FINAL REPORT

# Renewable and Low Carbon Energy Assessment

Carmarthenshire County Council

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Carmarthenshire County Council

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# 1. Introduction

## 1.1 Background to this Assessment

The Welsh Government is required to make a contribution to the International, EU and UK targets for greenhouse gas emission reductions. The Climate Change Act 2008 provides the statutory framework for the reduction of greenhouse gas emissions in the UK. At the core of the Act there is a requirement for the UK to reduce net UK greenhouse gas emissions by 100% by 2050 – and $CO_2$ emissions by at least 34% by 2020 – against a 1990 baseline. The Act also established a system of five-yearly carbon budgets, to serve as stepping stones on the way. Wales currently has a carbon budget of 80% against a 1990 bassline in legislation. The Committee on Climate Change has however recommended increasing this to 95% and the Welsh Government has made commitments to amend the legislation in 2020 to 100% against a 1990 bassline.

The UK is currently subject to the requirements of the EU Renewable Energy Directive to achieve 15% of energy from renewables by 2020. The UK Renewable Energy Roadmap sets the path for the delivery of these targets. Beyond 2020, the first five carbon budgets, leading to 2032, have been set in law. Meeting the fourth carbon budget (2023-27) will require that emissions be reduced by 50% on 1990 levels in 2025 and meeting the fifth (2028-32) will require that emissions be reduced by 57% on 1990 levels in 2030.

The Welsh Government is committed to playing its part by delivering an energy programme which contributes to reducing carbon emissions as part of its approach to mitigating anthropogenic climate change whilst enhancing the economic, social and environmental wellbeing of the people and communities of Wales in order to achieve a better quality of life for our own and future generations. This is outlined in the Welsh Government's Energy Policy Statement *Energy Wales: A Low Carbon Transition* (2012).

The aims of The Environment (Wales) Act 2016 is to secure a reduce reliance on energy generated from fossil fuels. Part 2 of The Act sets out a framework for emissions reduction, a long-term target for emission reduction by 2050, with supporting interim targets and carbon budgets. The new targets for Wales are to:

- Generate 70% of electricity consumption from renewable energy by 2030;
- One Gigawatt of renewable electricity capacity in Wales is to be locally owned by 2030;
- New renewable energy projects to have an element of shared ownership.

The Well-being of Future Generations Act (Wales) 2015 places a duty on the Welsh Ministers (and other public bodies) to produce well-being objectives and take reasonable steps to meet those objectives in the context of the principle of sustainable development. The Welsh Government has resolved that the planning system will play an important role in mitigating anthropogenic climate change through reducing greenhouse gas emissions.

The Welsh Government's Climate Change Strategy was published in October 2010 and outlined a target to reduce greenhouse gas emissions in Wales by 3% each year from 2011, relative to a baseline of average emissions over 2006-2010. It has also committed to a reduction of 40% in greenhouse gases in all sectors levels by 2020 from 1990 levels.

The use of fossil fuels is seen as a major contributor to greenhouse gas emissions, a major cause of global climate change. Moving towards a low carbon energy based economy to mitigate anthropogenic climate change and improve energy security are Welsh Government priorities.

## 1.2 Purpose of this Assessment

Local Authorities have several key roles to play that can facilitate the use and generation of renewable and low and zero carbon energy. These include:

- **Preparing planning policies** and allocating land in Local Development Plans (LDPs)**.**
- **Development management** – taking decisions on planning applications submitted to the Local Planning Authority (LPA) for development; as well as preparing Local Impact Assessments.
- **Corporate** – taking action at a council wide level to achieve a low carbon economy.
- **Leadership** – taking forward wider community action and communicating the need to increase the uptake of renewable energy.

This Renewable Energy Assessment (REA) constitutes an evidence base informing the LDP. This enables decisions to be taken based on policies that support

and facilitate the deployment of renewable and low and zero carbon energy systems. The REA consists of a high-level strategic assessment of the potential for different scales of renewable and low and zero carbon energy generation in different locations.

In terms of development management, the REA (used in conjunction with national planning policy guidance – 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners', Welsh Government (September 2015) ('the Toolkit') will be useful in three ways.

- **Firstly**, when assessing applications for new development sites, it can aid officers in discussions with developers around opportunities for district heating and making use of waste heat.
- **Secondly**, when assessing applications for larger scale new generation schemes, it can enable officers to identify whether there is the potential for those schemes to supply heat to new or existing development.
- **Thirdly**, in the case of wind and solar PV farm developments and other technologies, it can assist officers in understanding why a developer has chosen a particular location to develop a scheme.

As well as supporting Carmarthenshire County Council (CCC) planning officers, the intention is that the renewable energy opportunities identified will also be useful in assisting CCC to fulfil its role as a community leader, leading by example through its actions.

## 1.3 Method employed by this REA

This REA was originally compiled based on the method set out in the Welsh Government guidance document 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners' July 2010. A revision of the 'Toolkit' was produced in September 2015 and, in response this REA has been updated to incorporate changes. Also, where appropriate, new methods have been introduced to meet the requirements of Planning Policy Wales and/or to better reflect local data / circumstances.

The method is based on a Geographic Information System (GIS) approach to enable spatial identification of renewable energy opportunities. The outputs of this approach are maps that accompany and support policies. The maps referred to in this REA can be located in the document 'Carmarthenshire Renewable and Low Carbon Energy Assessment 2019 – Maps'.

## 1.4 Why this REA is important

This REA will inform action to support the deployment and delivery of renewable and low and zero carbon energy installations on the ground. This is expected to assist in meeting the two key challenges for UK energy policy, namely:

- Mitigating anthropogenic climate change by reducing carbon dioxide emissions, and;
- Improving energy security.

At an LPA strategic level, this REA provides an evidence base for the following policy[1] objectives, as follows:

- Identification and promotion of potential sites for renewable energy generation (not necessarily linked to new development);
- Development of area wide renewable energy contributions (e.g. installed megawatt of heat and electricity generation) as a stimulus for concerted local action;
- Informing the selection of land for development (allocation of sites), by identifying those sites with the greatest potential for sustainable energy and carbon reduction or sites that potentially could preclude renewable energy developments (e.g. by sterilising good wind power sites);
- Identification of opportunities for delivering strategic energy options that could link to an offset fund (i.e. some Council's, where land values may be less, view this as an opportunity to make sites more attractive to developers by making them "low and/or zero carbon enabled", rather than seeking to increase development burden by setting sustainability standards in excess of future Building Regulations.);
- To enable LPA exploration of requiring developers to connect to an existing or proposed district heating network (e.g. how much could they charge, how close would a development need to be and so on).

This REA delineates CCC's evidence base in support of its approach to securing renewable energy developments. The policy mechanisms to be employed by CCC have been developed through consideration of this study revision.

[1] Meant in the broad sense, i.e. not just planning policy

Within the REA, and at high level, the 'accessible' renewable energy resource has been identified.

This REA presents information that is potentially useful to developers and wider stakeholders alike in facilitating partnerships and taking forward delivery of the opportunities identified for CCC.

### 1.4.1 Wider corporate role

All local authorities including CCC have objectives and requirements for mitigating the effect of and adapting to climate change. This REA enables CCC to identify specific opportunities to facilitate renewable and low and zero carbon energy generation.

The opportunities identified can form the basis of more detailed implementation plans, feasibility studies and practical action to contribute towards a broader range of objectives. For instance, the opportunities may contribute to delivering local economic benefits either in terms of locally grown fuel supplies, or by enabling a proportion of expenditure on energy to be retained within the local economy, from local generation, rather than going out to external energy companies[2].

## 1.5 Scope of this Renewable Energy Assessment

### 1.5.1 Planning

The REA focuses on planning policy though there are associated implications for development management. This assessment has been developed primarily for CCC as the local planning authority, as an evidence base to inform renewable and low and zero carbon energy contributions and policies in the LDP.

This REA, and the targets and policies that it informs, will necessitate procedures for use by development management officers to assess planning applications for stand-alone renewable energy generating systems.

The assessment excludes Brecon Beacons National Park (BBNP) which is a planning authority in its own right and data is amended accordingly. Where no accurate way has been found to apportion renewable energy resource, generation or future uptake, an apportionment based on relative population between CCC and BBNP based on Statistics for Wales population statistics and projections has been utilised.

## 1.6 Technology

This assessment is not an exhaustive guide to the different renewable and low and zero carbon energy technologies that are available. Technical Advice Note 8[3] provides an introduction to a range of renewable and low and zero carbon technologies that should be the first point of reference. Other technology is listed by The Department for Energy and Climate Change[4] and the Energy Saving Trust[5].

### 1.6.1 Energy Hierarchy

The REA focuses on renewable and low and zero carbon energy generation, and the opportunities for promoting this through the Local Development Plan (LDP), rather than on improving energy efficiency in new or existing buildings. This is not to imply that the latter is less important in terms of mitigating the effects of anthropogenic climate change; it is at least as, if not more, important. However, it is not covered in this REA because there is only a limited amount that planning policy for new developments can contribute in this area, over and above the Approved Document Part L of the Building Regulations[6]. AECOM refers the reader to other sources of information on energy efficiency in buildings, existing and new, that already exist[7].

### 1.6.2 Transport

The REA does not include an assessment of the potential for renewable or low carbon fuels for transport.

### 1.6.3 Stand-alone electricity generating assets

Whilst Strategic Search Areas (SSAs) are alluded to (as they impact in the Carmarthenshire LPA area and effectively ring fence land for on-shore wind development), the REA is not intended to duplicate the analysis carried out in TAN 8.

Rather, the REA is concerned with identifying ways in which to secure additional opportunities for electricity generation outside of SSAs that would be determined either by the Welsh Government under The

[2] Low Carbon Wales, Sustainable Development Commission, 2009
[3] Technical Advice Note 8, Renewable Energy, http://wales.gov.uk/desh/publications/planning/technicaladvicenotes/ta n8/
[4] DECC http://www.planningrenewables.org.uk/page/index.cfm
[5] Energy Saving Trust at http://www.energysavingtrust.org.uk
[6] Obviously, there is a lot that can be done to reduce energy use in existing buildings, but these do not generally fall with the remit of the planning system.
[7] E.g. from the Energy Saving Trust in Wales, as per the web-link given above.

Developments of National Significance Regulations (2016) (DNS) or by the local planning authority.

Additionally, any potential for Local Search Areas (LSAs) are identified for wind farm developments (of between 5MW and 25MW per wind farm) and for solar PV farms (of between 5MW and 50MW) that might be investigated further for such development.

### 1.6.4 Soundness

This REA is based upon use of the Welsh Government guidance 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners' (2015). However, the 'Toolkit' does not provide a definitive template for sound evidence and it remains the sole responsibility of the Local Planning Authority to prepare appropriate evidence in support of LDP policies and the decisions taken in the LDP.

Assumptions and data used in carrying out this REA have been sought from established sources, and these are either referenced as footnotes to the text or appropriately appended. Where there are no established source assumptions have been derived based on available evidence and through dialogue with the Local Planning Authority.

In the future, guidance, assumptions and data sources may change, particularly as technology and the policy and regulatory framework evolves.

## 1.7 Defining renewable energy and low / zero carbon energy

### 1.7.1 Renewable energy

There are many definitions of renewable energy[8]. A useful one is:

> *"Renewable energy is that which makes use of energy flows which are replenished at the same rate as they are used[9]"*

TAN 8[10] defines renewable energy as follows:

> *"Renewable Energy - the term used to cover those energy flows that occur naturally and repeatedly in the environment. It includes all energy derived from the sun (solar, wind, tidal, wave, hydro and biomass) and geothermal sources.*

Another important characteristic of renewable energy, which will be explained in more detail below, is that unlike fossil fuels, it produces little or no net carbon dioxide ($CO_2$) – which is one of the main greenhouse gas emissions.

Most forms of renewable energy stem directly or indirectly from the sun. The direct ones include solar water heating and photovoltaic panels (electricity). Ground source heat pumps[11] make use of solar energy stored in the ground.

The indirect forms are: wind power, as wind is caused by differential warming of the Earth's surface by the sun; hydropower, as rainfall is driven by the sun causing evaporation from the oceans; and biomass energy (from burning organic matter), as all plants photosynthesise sunlight in order to fix carbon and grow.

As long as replanting occurs, the combustion of biomass fuel is acknowledged as carbon neutral, because although the combustion releases $CO_2$, the same amount of $CO_2$ was taken out of the atmosphere when the biomass was growing.

Biomass is generally regarded as non-fossil fuel when at least 98% of the energy content is derived from plant or animal matter or substances derived thereof.

The other two forms of renewable energy are tidal power, which relies on the gravitational pull of both the sun and the moon, and geothermal energy, which taps into the heat generated in the Earth's core.

Of all these resources, perhaps the most complex and multi-faceted is biomass energy, because it can take so many forms. Biomass energy can include:

- Burning of forestry residues;
- Anaerobic digestion of animal manures and food wastes;
- Combustion of straw and other agricultural residues and products;
- Methane produced from the anaerobic digestion of biodegradable matter in landfill sites (i.e. landfill gas)' and;

[8] More specifically, the EU Renewable Energy Directive (see chapter 2) gives guidance on which technologies are eligible to qualify for meeting the UK's renewable energy target for 2020

[9] Sorensen, B. (1999) Renewable Energy (2nd Edition), Academic Press, ISBN 0126561524

[10] Planning Policy Wales Technical Advice Nota 8: Planning for Renewable Energy (July 2005)

[11] Strictly speaking, these technologies are only partially renewable, as they also make use of, most commonly, grid electricity to power a compressor. However, if they have a good efficiency, they can provide a form of heating, in the UK, that produces less carbon per unit of output than using a gas condensing boiler.

- Energy generated from the biodegradable fraction of waste going into an energy from waste plant.

## 1.8 Technologies addressed in this REA

This REA covers the following renewable energy technologies (considering both electricity and heat):

- **Wind energy** on-shore wind generating electricity only;
- **Biomass Combined Heat & Power (CHP) and/or biomass boilers**: simultaneous generation of heat and electricity, or just heat generation from sources including forestry residues, Miscanthus and short rotation coppice;
- **Incineration (Energy from Waste)**: generation of heat from sources including waste wood, municipal waste, industrial and commercial waste – can include CHP for simultaneous generation of heat and power;
- **Anaerobic Digestion**: generation of gas and/or heat and electricity if CHP enabled, from sources such as food waste, agricultural wastes, and sewage sludge;
- **Hydropower**: generation of electricity from inland (non-coastal) water courses only;
- **Solar PV farms**: generation of electricity only;
- **Building Integrated Renewable** (BIR), generation of heat and electricity utilising technologies such as biomass boilers; air and ground source heat pumps, photovoltaics; small and micro wind power.

### 1.8.1 Low carbon energy options

Low carbon energy options cover a range of energy sources that are not renewable but can still produce less carbon than use of the conventional electricity grid or gas network and are therefore considered an important part of decarbonising the energy supply. These options include:

- Waste heat, e.g. from power stations, or industrial processes;
- Gas engine or gas turbine Combined Heat and Power (CHP), where the heat is usefully employed;
- Stirling engine or fuel cell CHP, where the heat is usefully employed;
- The non-biodegradable fraction of the output from energy from waste plants.

This REA covers both renewable as well as low carbon forms of energy and the extent to which both can be considered has informed the policy objectives selected by CCC.

### 1.8.2 Power vs. energy output

In the context of this Renewable Energy Assessment, power and heat is measured in either kilowatts (kW), or megawatts (MW), which is a thousand kW, or gigawatts (GW), which is a thousand MW. It is a measure of the electricity or heat output being generated (or used) at any given moment in time. The maximum output of a generator, when it is running at full load, is referred to as its installed capacity or rated power/heat output.

Energy, on the other hand, is the product of power and time. It has the units of kWh (the h stands for “hour”) or MWh, or GWh. As an example, if a 2MW wind turbine ran at full power for 1 hour, it would have generated 2 x 1 = 2MWh of energy. If it ran at full power for one day (24 hours), it would have generated 2 x 24 = 48MWh.

This distinction is important, because in carrying out the renewable energy resource assessment certain assumptions have been made to calculate both the potential installed capacity (or maximum power output) of different technologies, as well as the potential annual energy output.

### 1.8.3 Electricity vs. heat output

In terms of the units used, to avoid confusion, it is important to distinguish between whether a generator is producing electricity or heat. This is because some renewable energy fuels (i.e. biomass) can be used to produce either heat only, or electricity and heat simultaneously when used in a Combined Heat & Power (CHP) plant.

It is also important to be able to distinguish between renewable electricity targets and renewable heat targets. To do this, the suffix “e” is added in this REA to denote electricity power or energy output, e.g. MWe, or MWhe, whilst for heat, the suffix “t” is used (for “thermal”), to denote heat output, e.g. MWt, or MWht.

# 2. Policy context and drivers for renewable energy

## 2.1 Introduction

The UK is subject to the requirements of the EU Renewable Energy Directive[12]. These include a UK target of 15% of energy from renewables by 2020. The UK Renewable Energy Roadmap[13] sets the path for the delivery of these targets, promoting renewable energy to reduce global warming and to secure future energy supplies.

The Welsh Government is committed to playing its part by delivering an energy programme which contributes to reducing carbon emissions as part of our approach to mitigating the effect of anthropogenic climate change whilst enhancing the economic, social and environmental wellbeing of the people and communities of Wales in order to achieve a better quality of life for our own and future generations. This is outlined in the Welsh Government's Energy Policy Statement *Energy Wales: A Low Carbon Transition* (2012)[14].

The Welsh Government has resolved that all Local Planning Authorities will play the fullest possible part in meeting statutory UK and EU targets on greenhouse gas emission reduction.

The use of fossil fuels is seen as a major contributor to greenhouse gas emissions, a major cause of global climate change. Moving towards a low carbon energy-based economy to mitigate anthropogenic climate warming and improve energy security are Welsh Government priorities.

## 2.2 UK and Energy Policy Context

**EU Renewable Energy Directive:** The UK has signed up to the Directive, agreeing to legally binding targets of 15% of energy from renewable sources by 2020. The UK Renewable Energy Strategy (UK RES)[15] suggests that by 2020, this could mean:

- More than 30% of our electricity is generated from renewable energy sources;
- 12% of our heat generated from renewable energy sources;
- 10% of transport energy from renewable energy sources.

The UK RES sets out how the UK could increase the use of renewable electricity, heat and transport to meet this target and address the urgent challenges of climate change and national security of energy supply.

The Roadmap confirms that approximately 90% of the energy generation necessary to meet the 15% target can be delivered as is set out in Table 1 below. The remaining renewable energy generation necessary to meet the 2020 target, will come from technologies such as hydropower, solar PV, and deep geothermal heat and power.

