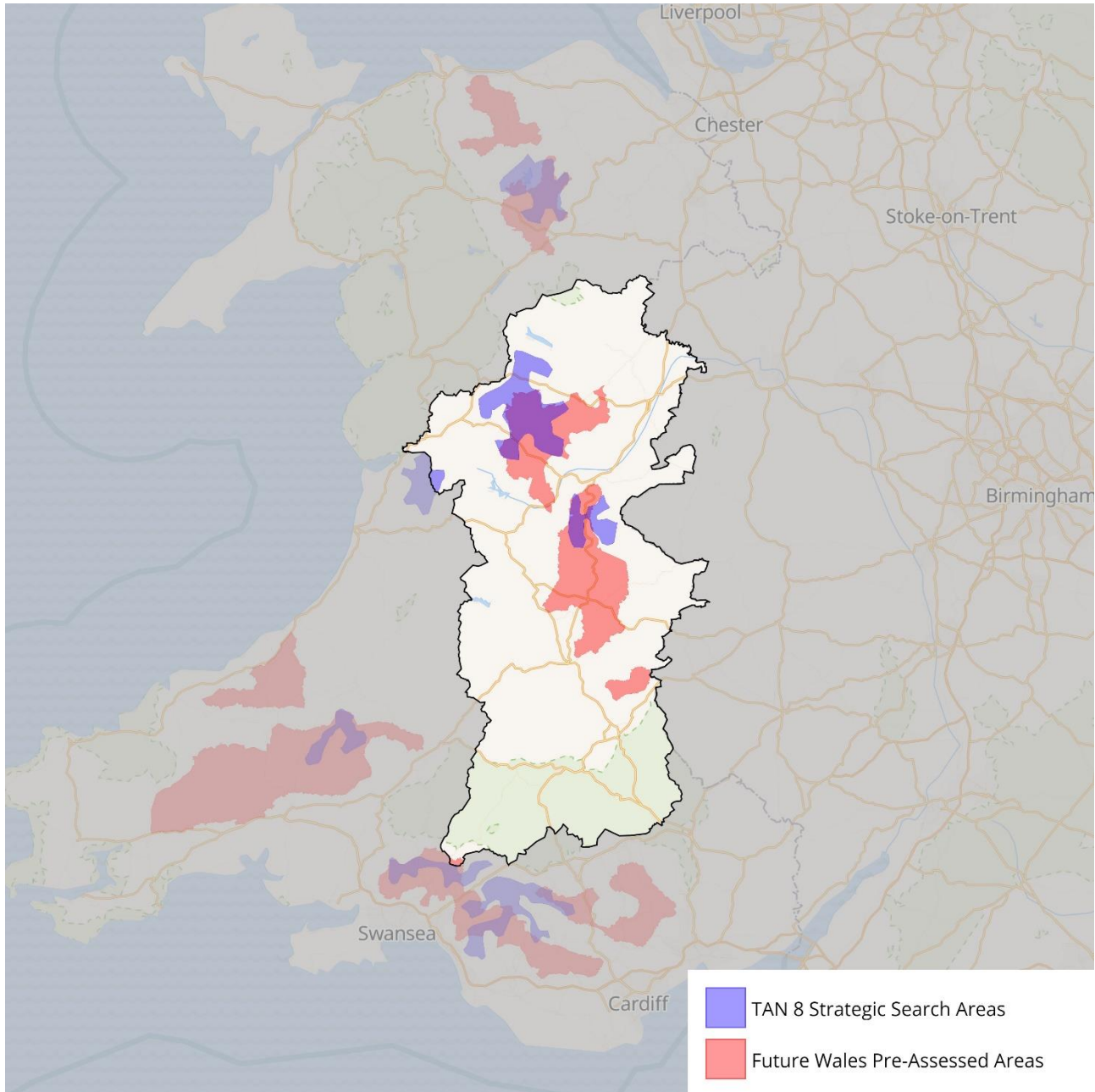


Figure 9-1: Tan 8 SSAs and Future Wales PAAs Comparison (using City Science’s Cadence 360 Software)

The area of the Powys PAAs and their potential capacity is shown in Figure 9-1 below, assuming an energy density of 10 MW/km² (Welsh Government, 2015) and capacity factor of 27% (Welsh Government, 2015). Note that the PAAs are not expected to be fully built out for onshore wind; these are simply areas that the Welsh Government has designated as being favourable for large scale wind development. The below figures therefore represented the maximum potential capacity.

PAA Area (km ²)	Potential Installed Capacity (MW)	Potential Energy Generated (GWh)
667	6,670	15,800

Table 9-4: Powys PAAs Onshore Wind Potential

9.3.2 Ground-Mount Solar PV

The 2017 RLCEA identified land parcels outside of the TAN 8 SSAs for ground-mount PV developments using a GIS constraint mapping exercise, categorised based on their prioritisation. The GIS mapping exercise evaluated constraints such as Special Protection Areas, and Special Areas of Conservation, Areas of Outstanding Natural Beauty (AONB), among several others. 220 MW of potential installed ground mount PV capacity was determined through this exercise. The degree of sensitivity of this potential land was determined using a landscape sensitivity assessment, which investigated the value and vulnerability of the land parcels.

Degree of Sensitivity	Potential Installed Capacity (MW)	Potential Energy Generated (GWh)
Low	100	88
Medium-Low	35	31
Medium	70	61
Medium-High	10	9
High	5	4
Total	220	193

Table 9-5: 2017 RLCEA Ground-Mount PV Potential