**Table 1:** *Technology breakdown (TWh) for central view of deployment in 2020*

| Technology | Central range for 2020 (TWh) |
|---|---|
| Onshore wind | 24 to 32 |
| Offshore wind | 33 to 58 |
| Biomass (electricity) | 32 to 50 |
| Marine | 1 |
| Biomass (heat) | 36 to 50 |
| Heat pumps | 16 to 22 |
| Renewable transport | Up to 48 |
| Other | 14 |
| **Estimated 15% target** | **234** |

The Climate Change Act of 2008 has been recently amended[16] to change the minimum percentage by which the net UK carbon account for the year 2050 must be lower than the 1990 baseline, with this increasing from an 80% target to a 100% target. This

[12] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources, European Union, December 2018
[13] UK Renewable Energy Roadmap, DECC, November 2013
[14] Energy Wales: A Low Carbon Transition, Welsh Government, March 2012
[15] The UK Renewable Energy Strategy, DECC, May 2009
[16] The Climate Change Act 2008 (2050 Target Amendment) Order 2019 No. 1056, BEIS, 2019

target means that it is now UK law to produce net zero carbon by the year 2050.

The information in Table 2 shows the Welsh Government's assessment of sustainable renewable energy potential for Wales as a whole from 2020 to 2025. ('A Low Carbon Revolution' – The Welsh Government Energy Policy Statement (March 2010) Appendix 1 (p19)).

**Table 2:** *Wales' sustainable renewable energy potential 2020 to 2025*

| Technology | Total capacity (GW) | Deliverable in main by |
|---|---|---|
| Onshore wind | 2 | 2015 to 2017 |
| Offshore wind | 6 | 2015 to 2016 |
| Biomass (electricity) | 1 | 2020 |
| Tidal range | 8.5 | 2022 |
| Tidal stream / wave | 4 | 2025 |
| Local electricity generation | 1 | 2020 |
| **Total (MWe)** | **22.5** | **2020 to 2025** |

## 2.3 Wales' Policy Context for Planning and Renewable Energy

### 2.3.1 The Environment (Wales) Act 2016

The Environment (Wales) Act 2016 sets a target for Welsh Government to reduce greenhouse gas emissions by at least 80% (on 1990 levels) by 2050. Welsh Government declared a climate emergency on 29th April 2019 and, as a response, accepted the recommendations from the UK Committee on Climate Change for emission reduction of 95% by 2050 with ambition to be net zero.

### 2.3.2 Prosperity for All: A Low Carbon Wales'

'Prosperity for All: A Low Carbon Wales' (March 2018) sets out the Welsh Government's approach to cut carbon emissions and increase efficiency in a way that maximises wider benefits for Wales, ensuring a fairer and healthier society. It sets out 100 policies and proposals that directly reduce emissions and support the growth of the low carbon economy.

### 2.3.3 Planning Policy Wales

Planning Policy Wales[17] states that planning policy at all levels should facilitate delivery of both the ambition set out in Energy Wales: A Low Carbon Transition and UK and European targets on renewable energy.

The Renewable Energy Directive contains specific obligations to provide guidance to facilitate effective consideration of renewable energy sources, high-efficiency technologies and district heating and cooling in the context of development of industrial or residential areas, and (from 1 January 2012) to ensure that new public buildings, and existing public buildings that are subject to major renovation fulfil an exemplary role in the context of the Directive.

The issues at the heart of these duties are an established focus of planning policy in Wales, and in this context both local planning authorities and developers should have regard in particular to the guidance contained in Technical Advice Note 8: Planning for Renewable and Low Carbon Energy – A Toolkit for Planners[18].

'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners' sets out a method that local authorities might use to produce an evidence base in support of their Local Development Plans: this evidence base is referred to as a 'Renewable Energy Assessment'.

This Renewable Energy Assessment can assist Carmarthenshire County Council planning policy officers deliver the national planning policy expectations as set out in Planning Policy Wales, namely:

**5.7.7** The planning system should secure an appropriate mix of energy provision, which maximises benefits to our economy and communities whilst minimising potential environmental and social impacts. This forms part of the Welsh Government's aim to secure the strongest economic development policies, to underpin growth and prosperity in Wales, recognising the importance of decarbonisation and the sustainable use of natural resources, both as an economic driver and a commitment to sustainable development.

**5.7.11** Planning authorities should plan positively for grid infrastructure. Development plans should facilitate the grid infrastructure required to support

[17] Planning Policy Wales, Welsh Government, December 2018

[18] Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government, September 2015

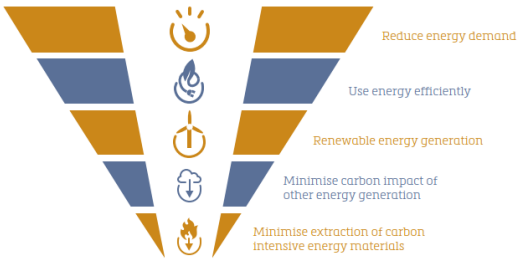
the renewable and low carbon energy potential for the area, particularly areas identified for such development. Planning authorities should support appropriate grid developments, whether or not the developments to be connected are located within their authority.

**5.7.12** Planning authorities and the energy industry, including National Grid and Distribution System Operators, should engage with each other to ensure development plans take grid infrastructure issues into account. This can also ensure investment plans for transmission and distribution align with the identified potential for renewable and low carbon energy.

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

**5.7.14** Welsh Government planning policy recognises an energy hierarchy (See Figure 1). The Welsh Government expects all new development to mitigate the causes of climate change in accordance with the energy hierarchy for planning, as set out in the following energy policies. Reducing energy demand and increasing energy efficiency, through the location and design of new development, will assist in meeting energy demand with renewable and low carbon sources. This is particularly important in supporting the electrification of energy use, such as the growing use of electric vehicles. All aspects of the energy hierarchy have their part to play, simultaneously, in helping meet decarbonisation and renewable energy targets.

**Figure 1:** *The Energy Hierarchy for Planning*




**5.7.16** The Welsh Government has set targets for the generation of renewable energy:

a. For Wales to generate 70% of its electricity consumption from renewable energy by 2030;
b. For one Gigawatt of renewable electricity capacity in Wales to be locally owned by 2030; and
c. For renewable energy projects to have at least an element of local ownership by 2020.

**5.7.18** To assist in the achievement of these targets, local authorities must take an active, leadership approach at the local or regional level, by identifying challenging, but achievable targets for renewable energy in development plans. In order to identify a measurable target, which can be assessed and monitored, it should be expressed as an absolute energy installed capacity figure. This should be calculated from the resource potential of the area and should not relate to a local need for energy.

**5.8.1** The planning system should support new development that has very high energy performance, supports decarbonisation, tackles the causes of climate change, and adapts to the current and future effects of climate change through the incorporation of effective mitigation and adaptation measures.

**5.8.2** The Welsh Government's policy is to secure zero carbon buildings while continuing to promote a range of low and zero carbon technologies as a means to achieve this.

**5.9.1** Planning authorities should facilitate all forms of renewable and low carbon energy development. In doing so, planning authorities should seek to ensure their area's full potential for renewable and low carbon energy generation is maximised and renewable energy targets are achieved.

**5.9.2** Planning authorities must develop an evidence base to inform the development of renewable and low carbon energy policies. Planning authorities should:

a. Take into account the contribution their area can make towards the reduction of carbon emission and increasing renewable and low carbon energy production;
b. Recognise that approaches for the deployment of renewable and low carbon energy technologies will vary;
c. Identify the accessible and deliverable renewable energy resource potential for their area, including heat, and consider the likely utilisation of this resource over the plan period;
d. Assess the social, economic, environmental and cultural impacts and opportunities arising from renewable and low carbon energy development;
e. Take into account the cumulative impact of renewable and low carbon energy

development and their associated infrastructure, for example grid connections;
f. Identify criteria for determining applications for sites based on their installed capacity;
g. Engage with the renewable energy development industry and consider the deliverability of schemes;
h. Take into account issues associated with grid connection (see Grid Infrastructure section) and the transportation network; and
i. Consider local and strategic priorities for renewable energy.

**5.9.4** Planning authorities should ensure development plan policies are supportive of renewable and low carbon energy development in all parts of Wales, direct developments to the right locations and set out clearly the local criteria against which proposals will be evaluated.

**5.9.5** The Welsh Government encourages the use of local renewable and low carbon energy as part of the imperative to reduce carbon emissions. Renewable and low carbon energy developments offer significant potential for communities and small businesses to develop their own projects for local benefit.

**5.9.8** Planning authorities should support and guide renewable and low carbon energy development to ensure their area's potential is maximised. Planning authorities should assess the opportunities for renewable and low carbon energy in the area and use this evidence to establish spatial policies in their development plan which identify the most appropriate locations for development. There should be a presumption in favour of development in identified areas, including an acceptance of landscape change, with clear criteria-based policies setting out detailed locational issues to be considered at the planning application stage.

### 2.3.4 Natural Resources Wales Policy

The Natural Resources Wales Policy[19] details that their main aim is a low carbon economy that delivers jobs and long erm prosperity for all, working in partnership with businesses and communities. To do this, Natural Resource Wales state that they will:

- Use decarbonisation to drive sustainable growth and expand developing markets around low carbon, renewable energy, resource efficient goods and services and to add value to the way we use our natural resources.
- Maximise the role of renewable generation to deliver secure and affordable low carbon energy for Wales. Decarbonising the energy sector will contribute to delivery of our Carbon Budgets.
- Support the delivery of low carbon energy, through a mix of different technologies and sizes, from community scale to major projects. Area Statements, the National Development Framework and Local Development Plans will provide evidence to identify locations where particular energy solutions might be appropriate.
- Help communities and businesses to use locally generated electricity and heat from renewable sources. The Welsh Government Local Energy Service will help achieve this. We will also set ambitious targets for renewable energy.
- Invest in the skills Wales will need to be competitive in a decarbonising global economy, supporting sustainable growth and innovation which will deliver a low-carbon and resource-efficient economy.
- Ensure that our consenting and regulatory regimes support the effective deployment of renewable energy technologies.

### 2.3.5 TAN8 & Ministerial Letters

Technical Advice Note (TAN) 8 (2.13) is noted whereby:

> *'The Assembly Government would support local planning authorities in introducing local policies in their development plans that restrict almost all wind energy developments, larger than 5MW, to within SSAs and urban/industrial brownfield sites. It is acceptable in such circumstances that planning permission for developments over 5MW outside SSAs and urban/industrial brownfield sites may be refused'.*

However, it is also clarified in TAN8 that it is referring only to "most areas" and elaborates that, whilst a whole county should not be covered with wind turbines, a balance is required between the desirability of renewable energy and **landscape protection** that should not result in severe restriction on the development of wind power capacity. LPAs should consider the evidence as it relates to their localities and particularly where there is potential nearby to SSA boundary lines.

The Ministerial Letter (ref: SF/CS/2027/15) dated 10 December 2015 reflects the most up-to-date position of

[19] Natural Resources Wales Policy, Welsh Government, 2017

the Welsh Government in respect of planning for renewable energy. It is clear from the letter that the Welsh Government wishes local authorities to "formulate local policies (including allocations or areas of search) … for 5MW-25MW renewable energy schemes or other low carbon energy generation", subject to the evidence.

In relation to wind energy, this REA is therefore primarily concerned with identifying opportunities for wind development of between 5MW and 25MW outside of the SSAs: but in the interest of completeness, the assessment of maximum available/potential wind resource across the Carmarthenshire LPA includes areas of land both inside and outside of the SSA.

### 2.3.6 Developments of National Significance (Procedure) (Wales) Order 2016

*The Planning (Wales) Act 2015 introduced a new category of Developments of National Significance (DNS) in Wales. These are planning applications submitted to the Welsh Government, rather than local planning authorities. The application process is defined by the Developments of National Significance (Procedure) (Wales) Order 2016 and subsequent Regulations. DNS are large infrastructure development projects of national importance, and include airports, railways, gas storage facilities, onshore wind electricity generating stations of 10 megawatts or over, and other onshore electricity generating stations of between 10 and 50 megawatts.*[20]

### 2.3.7 National Development Framework 2020 - 2040 Consultation Draft: August - 1 November 2019

The Welsh Government is developing a National Development Framework (NDF), due for completion in October 2020, which will replace the Wales Spatial Plan.

Once completed, the NDF is likely to include "Priority Areas" for large scale renewable energy developments. Large scale developments are those which are classed as Developments of National Significance and are determined by Welsh Ministers. Large scale energy developments are defined in the framework as:

- All on-shore wind generation over 10MW
- Other renewable energy generation sites with generating power between 10MW and 350MW

Large scale solar and wind generation will be favoured in the priority areas. Areas not within the Priority Areas will not carry explicit Welsh Government support for large scale developments and proposals will be determined on their individual merits.

As the details of the NDF policy framework may be subject to change, it has not therefore been included as a consideration in this REA.

### 2.3.8 Permitted Development Rights

To encourage take-up, changes have been made in Wales to 'permitted development' rights to make provision for the installation of certain types of micro-generation by householders and for non-domestic buildings without the need for planning permission, namely solar photovoltaic and solar thermal panels, ground and water source heat pumps, flues for biomass heating and other technologies.

### 2.3.9 Carmarthenshire LDP

The existing Carmarthenshire LDP runs from 2014 – 2021, a revised LDP to cover 2018 - 2033 is in the process of being produced at the time of writing.

The Carmarthenshire County council is committed in the current LDP to talking the counties carbon foot print with SP11 dedicated to renewable energy and energy efficiency.

***SP11 Renewable Energy & Energy Efficiency***

*Development proposals which incorporate energy efficiency measures and renewable energy production technologies will be supported in areas where the environmental and cumulative impacts can be addressed satisfactorily. Such developments will not cause demonstrable harm to residential amenity and will be acceptable within the landscape. Each proposal will be assessed on a case by case basis.*

Carmarthenshire County Council recognises the need for large scale wind but restricts installations to the TAN8 SSAs.

- **6.7.2** Large scale wind farms are considered to be necessary in order for WG to achieve committed energy targets. TAN8: Planning for Renewable Energy (2005) identifies seven areas in Wales that are considered to be the most appropriate locations for large scale wind farm development. These areas are known as Strategic Search Areas (SSA). SSA G: Brechfa Forest lies within Carmarthenshire, generating targets and upper limits for search areas are set by the Welsh Government. SSA

[20] Research Briefing The Planning Series: 14 – Developments of National Significance, 2016,National Assembly for Wales

E: Pontardawe is mainly located within the Neath Port Talbot and Swansea administrative boundaries, but a small part of it straddles the County boundary to the east of Ammanford. The principle of large scale wind turbine development and associated landscape change is accepted within SSAs.

- **6.7.3** This policy seeks to protect Carmarthenshire's landscape from being scattered with wind turbines, by directing large scale wind farms to Strategic Search Areas (SSAs). TAN8 has identified SSAs as being the most appropriate locations for large scale wind farm development (>25MW). The cumulative impact of wind farms can demonstrably harm the wider landscape and will be strictly controlled.

The Carmarthenshire LDP goes on to identify the need for small scale wind to meet Welsh Government targets and support for the installation of other forms of renewable generation.

- **6.7.21** This policy is applicable to all wind energy projects generating less than 25MW. Encouragement is given to the installation of local, community and small wind energy projects in appropriate locations.
- **6.7.22** Local scale and community based wind farms can play an important role in assisting to meet WG targets. Such turbines are encouraged in appropriate locations, including on previously developed land. An important consideration in assessing proposals will be the cumulative effect of turbines, with particular emphasis on turbine design and size, which can vary considerably.
- **6.7.23** Appropriate new developments will be encouraged to consider incorporating small, or microgeneration wind projects within their design. Small turbines are required to be located to, and closely related to existing buildings or structure of a similar nature. Turbines which are out of character with the area, in terms of their size or design, being over dominant in the area, will be refused. Proposals will not conflict with other policies contained within this Plan.
- **6.7.24** In assessing the cumulative impact of proposals, any unacceptable harm to the landscape, visual impact, noise, ecology and surface and groundwaters will also be considered against other wind and non-wind renewable energy installations.
- **6.7.27** The Government has promoted the installation of wind turbines in recent years as these are considered to be the best technology available in the short term to achieve targets of renewable energy generation. The assessment of proposals for wind turbines should be made in line with policies RE1 & RE2, this policy does not cover wind energy projects.
- **6.7.28** This policy covers a range of renewable energy technologies including Solar, Biomass, Hydro-Power and Combined Heat and Power. TAN8 provides technical detail and definitions for understanding the characteristics of these technologies to aid assessment of proposals. Small scale renewable energy can also be referred to as microgeneration. Microgeneration is defined under the Energy Act 2004 as: Technologies that generate electricity - 50 kW capacity (including solar photovoltaic panels, solar panels and micro-combined heat and power); or Technologies that generate heat (thermal) - 45kW capacity (including heat pumps, biomass and solar thermal).
- **6.7.29** Proposals for renewable energy technologies located within defined development limits will not cause unreasonable nuisance, and will pay due regard to the amenities of the land and people surrounding the site. Proposals should be integrated with the design of the building it is to be installed upon or close to. The impact of a proposal will be considered in relation to other policies contained within this Plan. Encouragement is given to the incorporation of renewable energy technologies in new and existing buildings in line with policies SP1 - Sustainable Places and Spaces and GP1 - Sustainability and High Quality Design.
- **6.7.30** It is acknowledged that there are certain proposals that will come forward which are located outside defined development limits. These proposals must be satisfactorily justified, for example, in the case of hydro-electricity having to be in contact with the resource being captured. Other proposals may relate to an existing property or structure that is situated outside development limits. In order to minimise the effect of development outside development limits, proposals should be located close to existing properties, buildings or structures. Proposals that would cause demonstrable harm to the landscape will not be permitted.
- **6.7.31** It is anticipated that an increasing number of proposals will come forward for large schemes to be located outside defined development limits, for example Solar Parks.

Such schemes can play an important role in assisting WG achieve its renewable energy generation targets, and for this reason, the need for the scheme will be weighed up against the need to protect the landscape from inappropriate development. Such schemes will be assessed against other policies contained within this Plan primarily relating to the impact on the landscape and biodiversity of the proposal and the cumulative impact of renewable energy installations.

- **6.7.32** Proposals for biomass facilities will be required to demonstrate that the source of the fuel used will not have an unacceptable ecological impact, domestically or elsewhere and will not adversely impact upon water resources. Developers of biomass facilities will be required to demonstrate that there is a sufficient local source of fuel for which there is no reason to suspect its availability will cease, and any fuel source options which are more local have had good cause to be ruled out.

# 3. Calculating the energy consumption in the Carmarthenshire LPA area in 2022 and 2031

## 3.1 BEIS energy reporting

The Business Energy and Industrial Strategy Department of the UK Government (formerly the Department for Energy & Climate Change) publishes annual energy consumption (GWh) at a sub national level.

**Table 3**: *Existing energy consumption (GWh) for the UK, Wales, and for Carmarthenshire in 2008 (DECC)*

| | Electricity (GWh) | Thermal (GWh) |
|---|---|---|
| UK | 304,625 | 815,624 |
| Wales | 16,267 | 55,657 |
| Carmarthenshire | 933 | 2,153 |
| % energy consumed in the BBNP | 1.06 | 1.06 |
| **Carmarthenshire LPA** | **923** | **2,130** |

The electricity and thermal consumption for Carmarthenshire during 2008 was reported as 933GWhe and 2,153GWht.

However, the BEIS dataset does not split consumption between the Carmarthenshire Local Planning Authority (LPA) area and Brecon Beacons National Park (BBNP) LPA area and so, utilising population figures sourced from Statistics for Wales (circa 1.06%[21] of the population of Carmarthenshire live in the BBNP) energy consumption has been apportioned accordingly.

This means that the energy consumption for the Carmarthenshire LPA area was 923GWhe and 2,130GWht (see Table 3).

Electricity consumption across the Carmarthenshire LPA area represented circa 6% of Wales total reported electricity consumption, and circa 0.3% of the UK's total reported electricity consumption in 2008.

Thermal consumption across the Carmarthenshire LPA area represents circa 4% of Wales total reported thermal consumption, and circa 0.3% of the UK's total reported thermal consumption in 2008.

## 3.2 Calculating future energy consumption

The UK Renewable Energy Strategy (UK RES) comprises detail of the energy consumption in 2008 and predicted future (2020) energy consumption across the UK for electricity and natural gas. The UK RES report confirms that within this period electricity energy consumption will contract by circa 0.3%, and that natural gas consumption will contract by circa 15.8%.

CCC's current Local Development Plan period runs until 2021: it is in the process of being revised and extended to 2033. Using the UK RES to derive annual rate of change (from 2008 to 2020), this REA therefore comprises a projection of energy consumption in the Carmarthenshire LPA area to 2021 and 2033. Thus, the predicted electrical and thermal annual energy consumption across the Carmarthenshire LPA area in 2021 is 920GWhe, and 1,770GWht respectively (see Table 4).

**Table 4**: *Predicted energy consumption for the Carmarthenshire LPA area in 2021 and 2033.*

| | Electricity (GWh) | Thermal (GWh) |
|---|---|---|
| Energy consumed in 2008 | **923** | **2,130** |
| Projection to 2020[22] | 99.7% | 84.2% |
| Predicted energy consumed in 2020 | 920 | 1,794 |
| Annual rate of change between 2008 and 2020 | -0.03% | -1.32 |
| Total percentage change from 2020 to 2021 | -0.03% | -1.32% |
| **Predicted energy consumption in 2021** | **920*** | **1,770*** |
| Total percentage change from 2021 to 2033 | -0.30% | -15.61% |
| **Predicted energy consumption in 2033** | **917*** | **1,494*** |

**Numbers are rounded down to whole GWh.*

[21] The data set for the population split between Carmarthenshire LPA and BBNP provided by Statistics for Wales (https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Projections/National-Park/2014-Based/populationprojections-by-year-nationalpark) begins in 2013. It is assumed that the split in 2008 is the same as 2013.

[22] Based on projected change as identified in Table 2.1, of The UK Renewable Energy Strategy (2009)

**Figure 2**: *Predicted change in energy consumed in the Carmarthenshire LPA between 2008, 2021 and 2033.*

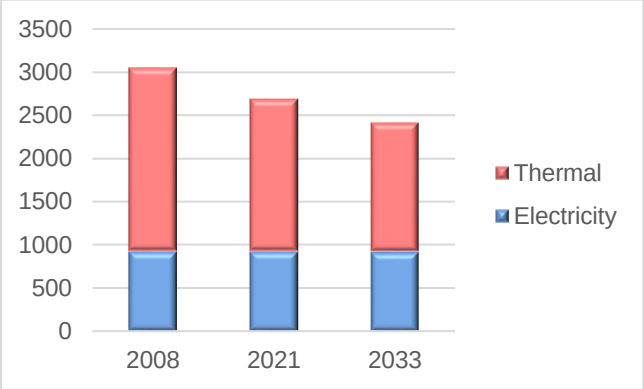



Figure 2 illustrates the predicted change in energy consumption in the Carmarthenshire LPA area between 2008, 2021 and 2033 with total electricity consumption reducing by circa 6GWh, and total heat consumption reducing by circa 636GWh.

## 3.3 LZC energy technologies in the Carmarthenshire LPA area in 2019

To understand the progress being made with the development of Low and Zero Carbon (LZC) technologies, the existing capacity (correct at 12/07/2019) of LZC technologies in the CCC LPA area has been established. Where LZC energy technologies already exist (including both those consented and to be constructed; and those under construction), the installed capacities (measured in MW) were recorded to inform discussions about future contributions.

This assessment of existing capacity includes technologies generating electricity, heat and both electricity and heat simultaneously. The assessment includes 'stand-alone' generators (such as wind farms) as well as those installed in buildings (e.g. biomass boilers).

The locations of 'stand-alone' wind and solar PV generators (unconnected to buildings) have been plotted using GIS. The installed capacities of existing energy from waste schemes and biomass schemes have also been marked for their potential contribution to supply heat to strategic new development sites.

Data for existing large-scale projects has been derived from CCC, BEIS[23] and Ofgem[24]. Data regarding LZC technologies that are providing energy to buildings are located within or on buildings, has been collected from the following sources:

- The Local Authority;
- Feed-in-Tariff (FiT) & Renewable Heat Incentive (RHI) Registers (Ofgem).

## 3.4 Capacity of LZC energy technology installations in 2019

### 3.4.1 'Stand-alone' LZC energy installations in 2019

The total capacity (including operational, under construction or consented, correct at the time of writing 12/07/2019) of 'stand-alone' renewable energy technologies in the Carmarthenshire LPA area was calculated as 300.5MWe and 0.2MWt (see Table 5). It was assumed where planning information did not include the size of the wind turbine or solar PV panels these installations were building integrated.

**Table 5**: *Renewable energy generation from 'stand-alone' installations in the Carmarthenshire LPA area at 12/07/ 2019*

| Technology | Electricity (MWe) | Thermal (MWt) |
|---|---|---|
| Biomass | 0 | 0 |
| Hydropower | 6.6 | - |
| Landfill Gas | 2.3 | 0 |
| Wind Power | 164.1 | - |
| Solar PV Farms | 126.5 | |
| Other (anaerobic digestion) | 1.0 | 0.23 |
| **Total** | **300.5** | **0.23** |

Of the above total for electricity generation, wind energy (including the SSAs) accounts for 164.1MWe, hydro 6.6MWe, solar PV farms 126.5MWe, landfill gas 2.3MWe and anaerobic digestion the remaining 1MWe. There is a potential 6MWt from existing renewables however the location of the Nant y Caws Landfill site means that there is no heat demand within a viable distance of the plant. The potential 5MWt generated by landfill gas and anaerobic generation on the site is

[23] BEIS (2019) *REPD Monthly Extract,* https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract.

[24] Ofgem (2019) *Renewables & CHP – Accredited Stations,* https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.aspx?ReportVisibility=1&ReportCategory=0 .

therefore unused. Likewise, one out of the two other anaerobic digesters in Carmarthenshire, is on a farm which is not currently using the thermal energy. The current thermal generation in Carmarthenshire at the time of writing is therefore only 0.23MW

In the context of overall Welsh Government renewable energy targets as set out in the Energy Policy Statement[25], and including operational, under construction and consented, the Carmarthenshire LPA area could be contributing approximately 8% of the target of 2GW of electrical energy associated with onshore wind.

### 3.4.2 Capacity of 'building-integrated' LZC installations in 2017

**Table 6**: *Renewable energy generation from 'building-integrated' installations in the Carmarthenshire LPA area in 2019*

| Technology | Electricity (MW) | Thermal (MW) |
|---|---|---|
| Hydropower | - | - |
| CHP | 0.5 | 0.7 |
| Photovoltaic | 9.2 | - |
| Other | - | 34.3 |
| Wind Power | 19.8 | - |
| **Total** | **29.4** | **35.0** |

As outlined in Table 6, the total installed capacity of 'building-integrated' renewable energy installations in the Carmarthenshire LPA area (as at 12/07/2019) was calculated as 29.4MWe, and 35.0MWt. Photovoltaic systems accounted for circa 9.2MWe, with micro-wind generating 19.8MWe.

The breakdown of technology types is unknown for renewable heat generation but the RHI register identifies 218 'non-domestic' renewable heat installations with installed capacity of 31.3MWt. 606 domestic renewable heat installations are also identified but with no installed capacities: we have assumed 5kW per dwelling giving a total additional figure of 3.03MWt, giving a total of 34.3MWt under other.

The total existing renewable installed capacity in the Carmarthenshire LPA area in 2019 was calculated as 330MWe of electrical power, and 35.2MWth of thermal energy.

The maximum amount of energy that could be generated from the above installations depends upon the capacity factor, which is discussed in the section of this report entitled 'Identifying the Local Planning Authority Wide Contribution to the National Targets'. Based on typical capacity factors, the total theoretical renewable energy generation in the Carmarthenshire LPA area as at 12/07/2019 is calculated as 562GWhe (561,895 MWhe), and 62GWht (62,278 MWht).

**Figure 3**: *Difference between the renewable energy generation (GWh) of current (2019) installations and predicted consumption (in 2021 and 2033)*

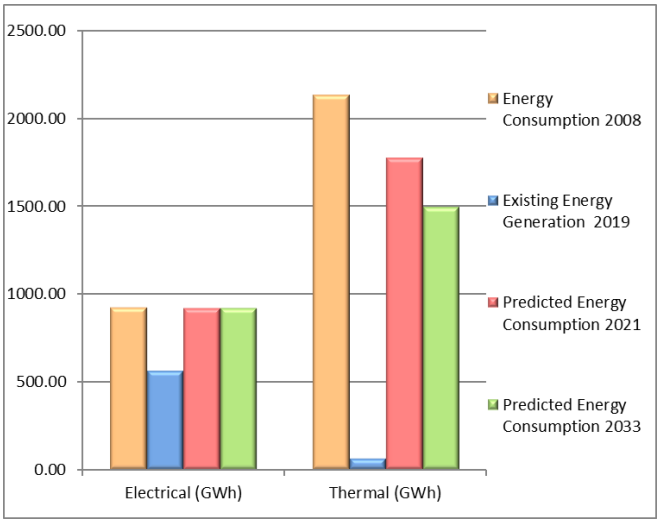



Figure 3 shows a comparison of the potential amount of energy that could be generated by currently installed renewable energy technologies and the predicted energy consumption across the Carmarthenshire LPA area in 2021 and 2033.

[25] A Low Carbon Revolution – The Welsh Assembly Government Energy Policy Statement; March 2010

# 4. Wind Energy Resource

## 4.1 Introduction

The focus of this section of the REA is on establishing the potential wind resource across the Carmarthenshire LPA area.

For the purposes of planning policy in Wales large scale wind power has been defined in TAN 8 as wind farms of greater than 25MW. Wind farms with more than 25MW of generating capacity can only be sited in an SSA.

TAN 8 provides details of 'Strategic Search Areas' (SSA), sites identified as suitable and potential locations for large scale wind.

There is one large SSA in the north of Carmarthenshire (SSA G: Brechfa Forest), running from east of Allt-Walis to the south of Llanybydder before turning south to Abergorlech, see Figure 4.

There is a second SSA that infringes on Border of Carmarthenshire south east of Ammanford (SSA E: Pontardawe).

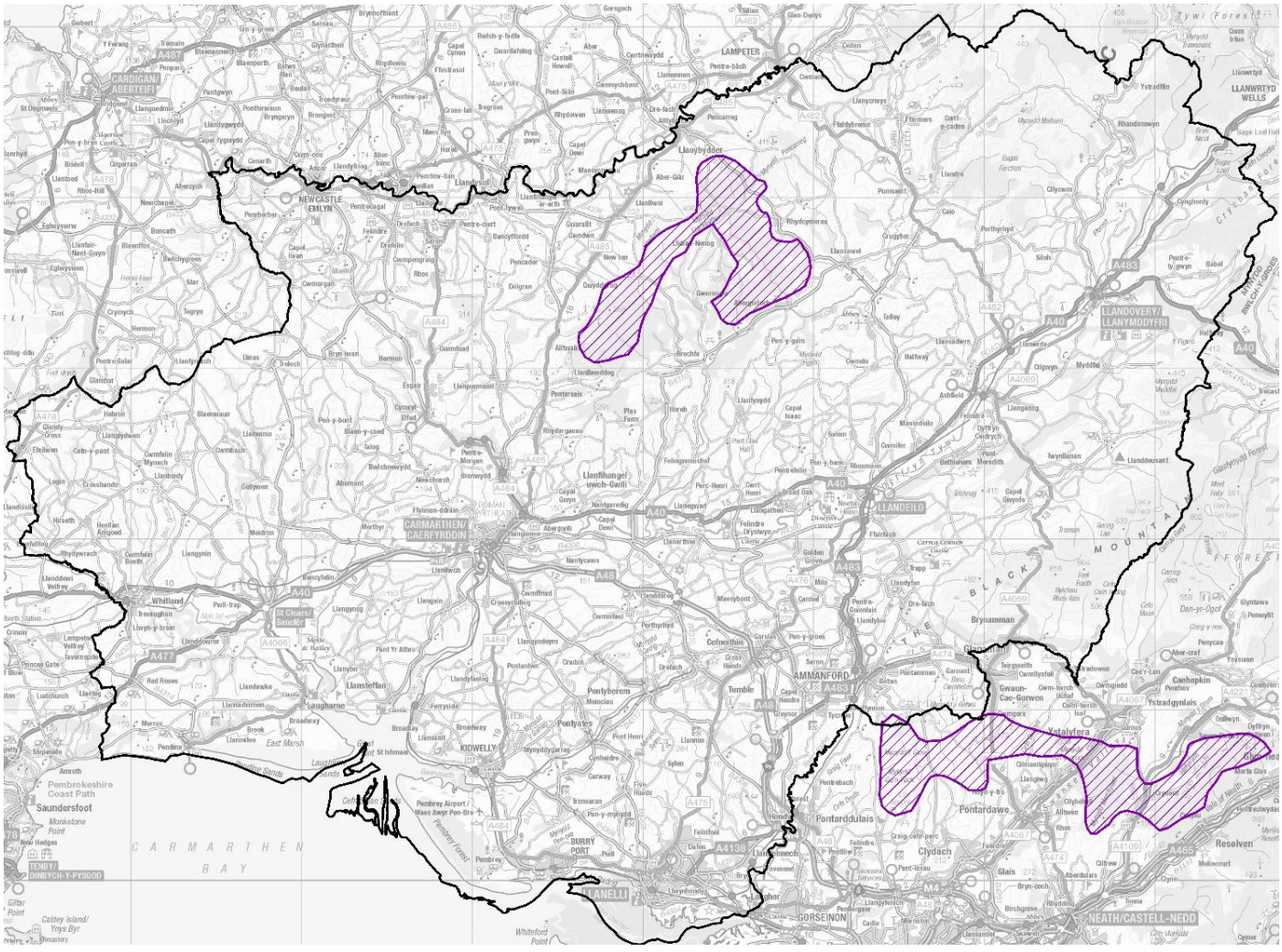
Technical Advice Note (TAN) 8 (2.13) is noted whereby:

> *'The Assembly Government would support local planning authorities in introducing local policies in their development plans that restrict almost all wind energy developments, larger than 5MW, to within SSAs and urban/industrial brownfield sites. It is acceptable in such circumstances that planning permission for developments over 5MW outside SSAs and urban/industrial brownfield sites may be refused'.*

However, it is also clarified in TAN8 that it is referring only to "most areas" and elaborates that, whilst a whole county should not be covered with wind turbines, a balance is required between the desirability of renewable energy and **landscape protection** that should not result in severe restriction on the development of wind power capacity. LPAs should consider the evidence as it relates to their localities and particularly where there is potential nearby to SSA boundary lines.

The Ministerial Letter (ref: SF/CS/2027/15) dated 10 December 2015 reflects the most up-to-date position of the Welsh Government in respect of planning for renewable energy. It is clear from the letter that the Welsh Government wishes local authorities to "formulate local policies (including allocations or areas

**Figure 4***: TAN 8 areas within Carmarthenshire*



of search) for 5MW-25MW renewable energy schemes or other low carbon energy generation", subject to the evidence.

In relation to wind energy, this REA is therefore primarily concerned with identifying opportunities for wind development of between 5MW and 25MW outside of the SSA: but in the interest of completeness, the assessment of maximum available/potential wind resource across the Carmarthenshire LPA includes areas of land both inside and outside of the SSA.

## 4.2 Mapping

Maps have been produced to illustrate at each stage the process of identifying spatial constraints and opportunities. Throughout, reference is made to titles and reference numbers to correspond with maps contained in the accompanying document 'Carmarthenshire Renewable and Low Carbon Energy Assessment 2019 – Maps'. The maps follow a series of steps as follows:

### 4.2.1 Step 1:

### 4.2.2 Map Reference & Title: W1 – Wind Resource in the Carmarthenshire LPA Area

A map has been produced to show wind speeds sufficient for the development of wind farms. The performance of wind turbines is a function of wind speed. Utilising Ordnance Survey maps and Meteorological Office data sourced via the Welsh Government, AECOM has created a 1.5km$^2$ grid GIS data layer for the Carmarthenshire LPA area showing average annual wind speed at 45m above ground level (agl) attributed to each respective 1.5km$^2$ cell.

Areas with wind speeds greater than 6.5m/s and those between 6.0m/s and 6.5m/s are differentiated in order to inform an area prioritisation exercise later in in the process. It has been assumed that there is no wind energy potential in areas with an average annual wind speed of less than 6.0m/s.

At this stage, the areas shown on the map are only constrained by the Carmarthenshire LPA and the BBNP LPA boundaries.

### 4.2.3 Step 2:

### 4.2.4 Map Reference & Title: W2 - Statutory and Strategic Constraints

To establish the potential wind energy resource across the Carmarthenshire LPA area, consideration has been given to the spatial constraints associated with restrictions to wind energy development. A comprehensive table of the data sources and assumptions used is given in Appendix B.

There are numerous constraints when considering wind energy development to establish the maximum potential wind resource across the Carmarthenshire LPA area, and these are discussed below.

#### 4.2.4.1 Statutory Designations

The wind constraints maps illustrate the principal constraints to the development/ deployment of wind energy. Many of the constraints can be attributed to statutory designations such as environmental and historic protected sites. The statutory designations utilised for this assessment are as follows:

- Special Protection Areas (SPA) and foraging buffers
- Special Areas of Conservation (SAC)
- Candidate Special Areas of Conservation (cSAC)
- RAMSAR sites
- National Nature Reserves (NNR)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- Scheduled Ancient Monuments (SAM)
- Areas of Outstanding Natural Beauty (AONB)
- National Parks (already constrained in Map 1)

#### 4.2.4.2 Non-Statutory Considerations

The purpose of this assessment is to establish, through the identification of constrained areas, the maximum potential wind energy resource across the Carmarthenshire LPA area.

Many of the non-statutory designations are specifically linked to minimising potential impacts upon people or infrastructure through the application in the maps of buffer areas. The extent of the buffer areas are informed directly by the characteristics of the turbine (e.g. height of turbine; etc.).

This assessment is based on constraints associated with a typical 2 MW wind turbine[26] to maintain consistency with the Welsh Government guidance contained in 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners'[27]. For ease of reference, the assumptions about the wind turbine are:

- Rated output: 2MW
- Hub height: 80m
- Rotor diameter: 80m
- Height to blade tip at the highest point ("tip height"): 120m

Noise buffers have been applied by AECOM around existing buildings. Given the noise related impact that wind turbines can have on building occupants, particularly residents, and the spatial extent that such an impact can have on identifying potentially available wind resource, this study has assumed there will be no wind energy development within 500m distance of any buildings.

The non-statutory designations considered are:

- Ancient Woodlands
- Major transport infrastructure – Topple distance plus 50m
- Minor transport infrastructure – Topple distance plus 10%
- Existing buildings – 500m (Noise Buffer)
- Protected Landscapes (National Parks & AONBs 7km)
- Strategic Search Areas, existing and consented (but not yet constructed) wind farms and those proposed in the planning system as of 12/07/2019 (7km)[28]
- Watercourses – including major, secondary and minor rivers, canals and lakes.
- Woodlands – including broad leaved woodland and ancient woodlands.
- Aviation and radar – includes data supplied by Ministry of Defence (MOD), National Air Traffic Service (NATS), Civil Aviation Authority (CAA) and Low Flying Tactical Training Areas.
- Areas of thick peat

### 4.2.5 Step 3

### 4.2.6 Map Reference & Title: W3 – Wind Resource Available

At this stage of the assessment, land slivers, fire breaks and tracks, as well as parcels of land insufficient to support a wind farm of 5MW or more (this is a minimum of 0.5km$^2$ based on using 2MW turbines) are removed from the maps.

**There are no remaining least constrained land parcels of sufficient area to identify wind LSAs for local authority wide schemes of installed capacity range 5-25MW.**

### 4.2.7 Step 4:

### 4.2.8 Map Reference & Title: W4 – Local Constraints

**There is no map**

The following additional local non-statutory constraints are applied:

- Local Nature Reserves
- Conservation Areas
- Registered Historic Landscapes
- Windfarms not in TAN 8 Strategic Search Areas, existing and consented (but not yet constructed) wind farms and those proposed in the planning system as of 12/07/2019 (7km)[29]
- Woodlands – All other woodlands

[26] It should be noted that this does not preclude the potential development / deployment of larger or smaller wind turbines across the Carmarthenshire LPA area.

[27] Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government 2015 Update

[28] This includes wind development outside of the boundary of the county where the 7km cumulative impact buffer extends inside the Carmarthenshire LPA area.

[29] This includes wind development outside of the boundary of the county where the 7km cumulative impact buffer extends inside Carmarthenshire.

### 4.2.9 Step 5

### 4.2.10 Map Reference & Title: W5 – Wind Resource Available

**There is no map**

At this stage of the assessment, land slivers, fire breaks and tracks, as well as parcels of land insufficient to support a wind farm of 5MW or more (this is a minimum of 0.5km$^2$ based on using 2MW turbines) are removed from the maps.

**There are no remaining least constrained land parcels of sufficient area to identify wind LSAs for local authority wide schemes of installed capacity range 5-25MW.**

### 4.2.11 Step 6

### 4.2.12 Map Reference & Title: W6 – Wind Resource Available within Grid Connection

**There is no map**

Onshore wind farms require a connection to the grid to which to export the electricity.
PPW[30] requires consideration of the electricity grid as part of the renewable energy evidence base to inform LDP policies.

A key constraint to the development of wind farms can be the cost of connecting to the electricity grid. A high-level cost analysis exercise has been undertaken.

Similar to the approach taken in the development of TAN8[31], areas that are considered likely to be too distant to connect to grid cost effectively have been constrained.

Electricity grid comprising 33, 66 and 132kV has been mapped with only sites with available resource within 10km of any line being considered accessible[32].

**There are no remaining least constrained land parcels of sufficient area to identify wind LSAs for local authority wide schemes of installed capacity range 5-25MW.**

### 4.2.13 Step 7 – Wind Farm Initial Local Search Areas

### 4.2.14 Map Reference & Title: W7 – Wind Land to be Assessed for Landscape Impact

**There is no map**

**There are no remaining least constrained land parcels of sufficient area to identify wind LSAs for local authority wide schemes of installed capacity range 5-25MW.**

**There are no LSAs identified.**

It should be noted that technology advances could enable single turbines which meet the policy thresholds to come forward anywhere there is potential resource and subject to site specific assessment.

It is also anticipated there will still be some wind contribution in the REA through smaller schemes and single turbines.

## 4.3 Maximum available wind resource

This report has assumed that a maximum of five 2 MW wind turbines can be installed on 1km$^2$ of land. Therefore, the minimum area for a 5MW wind farm is 0.5km$^2$.

The total area of unconstrained wind resource informs the calculation of the total potential capacity and informs the setting of renewable energy contributions from the Carmarthenshire LPA area. Assuming that over the course of a year a 2 MW wind turbine will only generate energy for 27%[33] of the time (2,365 hours), the total potential energy (GWh) has been calculated.

[30] Planning Policy Wales (Edition 9), Welsh Government November 2016

[31] 'Facilitating Planning for Renewable Energy in Wales- Meeting the Target - Final Report 'Welsh Assembly Government July 2004 Section 5.3.4

[32] Whilst grid information has been utilised to constrain some sites, it does not imply that remaining sites could connect: studies would need to be conducted in detail for each individual project.

[33] DUKES 2009, cited in Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government 2015 Update

**Table 7**: *Theoretical maximum potential wind resource ($km^2$) for the Carmarthenshire LPA area excluding the SSA.*

| Wind Resource | |
|---|---|
| Area ($km^2$) | 0 |
| Potential Capacity (MW) | 0 |
| Generating Time (hours /year) | 8,760 |
| Capacity Factor (%) | 27 |
| **Potential Energy Generated (GWh)** | **0** |

The installed capacity figure represents the maximum accessible wind resource in the Carmarthenshire LPA area, excluding the SSA (which is counted as 'existing generation'). Therefore, the additional future potential is outlined in Table 7

## 4.4 Further constraints to wind energy sites

Further constraints to onshore wind development not considered within this REA include (and this is not meant to be an exhaustive list):

- Practical access to sites required for development;
- Landowner willingness for development to go ahead;
- Political will;
- Time to complete planning procedures.
- An economic distance to the nearest appropriate electricity grid connection.

## 4.5 Potential opportunities for future development

In relation to wind energy, potential opportunities for CCC could be:

- Investment interest of Energy Services Companies (ESCOs);
- CCC involvement with ESCO to secure greater community benefits;
- Wind farms can provide significant revenue streams.

# 5. Biomass Energy Resource

## 5.1 Introduction

The focus of this section of the REA is on establishing the potential biomass resource defined as either:

- Energy crops (miscanthus & short-rotation coppice), or;
- Wood fuel resource.

There is no consideration of the utilisation of straw as an energy source as Wales is a net importer.

Unlike wind farms, biomass can be utilised for the generation of both electricity and heat & domestic hot water (DHW).

The use of energy crops, forestry residues and recycled wood waste for energy generation can have a number of advantages:

- Provide opportunities for agricultural diversification;
- Encourage increased management of woodland;
- Can have positive effects on biodiversity;
- Remove biodegradable elements from the waste stream;
- $CO_2$ savings if replanting occurs and long-distance transportation is avoided.

The Welsh Government's Energy Policy Statement (2010) confirms a target of 1,000MWe (1GWe) capacity from biomass by 2020. This is circa 7TWh per annum of electrical production coming from biomass.

There are currently no large scale biomass plants within Carmarthenshire. There are however a small number of domestic/residential applications to install biomass boilers.

## 5.2 Constraints to biomass energy resource

To establish the potential biomass energy resource across the local planning authority area, consideration has been given to the spatial constraints associated with restrictions to harvesting energy crops and wood fuel. The assessment used the following principal constraints to biomass energy to establish the maximum potential biomass energy resource across Carmarthenshire County Council:

- Agricultural land classification;
- Areas of broadleaved woodland;
- Areas of environmental protection (including ancient woodlands);
- Areas of historic and cultural importance.

A comprehensive table of the sources and assumptions used is given in : Biomass Energy Resource Methodology.

## 5.3 Energy Crops

### 5.3.1 Usable land and crop yield

The principal constraint to harvesting energy crops across Carmarthenshire County Council is the availability of suitable agricultural land. This study has assumed that energy crops can only be potentially grown on agricultural land of Grade 4[34], which is not constrained by environmental or historical protected areas.

The majority (90%) of agricultural land across the Carmarthenshire LPA is classified as either Grade 4 or 5, the latter likely being unsuitable for growing energy crops.

Based on the above constraints the theoretical maximum area of land that could be planted with energy crops across the Carmarthenshire LPA is identified as 918.68 $km^2$. This gives consideration to existing agricultural land classifications, environmental and cultural constraints on the land.

For this assessment it is then assumed that only 10% of the suitable land area identified for energy crops could actually be planted with energy crops. This reflects a range of factors including, for example, competition with other crops, livestock grazing, solar PV farms as well as unsuitable topography. Therefore, the total usable area of land for energy crops across the Carmarthenshire LPA is 91.87 $km^2$.

'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners' (Welsh Government; 2015) confirms an average figure of 1,200 oven dried tonnes (odt) of energy crops can be delivered per $km^2$. Therefore, the total energy crop yield across

[34] The classification is Grade 4 - poor quality agricultural land. Land with severe limitations which significantly restrict the range of crops and/or level of yields. It is mainly suited to grass with occasional arable crops (e.g. cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties in utilisation. The grade also includes very droughty arable land.

Carmarthenshire County Council is 110,242 odt per annum.

### 5.3.2 Technologies

#### 5.3.2.1 Installed Power and Heat Generation Capacity

The amount of energy that the potential quantity of biomass could produce will be dependent on whether the fuel is burnt in facilities that only generate electricity (and the waste heat is not used), or produce Combined Heat and Power (where the heat is used), or is burnt in a boiler to produce heat only.

For the purposes of this assessment, it has been assumed that the energy crop resource is used to fuel a biomass CHP system to produce electricity and heat. A typical biomass CHP system will require about 6,000odt of energy crops for each 1MWe of installed power generation capacity. The biomass CHP system will also simultaneously produce about 2MWt

Table 8 confirms the maximum potential energy crop resource for the Carmarthenshire LPA.

**Table 8**: *Total potential energy crop resource for the Carmarthenshire LPA area*

| Energy Crop | |
|---|---|
| Available area (km$^2$) | 918.68 |
| Usable area (km$^2$) | 91.87 |
| Yield (odt per km$^2$) | 1,200 |
| Yield (odt) | 110,242 |
| Required yield per MWe | 6,000 |
| **Potential installed capacity (MWe)** | **18.37** |
| Heat to power ratio | 2:1 |
| **Potential installed capacity (MWt)** | **36.75** |

## 5.4 Wood Fuel

### 5.4.1 Usable land and yield

The total area of national forest across the Carmarthenshire LPA as identified by the National Forestry Inventory (NFI) database is 399.8 km$^2$, of which 113.2 km$^2$ is located on Natural Resources Wales (formerly Forestry Commission) owned land.

The Bioenergy Action Plan for Wales confirms that 60 oven dried tonnes (odt) of available wood fuel per km$^2$ of woodland per annum. Therefore, the total wood fuel yield from all national forest across the Carmarthenshire LPA area is 23,989odt per annum, of which 6,791odt per annum could be derived from Natural Resource Wales (formerly Forestry Commission) owned land.

This is a long term, annual averaged sustainable yield, based on wood fuel that can be harvested from the small round wood stems, tips and branches of felled timber trees and thinning as well as poor quality round wood. This figure takes into account of competition from other markets in Wales, such as particle board manufacturing. The figure also takes into account technical and environmental constraints.

### 5.4.2 Technologies

#### 5.4.2.1 Installed Power and Heat Generation Capacity

The amount of energy that the potential quantity of biomass could produce will be dependent on whether the fuel is burnt in facilities that only generate electricity (where the heat is not used) or produce Combined Heat and Power (where the heat is usefully employed) or is burnt in a boiler to provide Space Heating (SH) and/or Domestic Hot Water (DHW).

For the purposes of this assessment, it is assumed that the energy resource from wood fuel is utilised for SH and/or DHW (i.e. a biomass boiler). Utilised in this way, a biomass boiler will require about 60odt of wood fuel for each 1MWt of installed capacity.

**Table 9:** *Total potential energy resource from wood fuel for the Carmarthenshire LPA area*

| **Wood fuel** | |
|---|---|
| Available area (km$^2$) | 399.8 |
| Usable area (km$^2$) | 399.8 |
| Yield (odt per km$^2$) | 60.0 |
| Yield (odt) | 23,989 |
| Required yield per MWt | 660 |
| **Potential installed capacity (MWt)** | **36.3** |

Table 9 confirms the maximum potential biomass resource for Carmarthenshire County Council.

**Of the potential 36.3 MWt that could be derived from woodland residue across the Carmarthenshire LPA, 10.3 MWt could be derived from NRW owned land.**

## 5.5 Further constraints to biomass energy resource

Although where areas of land have been indicated as having potential for the growing of energy crops, further detailed studies are required prior to action. Furthermore, market demand is likely to play a key role in what, and how much is planted.

Even where there is local demand for a biomass supply, constraints (not considered within this REA) can persist including, for example, the proximity of supply to the plant and practical access to sites required for the preparation and delivery of fuel.

In terms of biomass plant, landowner willingness, political will, the time involved in completing planning applications and an economic distance to the nearest appropriate electricity grid connection will all be key considerations but are not considered within this assessment.

Biomass is most usually utilised for electricity generation (normally situated away from residential development) or for heating non-domestic buildings where there is sufficient room for fuel storage and access for large delivery vehicles.

## 5.6 Potential opportunities for future development

In relation to biomass energy generation, potential opportunities for CCC are:

- Investment interest of Energy Services Companies (ESCOs) may be secured through the identification of appropriate sites and heat demand;
- Biomass fed renewable installations can provide significant revenue streams to LA's, including from the Renewable Heat Incentive.

# 6. Energy from Waste

## 6.1 Introduction

Local Waste Planning Authorities (LWPAs) develop detailed plans on how to treat the Municipal Solid Waste (MSW) stream arising in the LWPA area. Some LWPAs, such as CCC work with neighbours and Regional Waste Teams to investigate preferred options for the treatment of waste.

Regional Waste Strategies (RWS) comprise details of which particular technologies for treating waste will be employed, their capacities and preferred locations. Therefore, as well as informing this REA, the findings of this REA should be incorporated within the RWS to ensure that planned generation of energy from waste plant is considered to the fullest extent.

Whilst LWPAs manage the MSW stream, less is known about the plans of commercial waste operators to treat commercial and industrial waste streams. Organisations involved in such activity should be fully engaged to ensure that opportunities to utilise energy are not lost.

Further guidance should be sought from the Welsh Government in relation to whether energy from waste (EfW) from some or all EfW technologies is, or will be, considered to be 'renewable' energy and, where it is confirmed to be 'renewable', for what proportion of the residual waste stream (the proportion usually refers to the proportion of residual waste deemed to be the biodegradable (BD) element).

Towards Zero Waste[35] describes the long-term framework for resource efficiency and waste management up to 2050. It proposed the following targets for municipal waste:

- A minimum of 70% of waste being reused, recycled or composted by 2025;
- A maximum level of 30% energy being created from waste by 2025;
- Wales to achieve zero waste by 2050.

Other targets for consideration include that waste fuelled CHP must achieve an operating efficiency of a minimum of 65%[36].

Additional potential energy sources derived from waste as reported on in the Bioenergy Action Plan for Wales include food waste; agricultural wastes; and sewage sludge. As such this section of the REA will report under the following subheadings:

- Commercial and Industrial Waste (C&I)
- Municipal Solid Waste (MSW)
- Agricultural Waste
- Sewage Sludge

A comprehensive table of the sources and assumptions used is given in : Energy from Waste Resource Methodology.

## 6.2 Commercial and Industrial Waste

The total predicted C&I waste across Carmarthenshire in 2021 and 2033, is projected using www.statswales.wales.gov.uk figures and projections of residual waste from 'Collections, Infrastructure and Markets Sector Plan' (Welsh Government 2013) for the method us to produce the waste projections see Appendix D. It has been calculated as 6,902 tonnes and 4,694 tonnes respectively.

The data utilised to inform this calculation did not enable the identification of the origin of the waste. An apportionment[37] has been undertaken to remove the C&I waste element originating in the BBNP. The Brecon Beacons National Park (BNP) proportion is calculated utilising population figures (1.01% of the population of CCC are projected to live in the BBNP in 2021 and 1.22% in 2033), leaving a **total figure for C&I waste in the CCC LPA area of 6,833 tonnes for 2021 and 4,636 tonnes for 2033.**

However, to avoid conflict with existing recycling targets, it has been assumed that only 30% of this waste stream would be available for energy recovery. Therefore, the total predicted C&I waste that could be used for energy recovery across the Carmarthenshire LPA area is 2,050 tonnes for 2021 and 1,391 tonnes for 2033.

Energy from Waste facilities in Wales are required to be at least 65% efficient[27] and therefore cannot generate electricity without using some of the heat. It has therefore been assumed that C&I waste will be burnt in facilities that produce Combined Heat and Power where the heat is usefully employed.

[35] Towards Zero Waste One Wales: One Planet, WAG March 2011

[36] Waste Framework Directive from Commission Directive (EU) 2015/1127

[37] The percentage figures based on StatsWales figures for projected population of Carmarthenshire and the projected population for Carmarthenshire within the BBNP.

**Table 10***: Commercial and Industrial waste resource for the Carmarthenshire LPA area in 2021 and 2033*

| Commercial & Industrial Waste | 2021 | 2033 |
|---|---|---|
| Total waste (tonnes) | 6,909 | 4,694 |
| Proportion in BBNP | 1.01% | 1.22% |
| Total waste excluding BBNP (tonnes) | 6,833 | 4,636 |
| Total residual waste (tonnes) | 2,050 | 1,391 |
| Required wet tonnes per 1MWe | 10,320 | 10,320 |
| Potential installed capacity (MWe) | 0.199 | 0.135 |
| Total renewable element (35%) | 35% | 35% |
| **Potential installed capacity (MWe)** | **0.070** | **0.047** |
| Heat to power ratio | 2:1 | 2:1 |
| **Potential installed capacity (MWt)** | **0.139** | **0.094** |

Assuming that 10,320 tonnes of waste per annum are required for each 1MWe of electricity generating capacity in a CHP plant, and that a CHP facility will also produce about 2MWt of thermal output at the same time from the waste heat, the total potential capacity that could be supported by the C&I waste stream in the Carmarthenshire LPA area would be: 0.199MWe (2050/10,320) and 0.398MWt for 2021 and 0.135 MWe and 0.270 MWt for 2033.

However, under the requirements of the EU Renewable Energy Directive[38], which is the basis for the UK's target of 15% of energy to come from renewable sources by 2020, only the Biodegradable (BD) fraction of energy generation from waste is eligible to count towards the target.

There is no specific guidance in Wales on what the BD fraction should be assumed to be in future. The UK Government consultation on the re-banding of the Renewables Obligation suggested that the anticipated future biodegradable fraction, by 2020, would be about 35%, compared to a current nominal level of about 50%[39] [40]. Therefore assuming that 35% of the power and energy output of any waste facility count as renewable, **the renewable electricity and heat capacity across the Carmarthenshire LPA area for C&I waste would be: 0.070MWe and 0.139MWt for 2021; and 0.047MWe and 0.094MWt for 2033 respectively**, as shown in Table 10.

## 6.3 Municipal Solid Waste

The total predicted MSW across Carmarthenshire in 2021 and 2033, is projected using www.statswales.wales.gov.uk figures and projections of residual waste from 'Collections, Infrastructure and Markets Sector Plan' (Welsh Government 2013) for the method us to produce the waste projections see Appendix D. It has been calculated as 71,816 tonnes and 67,884 tonnes respectively.

The data utilised to inform this calculation did not enable the identification of the origin of the waste. An apportionment[41] has been undertaken to remove the MSW waste element originating in the BBNP. The proportion of waste originating in the BBNP are of Carmarthenshire is calculated utilising population figures (1.01% of the population of CCC are projected to live in the BBNP in 2021 and 1.22% in 2033), leaving a **total figure for MSW waste in the Carmarthenshire LPA area of 71,093 tonnes for 2021 and 67,055 tonnes for 2033.**

However, to avoid conflict with existing recycling targets, it has been assumed that only 30% of this waste stream would be available for energy recovery. Therefore, the total predicted MSW waste that could be used for energy recovery across the Carmarthenshire LPA area is 21,328 tonnes and 20,117 tonnes.

Energy from Waste facilities in Wales are required to be at least 65% efficient[27] and therefore cannot generate electricity without using some of the heat. It has therefore been assumed that MSW waste will be burnt in facilities that produce Combined Heat and Power where the heat is usefully employed.

Assuming that 10,320 tonnes of waste per annum are required for each 1MWe of electricity generating capacity in a CHP plant, and that a CHP facility will also produce about 2MWt of thermal output at the

[38] See http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[39] See para. 9.10 of the Government Response to the Statutory Consultation on the Renewables Obligation Order 2009, December

[40] see http://www.berr.gov.uk/files/file49342.pdf

[41] The percentage figures based on StatsWales figures for projected population of Carmarthenshire and the projected population for Carmarthenshire within the BBNP.

**Table 11**: *Municipal Solid Waste resource for the Carmarthenshire LPA area in 2021 and 2033*

| MSW | 2021 | 2033 |
|---|---|---|
| Total waste (tonnes) | 71,816 | 67,884 |
| Proportion in BBNP | 1.01% | 1.22% |
| Total waste excluding BBNP (tonnes) | 71,093 | 67,055 |
| Total residual waste (tonnes) | 21,328 | 20,117 |
| Required wet tonnes per 1MWe | 10,320 | 10,320 |
| Potential installed capacity (MWe) | 2.07 | 1.95 |
| Total renewable element | 35% | 35% |
| **Potential installed capacity (MWe)** | **0.72** | 0.68 |
| Heat to power ratio | 2:1 | 2:1 |
| **Potential installed capacity (MWt)** | **1.45** | **1.36** |

same time from the waste heat, the total potential capacity that could be supported by the MSW waste stream in the Carmarthenshire LPA area would be: 2.07MWe and 4.13MWt for 2021; and 1.95MWe and 3.90MWt for 2033.

However, under the requirements of the EU Renewable Energy Directive[42], which is the basis for the UK's target of 15% of energy to come from renewable sources by 2020, only the Biodegradable (BD) fraction of energy generation from waste is eligible to count towards the target.

There is no specific guidance in Wales on what the BD fraction should be assumed to be in future. The UK Government consultation on the re-banding of the Renewables Obligation suggested that the anticipated future biodegradable fraction, by 2020, would be about 35%, compared to a current nominal level of about 50%[43] [44].

Therefore assuming that 35% of the power and energy output of any waste facility count as renewable, **the renewable electricity and heat capacity across the Carmarthenshire LPA area for waste would be: 0.72MWe and 1.45MWt for 2021; and 0.68MWe and 1.36MWt for 2033 respectively**, as shown in Table 11.

## 6.4 Food Waste

According to StatsWales data for 2017/2018, Food waste from the MSW stream for Wales accounts for 118,143t/yr of the 904,105t/yr of waste that is recycled or composted nationally: this equates to 13.07%.

The total quantity of MSW food waste composted in Carmarthenshire in 2017/18 was 6,630 tonnes. Carmarthenshire's population in 2017 was 186,452, producing 0.036 tonnes of composted food waste per annum per person. Given that Carmarthenshire's population is expected to rise by an average 0.1% per annum it has been estimated that Carmarthenshire will generate 6,653 tonnes of food waste in 2021 and 6,732 tonnes of food waste in 2033.

An apportionment[45] has been undertaken to remove the food waste element originating in the BBNP. The proportion of food waste generated in the BBNP part

**Table 12**: *Potential installed capacity from total available food waste resource in the Carmarthenshire LPA area in 2021 and 2033*

| Resource from Food Waste | 2021 | 2033 |
|---|---|---|
| MSW food waste (tonnes) | 6,586 | 6,650 |
| Required tonnes per MWe | 20,000 | 20,000 |
| **Potential installed capacity (MWe)** | **0.33** | **0.33** |
| Heat to power ratio | 1.5:1 | 1.5:1 |
| **Potential installed capacity (MWt)** | **0.49** | **0.50** |

[42] See http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[43] See para. 9.10 of the Government Response to the Statutory Consultation on the Renewables Obligation Order 2009, December

[44] see http://www.berr.gov.uk/files/file49342.pdf

[45] The percentage figures based on StatsWales figures for projected population of Carmarthenshire and the projected population for Carmarthenshire within the BBNP.

of Carmarthenshire is calculated utilising population figures (1.01% of the population of CCC are projected to live in the BBNP in 2021 and 1.22% in 2033), leaving **a total figure for MSW food waste in the Carmarthenshire LPA area of 6,586 tonnes in 2021 and 6,650 tonnes in 2033.**

An Anaerobic Digestion plant would be suitable to use food waste to produce both electric and heat. With reference to the 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners (Welsh Government, 2015), it can be assumed that 20,000 tonnes of food waste are needed to produce 1MWe, and that the heat to power ratio of an Anaerobic Digestion plant is 1.5 to 1, the potential installed capacity therefore is: **0.33MWe and 0.49MWt for 2022; and 0.33MWe and 0.50MWt** (Table 12).

## 6.5 Agricultural Waste

### 6.5.1 Animal Manure

It is assumed that the farming mix will not change over the time period to 2033 and therefore energy generated from agricultural waste will be the same as the current scenario.

Utilising the latest statistics (2018), the total numbers of cattle and pig across the Carmarthenshire LPA area (i.e. excluding the BBNP) have been calculated as 193,559 and 1,037 respectively[46].

Assuming that each cattle produces 1 tonne of slurry a month, and each pig produces 0.1 tonnes per month, and assuming that slurry is only collected for 6 months of the year[47] the total annual tonnage of available manure across the Carmarthenshire LPA area is: 1,161,975.

In practice however, it will not be possible or practical to collect all of this potential resource. This will be because many farms will not use a slurry system but will collect the excreta as solid manure mixed with bedding which is then spread on the fields.

Furthermore, it will not be practical to collect the slurry from some of the farms, because they may be too small or too dispersed for this to be economically viable.

This study has therefore assumed that 50% of the farms use a slurry-based system and that of these, it would be feasible to capture the slurry from 50%. Therefore, the total available resource across the Carmarthenshire LPA area is: 290,494 tonnes/ annum.

An Anaerobic Digestion plant would be suitable to use animal slurry to produce both electric and heat. With reference to the 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners (Welsh Government, 2015), it can be assumed that 225,000 wet tonnes of slurry are needed to produce 1MWe, and that the heat to power ratio of an Anaerobic Digestion plant is 1.5 to 1, the potential installed capacity therefore is: **1.29 MWe and 1.94 MWt** (Table 13).

**Table 13**: *Potential installed capacity from total available animal slurry resource in the Carmarthenshire LPA area in 2021 and 2033*

| Animal slurry | |
|---|---|
| Total livestock (Cattle & Pigs) | 194,596 |
| Total slurry (tonnes) | 1,161,975 |
| Usable slurry (tonnes) | 290,494 |
| Required wet tonnes per MWe | 225,000 |
| **Potential installed capacity (MWe)** | 1.29 |
| Heat to power ratio | 1.5:1 |
| **Potential installed capacity (MWt)** | 1.94 |

### 6.5.2 Poultry Litter

It is assumed that the farming mix will not change over the time period to 2033 and therefore energy generated from agricultural waste will be the same as the current scenario.

Utilising the latest statistics (2018), the total number of poultry recorded across the Carmarthenshire LPA area (i.e. excluding BBNP) have been calculated as 15,177[48].

To allow for losses due to the economics associated with wide spatial distribution of poultry farms across the Carmarthenshire LPA area, this report has assumed that 50% of poultry farms could provide poultry litter for conversion into energy.

Data is available from DEFRA which provides the amount of excreta produced by different types of poultry[49]. This suggests a figure of 42 tonnes of litter per year per 1,000 birds[50].

[46] Welsh Governments Agricultural small area statistics - (2018).
[47] Assuming that livestock will only be kept under cover for, approximately, 6 months of the year.
[48] Welsh Governments Agricultural small area statistics - http://gov.wales/statistics-and-research/agricultural-small-area-statistics/?lang=en (May 2018).
[49] See the DEFRA leaflets on guidance to famers in Nitrate Vulnerable Zones, leaflet 3, table 3, see http://www.defra.gov.uk/environment/quality/water/waterquality/diffuse/ nitrate/documents/leaflet3.pdf
[50] Based on the figure for laying hens, which is 3.5 tonnes per month

With reference to 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners (Welsh Government; 2015), assuming that 11,000 tonnes of litter per annum are needed to produce 1MWe, and that the heat to power ratio of a bespoke plant with CHP is 2 to 1, the potential installed capacity is: 0.029 MWe and 0.058 MWt respectively.

In practice, as the potential capacity is less than 10MWe, it is unlikely that this would be enough to support a dedicated poultry litter power plant. However, given **the total combined resource from animal slurry and poultry litter is 1.32MWe and 1.99MWt, the resource could be combined with animal slurry to support an anaerobic digestion facility of 1.32MWe**, especially in partnership with neighbouring authorities.

**Table 14:** *Potential installed capacity from poultry litter in the Carmarthenshire LPA area in 2021 and 2033*

| Poultry litter | |
|---|---|
| Total poultry[51] | 15,177 |
| Accessible Poultry (50%) | 7,589 |
| Total litter (tonnes) | 319 |
| Required tonnes of litter per MWe | 11,000 |
| **Potential installed capacity (MWe)** | **0.029** |
| Heat to power ratio | 2 :1 |
| **Potential installed capacity (MWt)** | **0.058** |

[51] The number of poultry was taken from the Welsh Governments Statistical Directorate Agricultural Small Areas spreadsheet - worksheet Regions'.

## 6.6 Sewage Sludge

The population of Carmarthenshire LPA in 2021 and 2033, based StatsWales projections, is 185,195 and 187,007 respectively.

Assuming that the average amount of sewage produced per person per year is 0.03tonnes (t) the total sewage sludge across the Carmarthenshire LPA in 2021 equates to circa 5,556t and 5,610t in 2033.

An Anaerobic Digestion plant would be suitable for utilising sewage sludge to produce both electric and heat. Referring to 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners (Welsh Government; 2015), assuming that 13,000t of dry solids are needed to produce 1MWe, and that the heat to power ratio of an AD plant is 1.5, **the potential installed capacity is 0.43MWe and 0.64MWt respectively in 2021; and 0.43MWe and 0.65MWt in 2033.**

**Table 15**: *Potential installed capacity from total available sewage sludge resource in the Carmarthenshire LPA area in 2021 and 2033*

| Sewage Sludge | 2021 | 2033 |
|---|---|---|
| Carmarthenshire LPA Population[52] | 185,195 | 187,007 |
| Sewage per person (tonnes) | 0.03 | 0.03 |
| Total sewage (tonnes) | 5,556 | 5,610 |
| Required tonnes of sewage per MWe | 13,000 | 13000 |
| **Potential installed capacity (MWe)** | 0.43 | 0.43 |
| Heat to power ratio | 1.5:1 | 1.5:1 |
| **Potential installed capacity (MWt)** | 0.64 | 0.65 |

[52] The number of poultry was taken from the Welsh Governments Statistical Directorate Agricultural Small Areas spreadsheet - worksheet Regions'.

## 6.7 Waste Summary

A summary of the potential outputs from utilising the waste resource in the Carmarthenshire LPA area is provided below. There are a number of key issues which would impact on whether the resource can be exploited and/or counted towards RE contributions as follows:

- Viability, and therefore likelihood of building the necessary plant;
- Origin of the resource.

Along with a number of other South Wales Councils CCC acts as a Local Waste Planning Authority (LWPA) on behalf of the Beacon Beacons National Park (BBNP) and therefore has some control over the use of the resource generated in the BBNP LPA area.

However, to avoid double counting, the Toolkit[53] takes the approach that the LPA contribution is counted in the LPA area where the resource originates unless that resource is being utilised in an existing technology elsewhere.

Given that the Carmarthenshire LPA area is neither the place of origin of the resource or is utilising the resource for generation, the Municipal Solid Waste (MSW) and Commercial & Industrial Waste generated in the BBNP LPA area is removed from the Carmarthenshire LPA area resource.

In addition, when considering the LPA's contribution, high level consideration is given to the likelihood of the resource being exploited.

Carmarthenshire County council has a number of existing contracts for disposal of residual waste, which is processed out of the county at a mixture of landfill sites and Cardiff Energy Recovery Facility. It has been assumed that these contracts will run for the period of the new LDP i.e. up to 2033. Where landfill contracts are shorter than the planning period it is assumed residual waste will be sent to the Cardiff Energy Recovery Facility. There is therefore no scope within Carmarthenshire for an EfW plant.

There are three anaerobic digesters in Carmarthenshire. 0.35MWe at Nantycaws Landfill site where the heat produced is not utilised and two private anaerobic digesters on farms with a total output of 0.65MWe. Of this only 0.23MWt is currently used, with two out of the three sites not utilising the heat generated.

CCC confirm that a contractor is appointed to which all domestic food waste is processed at the Natycaws Landfill Site and so food waste is already covered under existing generation by anaerobic digestion.

Therefore, the only likely AD facilities within the Carmarthenshire LPA are likely to utilise agricultural slurries or sewage sludge.

The economics of generating energy from a dedicated poultry litter power plant means that anything less than 10MWe is likely not to be viable.

When considering all of the above, the final potential for renewable energy from waste resource is shown in Table 16.

[53] Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government 2015 Update

**Table 16:** *Summary of Energy from Waste*

| Resource | Prior to consideration of likelihood of utilisation for RE Generation | | | | | Reason for adjustment / change of technology | Post consideration of likelihood of utilisation for RE Generation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Technology | 2021 | | 2033 | | | Technology | 2021 | | 2033 | |
| | | MWe | MWt | MWe | MWt | | | MWe | MWt | MWe | MWt |
| C&I Waste (Table 10) | EfW with CHP | 0.070 | 0.139 | 0.047 | 0.094 | Currently recycled. Non-recyclable material is processed out of the county at a mixture of landfill sites and Cardiff Energy Recovery Facility. It has been assumed that these contracts will run for the period of the new LDP i.e. up to 2033. Where landfill contracts are shorter than the planning period it is assumed residual waste will be sent to the Cardiff Energy Recovery Facility. | None | - | - | | |
| MSW (Table 11) | EfW with CHP | 0.723 | 1.447 | 0.682 | 1.364 | Currently recycled. Non-recyclable material is processed out of the county at a mixture of landfill sites and Cardiff Energy Recovery Facility. It has been assumed that these contracts will run for the period of the new LDP i.e. up to 2033. Where landfill contracts are shorter than the planning period it is assumed residual waste will be sent to the Cardiff Energy Recovery Facility. | None | - | - | | |
| Food Waste (Table 12) | AD with CHP | 0.329 | 0.494 | 0.333 | 0.499 | Food waste is processed at the Natycaws Landfill Site and so food waste is already covered under existing generation by anaerobic digestion | None | - | - | | |
| Animal Slurry (Table 13) | AD with CHP | 1.291 | 1.937 | 1.291 | 1.937 | Combined with Poultry Litter | AD with CHP | 1.32 | 1.99 | 1.32 | 1.99 |
| Poultry Litter (Table 14) | Bespoke plant with CHP | 0.029 | 0.058 | 0.029 | 0.058 | Not likely to be enough resource for bespoke plant. Combines with Animal slurry. | None | - | - | | |
| Sewage Sludge ( Table 15 ) | AD with CHP | 0.43 | 0.64 | 0.43 | 0.65 | | AD with CHP | 0.43 | 0.64 | 0.43 | 0.65 |
| **Potential installed capacity** | | **2.87** | **4.72** | **2.81** | **4.60** | | | **1.75** | **2.64** | **1.75** | **2.64** |

# 7. Hydro Power Energy Resource

## 7.1 Introduction

Existing hydro power installations across the Carmarthenshire LPA area (including operational, under construction or consented, correct at the time of writing 12/07/2019) have a combined total installed electrical capacity of 6.56MWe, of which the Llyn Brianne Dam generates circa 4.4MWe.

The Environment Agency published a study[54] into the potential for small scale hydro power generation across England and Wales in 2010[55]. Table 17 confirms the total potential hydropower capacity according to each of the potential hydropower sites' sensitivity to exploitation, in the Carmarthenshire LPA area, excluding BBNP. Where the sensitivity categories of a potential sites were not given; the worst-case scenario was assumed, and it was assigned to have High environmental sensitivities.

**Table 17***: Potential hydropower capacity in Carmarthenshire LPA according to environmental sensitivity.*

| Environmental sensitivity | Potential capacity (MWe) |
|---|---|
| Low | 0 |
| Medium | 0 |
| High | 0.79 |
| **Total** | **0.79** |
| Proportion High Sensitivity included | 25% |
| **Potential Hydro Power Resource** | **0.2** |

Taking into account the environmental constraints of the potential hydropower sites due to their sensitivities, it is suggested that there is no potential hydropower resource across Carmarthenshire LPA of Low and Medium sensitivity sites.

The quantity and location of hydropower development shows that the uptake of schemes in recent years is not constrained to just those sites which are of 'low' and 'medium' sensitivity. It has therefore been assumed that 25% of 'high' sensitivity sites are suitable for hydroelectric generation, equating to 0.2 MWe in total.

The existing (as of 12/07/2019) installed capacity (including operational, under construction or consented) of 6.56MWe has surpassed the generating capacity predicted in the Environmental Agency study. However, the EA study only attributes 0.1MWe to the Llyn Brianne Dam which is actually generating 4.5MW. If we were to include the actual generation from the Llyn Brianne Dam site to the potential capacity it would predict 5.04MWe. This is still less than the currently installed 6.54MWe. A closer examination of the location of existing hydro generating sites has shown that with the exception of the Llyn Braine Dam all of the existing generation is not located at any of the sites indicated within the EA study. The total potential hydroelectric capacity in the Carmarthenshire LPA is therefore 7.25MWe with 0.69MW of resource available for development. If it is assumed that 25% of the 'high' environmentally sensitive sites will be exploited, then **there is a hydroelectric resource available for development of 0.17MWe.**

[54] Mapping Hydropower Opportunities and Sensitivities in England and Wales: Technical Report, Entec UK on behalf of Environment Agency (2010)

[55] Potential Sites of Hydropower Opportunity, Environment Agency, revised 2015 [https://data.gov.uk/dataset/e0f5a751-f4f3-4d04-a7ae-89d2dcc0c5f5]

# 8. Solar PV Farms

## 8.1 Introduction

This section provides a summary assessment of the potential for Solar PV Farms in the CCC LPA area.

Photovoltaic (PV) solar cells/ panels generate renewable electricity from the direct conversion of solar irradiation. PV is recognised as one of the key technologies in helping to meet the UK target of 15% renewable energy from final consumption by 2020.

In 2012, 84% of all new renewable installations across Wales were Solar PV and this figure is expected to increase due to a high level of interest in larger stand-alone (ground-mounted) installations.

The Department for Business Energy and Industrial Strategy (BEIS) -formerly the Department for Energy and Climate Change (DECC) defines a "stand-alone" installation as a "solar photovoltaic electricity generating facility that is not wired through a building, or if it is wired through a building, the building does not have the ability to use 10% or more of the electricity generated": this is typically a PV farm greater than 5MWe installed capacity (though dependent upon the electricity use of the building it is wired to). This definition is important as it was used to define the qualifying rate of Feed-in-Tariff.

As a relatively new phenomenon there is no standard agreed approach to constraints mapping for solar PV farms. This section therefore provides an approach, developed by AECOM on behalf of the Welsh Government (Planning for Renewable and Low Carbon Energy – A Toolkit for Planners; 2015), as to how to undertake a high-level assessment of the potential solar resource for 'stand-alone' PV farms.

## 8.2 Mapping

Maps have been produced to illustrate at each stage of the process the application of the method to identify spatial constraints and opportunities. Throughout the methodology description, titles and reference numbers are mentioned. The titles / references correspond with maps contained in the accompanying document 'Carmarthenshire Renewable and Low Carbon Energy Assessment 2019 – Maps'

As with the analysis of the wind resource, the identification of potential sites for solar PV farms follows a series of steps as follows:

### 8.2.1 Step 1:

### 8.2.2 Map Reference & Title: S1 – Solar Resource in the Carmarthenshire LPA Area

The performance of a photovoltaic panel system is directly related to the inclination, orientation and degree of shading of the panels. For the purposes of identifying the areas suitable for PV farm development, assumptions have been made on the suitability of slope gradient and orientation for PV deployment.

Using data from Ordnance Survey[56], AECOM has created a data layer for the Carmarthenshire LPA area showing orientation of slope and potential for shading. The following assumptions have been applied in this study:

**Table 18***: Suitability of sites for PV installation at varying inclinations*

| Suitability of sites | Inclinations |
|---|---|
| All suitable: | 0-3° from the horizontal |
| Only south-west to south east facing areas are suitable. All other orientations are considered constrained | Inclinations between 3-15° from the horizontal |
| All constrained | Inclinations >15° from the horizontal |

All areas with inclinations 0-3° from the horizontal are assumed suitable and optimum. Only south-west to south east facing areas are suitable where there are inclinations between 3-15° from the horizontal: all other areas are deemed unsuitable. At this stage, the areas shown on the map are only constrained by the Carmarthenshire LPA boundary and the Brecon Beacons National Park.

### 8.2.3 Step 2:

### 8.2.4 Map Reference & Title: S2 – Environmental & Heritage Constraints

Constraints were applied to establish the maximum potential resource for solar PV farms across the Carmarthenshire LPA area. A comprehensive table of

[56] Ordnance Survey, Terrain 50 dataset

the sources and assumptions used is given in Appendix E. The constraints applied in the maps are discussed below.

#### 8.2.4.1 Statutory Designations

The solar PV farm constraints maps illustrate the principal constraints to the development/ deployment of solar PV farms. Many of the constraints can be attributed to statutory designations. The constraints, except where specifically stated, relate to the extent of the designation only with no additional *constraint buffer* applied. The statutory designations utilised for this assessment are as follows:

- Special Protection Areas (SPA) and foraging buffers;
- Special Areas of Conservation (SAC);
- Candidate Special Areas of Conservation (cSAC);
- RAMSAR sites;
- National Nature Reserves (NNR);
- Sites of Special Scientific Interest (SSSI);
- Marine Nature Reserves (MNR);
- Scheduled Ancient Monuments (SAM);
- Areas of Outstanding Natural Beauty (AONB) - a 3.5km buffer is applied;

#### 8.2.4.2 Non-Statutory Considerations

Many of the non-statutory designations are specifically linked to minimising potential impacts upon people or infrastructure through the application in the maps of buffer areas. The extent of the buffer areas is informed directly by the nature/extent of the natural/built environment and the characteristics of the generating technology. This assessment is based on constraints associated with a typical 5MW solar PV array[57].

Unlike wind farms, solar PV development has little height. However, aviation buffers are retained in respect of interference from other factors such as glare, etc.

The other non-statutory designations considered are:

- Ancient Woodlands
- Major and minor transport infrastructure – No buffer is applied - extent only;
- Existing buildings -a 500m buffer is applied
- National Parks – a 3.5km buffer is applied;
- Strategic Search Areas and all other existing and consented (but not yet constructed) solar PV farms, including those proposed through the planning system[58];
- Watercourses – including major, secondary and minor rivers, canals and lakes: extent only – no additional buffer is applied;
- Some aviation and radar buffers – includes data supplied by Ministry of Defence (MOD) and Civil Aviation Authority (CAA).
- Areas of thick peat.

### 8.2.5 Step 3

### 8.2.6 Map Reference & Title: S3 – Solar PV Resource Available

At this stage of the assessment, land slivers, fire breaks and tracks, as well as parcels of land insufficient to support a solar PV farm of 5MW or more are removed from the maps. Land of Agricultural Grades 1, 2 and 3a have been constrained and only land of Agricultural Grades 3b, 4 and 5 have been considered for use for solar PV farms.

'Stand-alone' PV farms >5MW must be appropriately sited. However, with the large number of potential sites and areas of relatively low-grade land within Carmarthenshire, the aim of this constraint is to protect the best and most versatile agricultural land (Grades 1, 2 and 3a).

However, it is understood diversification helps to support agriculturally based businesses, promoting

[57] It should be noted that this does not preclude the potential development / deployment of larger or smaller PV farms across the Carmarthenshire LPA area.

[58] This includes wind development outside of the boundary of the county where the development/proposals extend inside the Carmarthenshire LPA area.

multi-functional use of land, etc. In all cases potential for benefits is to be weighed against this criterion.

Map S3 shows the remaining available land for solar PV development after combining maps S1 (showing suitable land inclination and orientation) and S2 (statutory and non-statutory constraints) as well as the removal of land parcels of higher quality and insufficient size.

The remaining land available for solar PV farms at this stage of the assessment equates to 10.19km$^2$.

### 8.2.7 Step 4:

### 8.2.8 Map Reference & Title: S4 – Local Constraints

The following additional local non-statutory constraints are applied:

- Local Nature Reserves
- Registered Historic Landscapes
- Solar PV farms, existing and consented (but not yet constructed) solar PV farms and those proposed in the planning system as of 12/07/2019 (3.5km)[59]
- Woodlands – All other woodlands

### 8.2.9 Step 5

### 8.2.10 Map Reference & Title: S5 – Solar PV Resource Available

At this stage of the assessment, land slivers, fire breaks and tracks, as well as parcels of land insufficient to support a solar PV farm of 5MW or more are removed from the maps.

Map S5 shows the remaining available land for solar PV development after combining maps S1 (showing suitable land inclination and orientation); S2 (statutory and non-statutory constraints) and S4 (local constraints) as well as the removal of land parcels of higher quality and insufficient size.

The remaining land available for solar PV farms at this stage of the assessment equates to 9.66km$^2$

### 8.2.11 Step 6

### 8.2.12 Map Reference & Title: S6 – Solar PV Farm Resource Available within Grid Connection

Solar PV farms require a connection to the grid in order to export the electricity. PPW[60] requires consideration of the electricity grid as part of the renewable energy evidence base to inform LDP policies.

A key constraint to the development of solar PV farms can be the cost of connecting to the electricity grid. A high-level cost analysis exercise has been undertaken.

Similar to the approach taken in the development of TAN8[61], areas that are considered likely to be too distant to connect to grid cost effectively have been constrained.

Electricity grid comprising 33, 66 and 132kV has been mapped with only sites with available resource within 10km of any line being considered accessible[62].

The remaining land available for solar PV farms at this stage of the assessment equates to 9.66km$^2$

### 8.2.13 Step 7

### 8.2.14 Map Reference & Title: S7 – Solar PV Farm land to be assessed for landscape impact

Remaining land parcels, following steps 1 to 6, are grouped together to inform parcels subject to landscape assessment. Map S7 shows the **initial** solar LSA's.

To define **initial** solar LSA's for landscape assessment, a set of criteria were applied to the remaining least constrained solar resource as follows:

[59] This includes solar PV development outside of the boundary of the county where the 3.5km cumulative impact buffer extends inside Carmarthenshire.

[60] Planning Policy Wales (Edition 9), Welsh Government November 2016

[61] 'Facilitating Planning for Renewable Energy in Wales- Meeting the Target - Final Report 'Welsh Assembly Government July 2004 Section 5.3.4

[62] Whilst grid information has been utilised to constrain some sites, it does not imply that remaining sites could connect: studies would need to be conducted in detail for each individual project.

- An initial LSA must contain at least one red area (as defined by map S4 i.e. >0.12 sq km = 5 MW) and preferably at least one amber area (<5 MW) of potential resource. Initial LSAs cannot be defined by amber areas alone;
- Initial LSAs must have a minimum size of 0.5 sq km);
- Initial LSAs should not be intersected by a class 1 or class 2 highway. Minor roads can intersect land parcels;
- Initial LSAs should not include a statutory environmental designation (e.g. SPA, SAC, SSSI), although non-statutory designations may be included (such as woodland and buildings). Statutory heritage designations can be included as setting can be considered at site specific development proposal stage;
- Initial LSAs should reflect topography e.g. two hilltops separated by a valley should not be joined together;
- Boundaries have been drawn "tight" to clusters of least constrained land parcels, so some "outliers" have been excluded but it may be possible to draw them into refined initial LSA boundaries provided constraints are not included or the other criteria above broken;
- It may be possible to cluster some of the initial LSAs together following landscape susceptibility assessment.

**Having applied the above criteria, 4 initial LSAs have been identified for landscape assessment**

### 8.2.15 Step 8

### 8.2.16 Solar PV Farm –Landscape Assessment

The assessment of landscape sensitivity is a combination of determining landscape value and landscape susceptibility. The interaction of four categories of landscape value and four categories of landscape susceptibility enable the generation of sixteen box matrix (Table 19) from which, six categories of overall landscape sensitivity have been identified. Each category of overall sensitivity has been defined as set out in Table 20 below

**Table 19:** *Landscape Sensitivity Assessment Matrix*

| | | Landscape Susceptibility | | | |
|---|---|---|---|---|---|
| | | *Very High* | *High* | *Medium* | *Low* |
| Landscape Value | *Very High* | | | | |
| | *High* | | | | |
| | *Medium* | | | | |
| | *Low* | | | | |

**Table 20:** *Landscape Sensitivity Categories*

| Sensitivity Level | Definition |
|---|---|
| Very High | Key characteristics and qualities of the landscape are highly vulnerable to change from the development type. No potential for locating the development type. |
| High | Key characteristics and qualities of the landscape are vulnerable to change from the development type. Highly limited potential for locating the development type. |
| Medium-High | Most of the key characteristics and qualities of the landscape are vulnerable to change from the development type. Limited potential for locating the development type. |
| Medium | Some of the key characteristics and qualities of the landscape are vulnerable to change from the development type. Some potential for locating the development type. |
| Medium-Low | Few of the key characteristics and qualities of the landscape are vulnerable to change from the development type. Potential for locating the development type. |
| Low | None of the key characteristics and qualities of the landscape are vulnerable to change from the development type. Clear potential for locating the development type. |

**Table 21***: Landscape Assessment Results*

| LSA | Landscape Sensitivity | Ranking |
|---|---|---|
| A | High | 3 |
| B | High | 4 |
| C | Medium High | 2 |
| D | Medium High | 1 |

The capacity assessment is very broad in its approach and is not definitive. It is based on assessment of a potential area, for example part of a

particular valley floor, and a calculation of the area of solar farm development within this area that could be undertaken without unacceptable landscape and visual effects.

Carmarthenshire County Council have undertaken a landscape assessment for the whole of Carmarthenshire[63]. The results of this landscape assessment are used to classify the LSAs.

For the purposes of this study the GIS data for medium typology from the Carmarthenshire solar PV landscape assessment is used to rank the LSA's based on the level of landscape sensitivity.

#### 8.2.17 Step 9

#### 8.2.18 Map Reference & Title: S9 – Solar PV Farm –Local Search Areas

Remaining land parcels, following steps 1 - 8, are grouped together to inform **final** Local Search Areas (referred to as "LSAs"), as shown in Map S9 and it is these areas that are referred to in Carmarthenshire County Council's Renewable Energy planning policies.

LSAs are identified to encourage developers to further investigate potential of solar PV farms in these areas. However, LSAs will not safeguard for solar PV development but may prioritise such development where there are simultaneously competing interests.

Further, it should be noted that, due to the grouping together of the unconstrained parcels, the LSAs do also contain some land that is identified as 'constrained'.

**Table 22**: *LSA Potential Capacity*

| LSA | Priority | LSA Area (km²) | Potential Installed Capacity (MW) |
|---|---|---|---|
| A | 3 | 3.31 | 73.0 |
| B | 4 | 1.32 | 33.3 |
| C | 2 | 0.72 | 20.0 |
| D | 1 | 0.99 | 30.3 |

## 8.3 Maximum available solar PV resource

**Table 23**: *Theoretical maximum potential solar PV resource (km²) for the Carmarthenshire LPA area excluding the SSA.*

| Solar PV Resource | |
|---|---|
| Area (km²) | 3.76 |
| Potential Capacity (MW) | 156.7 |
| Generating Time (hours /year) | 8,760 |
| Capacity Factor (%) | 10 |
| **Potential Energy Generated (GWh)** | **137.25** |

The assumptions about the PV array are:

- Rated output: 5MW
- Area of Land Required[64]: circa 0.12km²

The figure of 0.12km2 (this equates to 12Ha or c30acres) has been utilised to identify potential sites. The above conversions have been employed in the landscape assessment. Areas of land less than 0.12km2 have been constrained.

Once the total area of unconstrained solar PV farm resource is established the total potential installed capacity can be calculated.

A capacity factor (CF) of 0.1 has been assumed (as provided in 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government; 2015) in order to assess the annual energy output of the potential installed capacity

Therefore, assuming that over the course of a year a solar PV farm will only generate energy for 10% of the time (876 hours), the total potential energy is calculated as 137GWh.

Therefore, the additional future potential is outlined in Table 23

[63] Carmarthenshire Solar PV Development Landscape Sensitivity and Capacity Study – Anthony Jellard Associates LLP 2018

[64] According to the DECC UK Solar PV Strategy Part 1: 'Roadmap to a Brighter Future', the land area required for a 1MW fixed-tilt PV array is approximately 6acres (or 2.4Ha or 0.024km²).

## 8.4 Further constraints to solar PV farm sites

Further constraints to solar PV farm development not considered within this REA include (and this is not meant to be an exhaustive list):

- Practical access to sites required for development;
- Landowner willingness for development to go ahead;
- Political will;
- Time to complete planning procedures;

## 8.5 Potential opportunities for future development

In relation to solar PV farm energy, potential opportunities for CCC could be:

- Investment interest of Energy Services Companies (ESCOs);
- CCC involvement with ESCO to secure greater community benefits;
- Solar PV farms can provide significant revenue streams.

# 9. Building Integrated Renewable Energy Uptake

## 9.1 Introduction

This section provides a summary assessment of the potential building integrated renewable (BIR) energy technology uptake in the CCC LPA undertaken in 2012. More detailed assumptions utilised in the BIR analysis can be found in **Appendix F**. The assessment is based on the method detailed in 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners (2015)[65]'.

## 9.2 Definition of 'micro-generation' and 'building integrated renewables'

The official definition of micro-generation is given in the Energy Act 2004 as electricity generating capacity of 50kW or less, and heat generating capacity of 45kW or less. However, for the purposes of this study, we are using the broader term Building Integrated Renewable (BIR).

BIR can include systems that are larger than micro-generation, such as biomass boilers for schools, which can be up to 500kW of heat output or more. However, BIR technologies are still linking to existing or new buildings and are therefore distinct, in terms of how their potential can be modelled, from the larger scale stand-alone technologies.

The term BIR also excludes those micro-generation technologies that are not renewable, such as fuel cells (where the hydrogen is produced from mains gas) and small-scale CHP, using mains gas as the fuel source. This is because, for the potential purpose of setting area wide renewable energy contributions, we are only interested in the potential uptake of those micro-generation technologies that are renewable.

BIR are therefore taken to cover the following technologies:

- Solar photovoltaic (PV) panels
- Solar hot water panels
- Micro building-mounted wind turbines
- Small free-standing wind turbines
- Micro scale biomass heating (i.e. wood chip or pellet boilers or stoves)
- Ground source heat pumps
- Air source heat pumps
- Water source heat pumps

## 9.3 Calculation method

The calculation method includes consideration of the uptake of non-renewable micro-generation in order to account for those buildings which choose to take a non-renewable option, but these are excluded from the contribution.

The potential BIR uptake analysis is formed of two distinct calculations:

- The uptake of BIR in the **existing** building stock (residential and non-residential)
- The uptake of BIR in **future new** buildings (residential and non-residential)

The uptake of BIR in the ***existing*** building stock (residential and non-residential) is primarily driven by the financial attractiveness of installing BIR and the ease of retrofit.

This section is based on statistical data from National databases (see the Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government (2015) and the accompanying document to the 2010 Toolkit – Case Study of Pembrokeshire County Council - Welsh Government (2010).

The uptake of BIR in ***future new*** buildings (residential and non-residential) is predominantly driven by future Building Regulations and planning policies.

This section is based on the Carmarthenshire Deposit LDP (for a detailed explanation of the method see Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government (2015) and the accompanying document to the 2010 Toolkit – Case Study of Pembrokeshire County Council - Welsh Government (2010)).

These two calculations are brought together to report the total predicted new and existing BIR RE capacity for the Carmarthenshire LPA broken down as follows:

65 http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/toolkitfor planners/?lang=en

- By 2015 and 2021
- Renewable heat and electricity.

The BBNP[66] proportion (0.8% of the population of CCC lived in the BBNP in 2015 1.01% of the population of CCC are projected to live in the BBNP in 2021 and 1.22% in 2033) of the total housing stock is removed to calculate the potential BIR capacity across the Carmarthenshire LPA area.

## 9.4 BIR uptake in existing buildings

### 9.4.1 Existing building stock

Using Census 2001 data and Welsh Statistics a year by year timeline of the building stock in the Carmarthenshire LPA area from 2001 to 2011 was developed. A similar timeline was also generated for nondomestic buildings (Bulks and Non-Bulks) based on hereditaments data and council-owned property databases. This information has been used to establish the age of the base case 2008 building stock, and hence make an assumption on the heat demand of the 2008 base case stock. By understanding the age of the existing stock, and their heat demand, the modelling can recognise the increased benefits of installing renewable heat to older properties that are not as well insulated, for example.

A further analysis was required to establish the proportion of pre-1980 housing in the 2008 base case. This is because the Building Regulations requiring new constructions to reduce their energy consumption[67] was not in force before 1980 and a higher heating demand is attributed to this proportion of the 2008 base case housing stock. Welsh Statistics provided a breakdown of the age of the building stock as it was in 2008, shown in the pie chart below.

Figure 5 shows that 85% of the 2008 housing stock was built before 1981. Combined with the anticipated number of new homes in the Carmarthenshire LPA in the LDP plan period[68], by the end of the plan period in 2021, the pre-1980 homes will account for 78% of the Carmarthenshire LPA housing stock. If the average increase in house building out is extrapolated to 2033 the pre-1980 homes will still account for 72% of the Carmarthenshire LPA housing stock. Therefore, finding a low carbon solution for the older homes in the

**Figure 5:** *Age of residential stock in the Carmarthenshire LPA area (2008)*

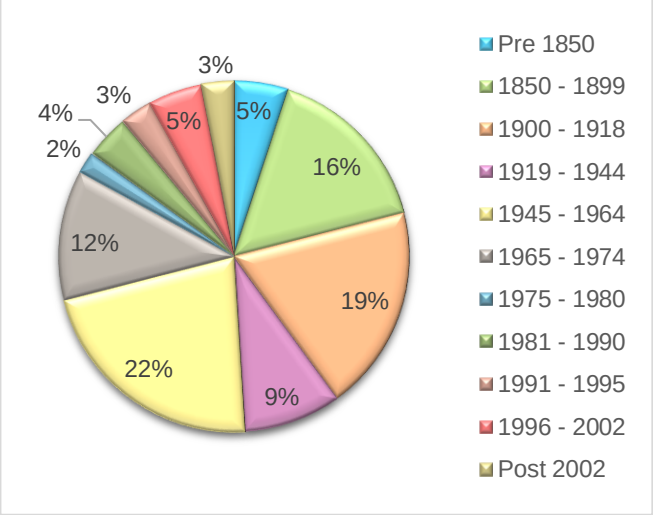
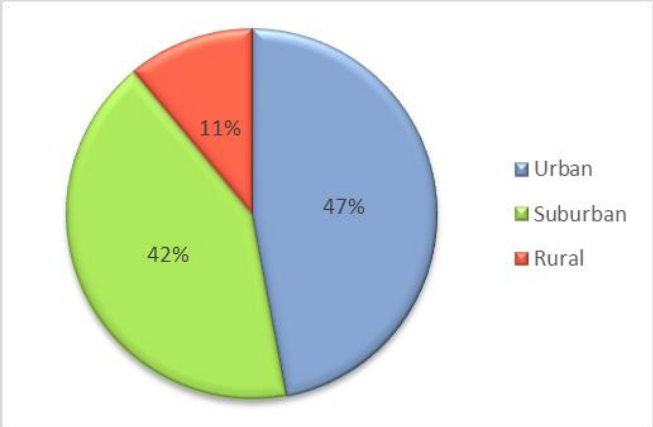



**Figure 6:** *Rural / Urban residential split in the Carmarthenshire LPA area (2004)*




Carmarthenshire LPA will be vital in reducing the overall $CO_2$ emissions of Carmarthenshire LPA by both 2021 and 2033.

The calculation for existing building uptake also takes into account the proportion of buildings in the Carmarthenshire LPA which are in urban, suburban or rural locations, as well as those which are flats or houses. The BIR calculation model uses this information to make assumptions on the sizes of the homes, as well as their potential for renewable energy such as ground source heat pumps, which may require a significant amount of outdoor space. Figure 6 shows

[66] The percentage figures based on StatsWales figures for projected population of Carmarthenshire and the projected population for Carmarthenshire within the BBNP.
[67] UK Building Regulations Part L (2010): Conservation of fuel and power

[68] Approximately 15,197 units are to be built over the LDP period 2006 to 2021 bases on the Carmarthenshire Deposit LDP (2006-2021).

the split of housing by urban, suburban or rural classification[69].

**Figure 7:** *BIR uptake (cumulative) in existing buildings*

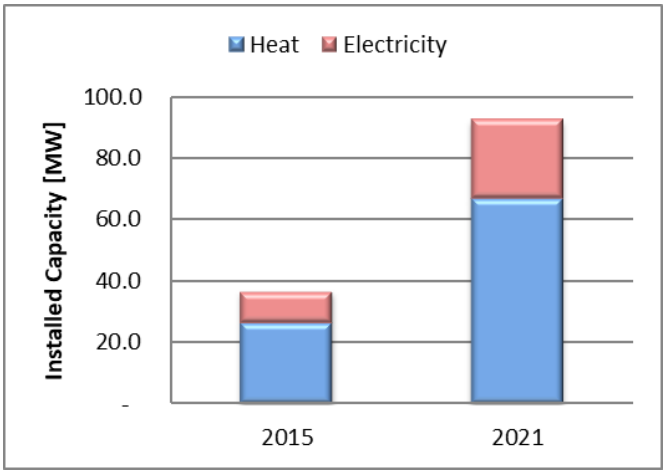



**Table 24**: *BIR uptake (cumulative) in existing buildings*

| Building | 2015 | 2021 |
|---|---|---|
| **Heat (MW)** | | |
| Residential | 26.6 | 66.5 |
| Non Residential | 9.9 | 26.1 |
| *Sub-total* | **36.5** | **92.7** |
| **Electricity (MW)** | | |
| Residential | 8.1 | 25.8 |
| Non Residential | 0.0 | 0.2 |
| *Sub-total* | **8.1** | **26.0** |
| **Total** | **44.6** | **118.7** |

### 9.4.2 Results: BIR uptake in existing buildings

The results show that by 2021, the uptake of BIR in existing buildings in the Carmarthenshire LPA area would equate to 118.7MW, which consists of 92.7MWt from renewable heat and 26.0MWe from renewable electricity. Table 24 summarises this uptake for 2015 and 2021.

## 9.5 BIR uptake in future new buildings

### 9.5.1 Future new building stock

For the future new buildings, the uptake will be predominantly driven by future Wales Building Regulations (Part L) and planning policies, requiring new buildings to reduce carbon dioxide emissions.

The Building Regulations Wales 2014 (Part L) AD1A (new homes) can currently be met through the design of fabric and services alone: compliance does not require the installation of low and zero carbon energy technologies.

For AD2A (non-domestic buildings) however, is likely to require either improvements to fabric, services and/ or low and zero carbon energy technologies sufficient to produce an equivalent to $CO_2$ savings from the installation of PV panels covering an area of 5.3% of GIA of each building in order to comply.

The key factors affecting uptake of any particular technology for this sector are likely to be the combination of technical viability, carbon savings, and the level of capital cost to a developer.

For Carmarthenshire, the Deposit Local Development Plan[70] sets out a total of 15,197 units are to be built over the LDP period 2006 to 2021. This equates to around 487 homes per year.

### 9.5.2 Results – BIR uptake in future new buildings

The results of the assessment show that by 2021, the uptake of BIR in new buildings in the Carmarthenshire LPA area could equate to 15.4MW, which consists of 10.2MWt from renewable heat and 5.2MWe from renewable electricity.

Figure 8 and Table 25 summarise this uptake summarises this uptake for 2015 and 2021 for a build out rate of 487 homes per year.

[69] Rural and Urban Area Classification for Super Output Areas, 2004

[70] Carmarthenshire Deposit LDP (2006-2021).

**Figure 8:** *BIR uptake (cumulative) in future new buildings*

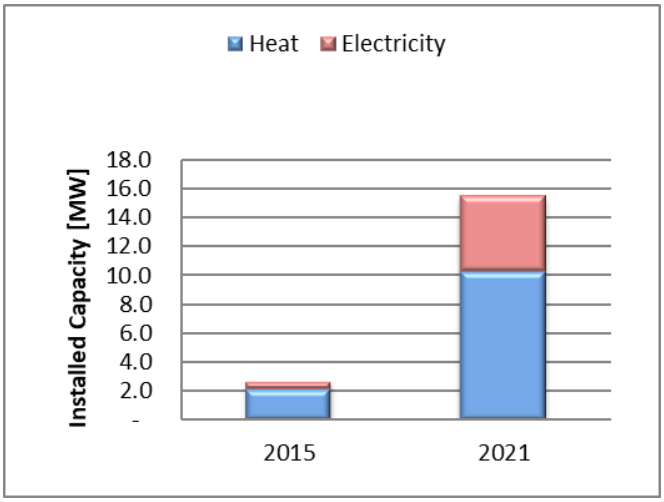



**Table 25:** *BIR uptake (cumulative) in future new buildings*

| Building | 2015 | 2021 |
|---|---|---|
| **Heat (MW)** | | |
| Residential | 1.4 | 6.8 |
| Non Residential | 0.8 | 3.4 |
| *Sub-total* | **2.2** | **10.2** |
| **Electricity (MW)** | | |
| Residential | 0.4 | 4.8 |
| Non Residential | 0.1 | 0.5 |
| *Sub-total* | **0.5** | **5.2** |
| **Total** | **2.7** | **15.4** |

## 9.6 Overall total for BIR uptake

This study has found that there is the potential to exploit a range of micro-generation technologies across the region. Based on the modelling assumptions used, the economically viable capacity for micro-generation technologies in the Carmarthenshire LPA is circa 102.9MWt and 31.3MWe for 2021 In most cases the potential is not spatially determined but is instead constrained by the size of the existing and future building stock.

The breakdown of estimated potential uptake in installed capacity and generated energy for the Carmarthenshire LPA in 2021 is shown in Table 26.

**Table 26:** *Total potential BIR uptake (cumulative) across the CCC LPA area*

| Building | 2015 | 2021 |
|---|---|---|
| **Heat (MW)** | | |
| Existing building (Table 24) | 36.5 | 92.7 |
| Future new building (Table 25) | 2.2 | 10.2 |
| *Sub-total* | **38.7** | **102.9** |
| **Electricity (MWe)** | | |
| Existing building (Table 24) | 8.1 | 26.0 |
| Future new building (Table 25) | 0.5 | 5.2 |
| *Sub-total* | **8.6** | **31.3** |
| **Total** | **47.3** | **134.1** |

## 9.7 2015 BIR uptake review

Since undertaking this analysis in 2012, data extracted from Ofgem datasets relating to FiT and RHI, as well as data from CCC has revealed that the uptake predictions slightly under estimated the renewable electricity but have been optimistic for the uptake of renewable heat. Uptake of renewable electricity up to the end March 2016 has been 10MWe (compared with 8.6MWe predicted by 2015 in the 2012 report) and 15.3MWt of renewable heat (compared with 36.5MWt predicted in the 2012 report).

The full analysis has not been re-run but rather the following method applied. The FiT and RHI figures have been used instead of the 2015 'predicted' figure and then the modelled yearly increases (the actual increases in MW, not percentages from the 2012 assessment) added to give a revised 2021 prediction and extrapolated out to 2033. The revised figures are as shown in Table 27 and Table 28.

**Table 27:** *2016 Revision of total potential BIR uptake (cumulative) across the Carmarthenshire LPA area*

| Building | 2015 | 2021 | 2033 |
|---|---|---|---|
| **Heat (MW)** | | | |
| Existing building | 15.3 | 33.6 | 50.3 |
| Future new building | - | 10.2 | 19.9 |
| *Sub-total* | 15.3 | 43.8 | 70.2 |
| **Electricity (MWe)** | | | |
| Existing building | 10.0 | 17.7 | 20.6 |
| Future new building | - | 5.2 | 12.6 |
| *Sub-total* | 10.0 | 23.0 | 33.2 |
| **Total** | **25.3** | **66.8** | **103.4** |

**Table 28**: *2016 Revision of total potential BIR uptake across the Carmarthenshire LPA area*

| Building | 2021 | 2033 |
|---|---|---|
| **Heat (MWt)** | | |
| Existing building | 18.3 | 35.0 |
| Future new building | 10.2 | 19.9 |
| *Sub-total* | **28.5** | **54.9** |
| **Electricity (MWe)** | | |
| Existing building | 7.7 | 10.6 |
| Future new building | 5.2 | 12.6 |
| *Sub-total* | **13.0** | **23.2** |
| **Total** | **41.5** | **78.1** |

# 10. Summary of Potential Renewable Energy Solutions

The maximum potential renewable electrical and thermal installed capacity across the Carmarthenshire LPA excluding that which is already installed, was calculated as circa 191.1MWe and circa 106.3MWt. for 2021 and circa 201.3MWe and circa 132.6MWt for 2033. These figures exclude the consideration of deliverability.

The total potential electrical capacity across the Carmarthenshire LPA in 2033 is dominated by solar PV farms at circa 156.7MWe with significant contributions from biomass CHP 18.4MWe; and building integrated renewables 23.2MWe. There is no identified potential for large scale wind development due to the statutory and strategic constraints excluding the whole of Carmarthenshire.

The total potential thermal capacity across the Carmarthenshire LPA in 2033 is dominated by building integrated renewables, primarily this will be biomass boilers and heat pumps for heating at circa 54.9MWt. Potential energy crops for CHP could equate to a further 36.7MWt of renewable heat generation and Wood for biomass boilers 36.3MWt.

These figures however, represent a theoretical maximum potential resource and assumes that all potential areas would be developed.

**Table 29:** *Potential renewable energy resource in the Carmarthenshire LPA area in 2021 and 2033 (excluding that which is already installed)*

| Resource | 2021 | | 2033 | |
|---|---|---|---|---|
| | Electricity (MWe) | Thermal (MWt) | Electricity (MWe) | Thermal (MWt) |
| Biomass Energy Crop (CHP) (Table 8) | 18.4 | 36.7 | 18.4 | 36.7 |
| Biomass Boilers, Wood (Table 9) | - | 36.3 | | 36.3 |
| Energy from Waste with CHP (Table 16) | 0.8 | 1.6 | 0.7 | 1.5 |
| Hydropower (Table 17) | 0.2 | - | 0.2 | - |
| Landfill Gas | - | - | - | - |
| Wind (Table 7) | - | - | - | - |
| Solar PV Farms (Table 23) | 156.7 | - | 156.7 | - |
| Other including food waste, animal slurry, poultry litter and sewage sludge. (AD with CHP) (Table 16) | 2.1 | 3.1 | 2.1 | 3.1 |
| Building Integrated (Table 28) | 13.0 | 28.5 | 23.2 | 54.9 |
| **Total** | **191.1** | **106.3** | **201.3** | **132.6** |

# 11. Identifying the Local Planning Authority Wide Contribution to the National Targets

The results of the area wide resource assessment provide an indication of the potential installed capacity for different technologies (in MW) that can be supported by the available resource.

The UK renewable energy target for 2020 is expressed in terms of a percentage of energy demand. In order to identify the potential contribution of the Carmarthenshire LPA area to meeting this target, estimation is required of how much energy the potential capacity might generate.

As referred to in Planning for Renewable and Low Carbon Energy – A Toolkit for Planners - Welsh Government (2015), a simple and well-established way of doing this is to use capacity factors (as referred to as load factors).

These factors, which vary by technology, are a measure of how much energy a generating station will typically produce in a year for any given installed capacity.

This reflects the fact that the installed capacity is a measure of the maximum amount of power that a generating station can produce at any given moment. However, for reasons to do with either fuel availability, the need for maintenance downtime, or, for heat generating plant, a lack of heat demand at certain times of day or year, the capacity factor is always less than 1.

The annual energy output can be calculated by multiplying the installed capacity by its capacity factor and the number of hours in a year (8,760).

A summary of the different capacity factors for different technologies is given in Table 30.

**Table 30**: *Capacity factors for renewable and low and zero carbon technologies*

| Technology | Capacity Factor[71] |
|---|---|
| Onshore wind | 0.27 |
| Biomass (electricity) | 0.90 |
| Biomass (heat) | 0.50 |
| Hydropower | 0.37 |
| Energy from Waste (electricity) | 0.90 |
| Energy from Waste (heat) | 0.50 |
| Landfill gas | 0.60 |
| Sewage gas | 0.42 |
| Solar Farm | 0.1 |
| BIR (electricity) | 0.10 |
| BIR (thermal) | 0.20 |

[71] Capacity factors derived from the Planning for Renewable and Low Carbon Energy - A Toolkit for Planners (2015).

## 11.1 Energy generated from existing renewable sources

The total electrical energy that is currently being generated across the Carmarthenshire LPA (or will be when all currently consented projects and those under construction are built) from renewable and low and zero carbon energy technologies is circa 562GWhe.

This equates to circa 61% of the total electrical consumption across the Carmarthenshire LPA in 2008; 2021 and 2033.

Electricity generation from large scale wind accounts for circa 388GWhe, 42% of total electrical consumption across the Carmarthenshire LPA area in 2008, 2021 and 2033.

The total thermal energy that is currently being generated across the Carmarthenshire LPA area from renewable and low and zero carbon energy technologies is circa 62GWht, which equates to circa 3% of the total thermal consumption across the Carmarthenshire LPA in 2008 and 4% of the total predicted thermal consumption across the Carmarthenshire LPA in 2021 and 2033.

## 11.2 Energy generated from existing and potential renewable sources

The maximum potential electrical energy that could be generated across the Carmarthenshire LPA from renewable and low and zero carbon energy technologies (including existing and potential) in 2021 is circa 870GWhe and in 2033 circa 878GWhe. For 2021 and 2033 this equates to circa 5% of the total electrical consumption across Wales in 2008.

The maximum potential thermal energy that could be generated across the Carmarthenshire LPA from renewable and low and zero carbon energy technologies in 2021 is circa 453GWht and in 2033 circa 499GWht.

**Table 31**: *Existing and consented large scale renewable energy generated in the Carmarthenshire LPA area*

| Technology | Electricity (MWh) | Thermal (MWh) |
|---|---|---|
| Wind Power | 388,129 | - |
| Biomass CHP | - | - |
| Hydropower | 21,304 | - |
| Landfill Gas | 11,826 | - |
| Solar PV Farms | 110,851 | - |
| Other (AD with CHP) | 3,679 | 986 |
| **Total** | **535,789** | **986** |

**Table 32**: *Existing small-scale renewable energy generated in the Carmarthenshire LPA area*

| Technology | Electricity (MWh) | Thermal (MWh) |
|---|---|---|
| Hydropower | - | - |
| CHP | 438 | 1,139 |
| Photovoltaic | 8,046 | |
| Other | - | 60,153 |
| Wind Power | 17,308 | |
| **Total** | **25,792** | **61,292** |

**Table 33**: *Existing and potential renewable electricity generated in the Carmarthenshire LPA area in 2021 and 2033*

| Resource | 2021 | | 2033 | |
|---|---|---|---|---|
| | Electrical Capacity (MWe) | MWh generated | Electrical Capacity (MWe) | MWh generated |
| Wind | 164.1 | 388,129 | 164.1 | 388,129 |
| Biomass Energy Crop (CHP) | 18.4 | 144,857 | 18.4 | 144,857 |
| Energy from Waste with CHP | 0.8 | 6,251 | 0.7 | 5,751 |
| Hydropower | 6.7 | 21,860 | 6.7 | 21,860 |
| Landfill Gas | 2.3 | 11,826 | 2.3 | 11,826 |
| Solar PV Farms | 283.2 | 248,097 | 283.2 | 248,097 |
| Other including food waste, animal slurry, poultry litter, sewage sludge and sewage gas. (AD with CHP) | 3.1 | 11,320 | 3.1 | 11,347 |
| Building Integrated | 42.4 | 37,168 | 52.7 | 46,133 |
| **Total** | **521.0** | **869,509** | **531.2** | **878,000** |

**Table 34**: *Existing and potential renewable heat generated in the Carmarthenshire LPA area in 2021 and 2033*

| Resource | 2021 | | 2033 | |
|---|---|---|---|---|
| | Thermal Capacity (MWt) | MWh generated | Thermal Capacity (MWt) | MWh generated |
| Biomass Energy Crop (CHP) | 36.7 | 160,953 | 36.7 | 160,953 |
| Biomass Boilers, wood | 36.3 | 159,197 | 36.3 | 159,197 |
| Energy from Waste with CHP | 1.6 | 6,945 | 1.5 | 6,390 |
| Other including food waste, animal slurry, poultry litter, sewage sludge and sewage gas. (AD with CHP) | 3.4 | 14,693 | 3.4 | 14,742 |
| Landfill Gas (with CHP) | 0 | 0 | 0 | 0 |
| Building Integrated | 63.5 | 111,205 | 89.9 | 157,440 |
| **Total** | **141.5** | **452,994** | **167.8** | **498,721** |

## 11.3 Setting LPA wide renewable energy contributions

### 11.3.1 Summary

For larger scale electricity generation potential solar farms have been identified. These are however in areas with either high or medium-high landscape sensitivity.

The levels of electricity that are projected for, building integrated renewables is such that they will also need to be a part of the primary strategy for delivering renewable energy generation in the Carmarthenshire LPA area.

Renewable heat is, by nature dependent upon a demand for its use. The demand for heat in the Carmarthenshire LPA area is limited and dispersed and therefore does not lend itself to the generation of large quantities of renewable heat in the Carmarthenshire LPA.

The Carmarthenshire LPA does however have considerable potential to produce energy crop and woody biomass which could facilitate neighbouring areas of Wales to generate renewable heat where there is demand.

The Carmarthenshire LPA could gear up for this role by developing its supply chain to deliver biomass generated heat to its building stock wherever appropriate: this could be secured through an invitation by the Council for developers to consider these options as part of the planning process.

### 11.3.2 Rationale for the setting of contributions

#### 11.3.2.1 Electricity

The totals in Table 33 and Table 34 represent the theoretical maximum renewable energy resource that could be delivered by 2021 and 2033, it may be that developers will not come forward to deliver or more detailed individual site studies will constrain the figures further.

Table 35 and Table 36 below detail the realistic renewable energy contributions that could be made towards meeting a proportion of the total demand for energy in the Carmarthenshire LPA area in 2021 and 2033. The rationale is as follows:

- Whilst there is resource to supply biomass CHP there is no developed supply chain network in the County. CCC does however have a target to investigate the potential within the County
-hence the contribution is set to zero;
- Whilst there is potential to generate energy from the incineration of waste with electricity generation and heat recovery. Non-recyclable material is processed out of the county at a mixture of landfill sites and Cardiff Energy Recovery Facility. It has been assumed that these contracts will run for the period of the new LDP i.e. up to 2033. Where landfill contracts are shorter than the planning period it is assumed residual waste will be sent to the Cardiff Energy Recovery Facility.
-hence the contribution is set to zero;
- The hydropower contribution is based on the (2010) Environment Agency report referring to win-win schemes in the county of Carmarthenshire, with an uptake of 75%;
- Given that there is already recovery of landfill gas that is utilised for electricity generation in the county, it is assumed that all economic opportunities have already been exploited – hence the contribution is set to zero;
- It is assumed that the small number of opportunities identified will be realised in full during the plan period;
- It is assumed that an Anaerobic Digestion plant will be constructed in the county utilising available animal slurry, with the heat usefully employed;
- It is assumed that 20% of the uptake of the microgeneration of renewable electricity predicted via modelling will be achieved over the plan period.

#### 11.3.2.2 Heat

- Whilst there is resource to supply biomass CHP there is no developed supply chain network in the County. No target has therefore been set. CCC does however have a target to investigate the potential within the County;
- Whilst there is resource to supply biomass wood there is there is no developed supply chain network in the County. No target has therefore been set. CCC does however have a target to investigate the potential within the County;

- Whilst there is potential to generate energy from the incineration of waste with electricity generation and heat recovery. Non-recyclable material is processed out of the county at a mixture of landfill sites and Cardiff Energy Recovery Facility. It has been assumed that these contracts will run for the period of the new LDP i.e. up to 2033. Where landfill contracts are shorter than the planning period it is assumed residual waste will be sent to the Cardiff Energy Recovery Facility.

-hence the contribution is set to zero;

- It is assumed that an Anaerobic Digestion plant will be constructed in the county utilising available animal slurry, with the heat usefully employed;
- It is assumed that 20% of the uptake of the microgeneration of renewable heat predicted via modelling will be achieved over the plan period.

**Table 35**: *Resource summary table for renewable electricity in the Carmarthenshire LPA area in 2021 and 2033.*

| Energy Technology | Capacity Factor Assumed | Maximum* Potential 2033 | | Existing | | Additional** Target 2033 | | Total Installed Capacity | Total Energy Generated |
|---|---|---|---|---|---|---|---|---|---|
| | | Electrical Capacity (MWe) | Energy Generated (MWh) | Installed Capacity (MW) | Energy Generated (MWh) | Installed Capacity (MWe) | Energy Generated (MWh) | 2033 (MWe) | 2033 (MWh) |
| Wind Power (existing includes SSAs) | 0.27 | 164.1 | 388,129 | 164.1 | 388,129 | 0 | 0 | 164.1 | 388,129 |
| Biomass Energy Crop (CHP) | 0.9 | 18.4 | 144,857 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Energy from Waste with CHP | 0.9 | 0.7 | 5,751 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Hydropower | 0.37 | 6.7 | 21,860 | 6.6 | 21,304 | 0.1 | 417 | 6.7 | 21,721 |
| Landfill Gas | 0.6 | 2.3 | 11,826 | 2.3 | 11,826 | 0.0 | 0 | 2.3 | 11,826 |
| Solar PV Farms | 0.1 | 283.2 | 248,097 | 126.5 | 110,851 | 60 | 52,560 | 186.5 | 163,411 |
| Other including food waste, animal slurry, poultry litter, sewage sludge and sewage gas. (AD with CHP) | 0.42 | 3.3 | 12,046 | 1.0 | 3,679 | 1.3 | 4,857 | 2.3 | 8,536 |
| Building Integrated | 0.1 | 52.7 | 46,133 | 29.4 | 25,792 | 4.6 | 4,068 | 34.1 | 29,860 |
| **Total** | | **531** | **878,700** | **330** | **561,534** | **66** | **61,902** | **396** | **623,483** |
| **Electrical energy demand 2008** | | | | | **923,148** | **Projected electrical energy demand** | | | **917,389** |
| **Percentage electricity demand met by renewable energy resource** | | | | | **61%** | | | | **68%** |

* This is the maximum resource, it includes existing capacity and 100% of the potential.

**Targets are based on a percentage of maximum potential minus existing generation

### Table 36: Resource summary table for renewable heat in the Carmarthenshire LPA Area in 2021 and 2033

| Energy Technology | Capacity Factor Assumed | Maximum* Potential 2033 | | Existing | | Additional** Target 2033 | | Total Installed Capacity | Total Energy Generated |
|---|---|---|---|---|---|---|---|---|---|
| | | Heat Capacity (MWt) | Energy Generated (MWh) | Installed Capacity (MWt) | Energy Generated (MWh) | Installed Capacity (MWt) | Energy Generated (MWh) | 2033 (MWt) | 2033 (MWh) |
| Existing Biomass (CHP) | 0.5 | 36.7 | 160,953 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Biomass Boilers, wood | 0.5 | 36.3 | 159,197 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Energy from Waste with CHP | 0.5 | 1.5 | 6,390 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Other including animal slurry, poultry litter, sewage sludge and sewage gas. (AD with CHP) | 0.5 | 3.7 | 15,990 | 0.2 | 986 | 2.0 | 8,736 | 2.2 | 9,722 |
| Landfill Gas (with CHP) | 0.5 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Building Integrated | 0.2 | 89.9 | 157,440 | 35.0 | 61,292 | 11.0 | 19,230 | 46.0 | 80,522 |
| **Total** | | | | **35.2** | **62,278** | **13.0** | **27,966** | **48.2** | **90,244** |
| **Heat energy demand 2008** | | | | | **2,130,266** | **Projected heat energy demand** | | | **1,493,795** |
| **Percentage heat demand met by renewable energy resource** | | | | | **3%** | | | | **6%** |

* This is the maximum resource, it includes existing capacity and 100% of the potential.
**Targets are based on a percentage of maximum potential minus existing generation

# 12. Heat opportunity assessment

## 12.1 Introduction

This component of the REA considers some of the issues associated with mapping opportunities for the utilisation of renewable and low carbon heat. The analysis of the extent to which the utilisation of heat is viable, or likely to be viable, comprises a number of levels of complexity ranging from:

- Heat opportunities mapping
- Developing an energy opportunities plan for district heating networks
- Assessing the technical and financial viability of district heating networks

The reason for the different levels of complexity relates to the timing of when each level of analysis should be employed. For instance, heat opportunities mapping provides sufficient levels of detail for sieving candidate sites and to set a policy requiring a developer to investigate a District Heat Network (DHN).

Any policy requiring specific site/building $CO_2$ reduction targets, or connections to DHN, will require a more detailed economic and technical appraisal.

## 12.2 Background

There are multiple reasons for identifying and understanding the nature of existing and future energy demand and infrastructure, some of which are:

- Identification of public sector buildings to act as anchor 'heat' loads (AHLs);
- To establish the energy densities of particular areas. New CHP/District Heating technology installations are more likely to be economically viable in areas of high-density energy demand but can be more complex to install. This dataset assists with the identification of sites with significant potential;
- The proportions of the relative demand for electricity and heat are also useful indicators as to what type of Low and Zero Carbon (LZC) technologies might be appropriate in a particular area;
- Areas of high-density energy demand may not always present the greatest opportunities. Energy density data needs to be combined with other data, such as the nature of energy demand, the composition of building types and uses, the accessible renewable energy resource, land and building ownership, existing infrastructure and any proposed development in order to identify the greatest opportunity. These opportunities should also be reviewed against community priorities to align delivery to local requirements;
- Energy demand can be estimated from the types of proposed buildings, the quantity of development and the energy efficiency level. Energy efficiency can reduce the energy consumption, so it is important to estimate the future requirements in this regard;
- The locations of new development will be needed for assessments of strategic opportunities.

### 12.2.1 Identifying anchor "heat" loads (AHLs) and "clusters"

'Anchor heat loads' pertain to buildings with a high and continuous demand that could provide economically viable and practical opportunities for utilising heat. It is known as an 'anchor' load because further opportunities may arise for connecting nearby buildings to the original anchor load. An 'AHL' therefore refers to a building energy load that can act as a base for a District Heating (DH) schemes.

Buildings that are located near to an AHL (such as social housing, etc.) and which may benefit from and contribute to the viability of DH schemes are known as a 'cluster'. A 'cluster' usually refers to a mix of residential and non-residential buildings which, together, represent opportunities due to their:

- Complementary energy demand profile;
- Planned development programme
- Commitment to reduce $CO_2$ emissions

The identification of AHLs and clusters requires the mapping of:

- Buildings owned by organisations with corporate climate change mitigation policies and an active commitment to reducing their carbon footprint, and;
- Planned new development/ refurbishment by the 'anchor heat load' organisation. New development is likely to be the catalyst for such change. DH schemes are most cost-

effective when installed as part of new development rather than retro-fitting.

- Social housing schemes. These organisations are often tasked with achieving greater than the minimum environmental performance standards. The inclusion of such developments in DH schemes often enhance the energy profile to provide further evening, weekend and night time energy demands.

AHLs can help a DH scheme to become a realistic prospect and there are usually particular conditions that need to be in place, such as planned new development and/ or an AHL building/ group of buildings with a significant demand for heat and/ or with an energy profile suitable for the installation of a particular technology.

Given the responsibilities placed upon local authorities and the public sector in general for driving the climate change mitigation agenda (particularly in light of the 'Well-being of Future Generations (Wales) Act – Welsh Government (2015), the many District Heating enabling roles that are the responsibility of the local authority, and the ability that local authorities have to accept lesser returns on investment than private sector in order to obtain wider social value, AHL's are often provided by buildings such as council administration centres, leisure buildings (particularly those with swimming pools) and hospitals; although shopping arcades and precincts have also been utilised in this way.

Privately owned buildings are less often utilised as AHLs due to more attractive returns from competing investments, reduced willingness to commit to long term energy procurement contracts and other issues such as a greater tendency for private companies to rent property rather than own it. In the residential market, it is preferable to for district heating schemes to connect to social housing, and in particular with apartment blocks due to the increased heat demand density offered. It is often impractical for developers to have to negotiate with many individual private householders whereas social landlords can more readily act on behalf of their tenants.

In order to calculate the heat demand of the non-residential buildings. The following methods and sources are used.

- Metered energy data;
- Display Energy Certificates (DEC), if metered data is not available;
- Chartered Institute of Building Services Engineers Technical Memorandum TM46 energy benchmarking conversions (only incorporated if DEC or metered data are not provided);
- An improved TM46 benchmarking tool based on AECOM's experience, this is used to estimate heat demand of new developments.

### 12.2.2 Social Housing Associations in Carmarthenshire

Social housing provisions for Carmarthenshire has been provided by CCC who administers the housing lists for CCC and four housing associations within Carmarthenshire.

### 12.2.3 Identifying off-gas areas

Off-gas areas refer to those areas not served by the gas mains network with the result being that many residents and, less often, businesses often utilise less economic and more polluting fuels for heat and Domestic Hot Water (DHW). In the case of dwellings, this can be a contributing factor to fuel poverty.

There are several important reasons for identifying these areas, namely:

- The use of fuels other than natural gas for heat and DHW often incur additional cost to the user. Whereas the economic case (at the time of writing) for the installation of renewable heat energy technologies may not be particularly attractive in relation to natural gas, these increased costs may enable the development of a solid business case for the installation of building integrated LZC technologies.
- The reason DHN schemes are often not developed in rural locations is often the same as the reason why the gas network has also not been extended – financial viability. It is the case however that rural housing can contribute to providing a useful energy demand profile to counterbalance the energy demands of commercial organisations (daytime requirement only) that may have installed CHP or plant large enough to supply DH scheme.
- DHN schemes fed by alternative fuels such as waste or biomass are often located in rural areas or on the urban fringe due to the space requirements necessitated by storage and vehicle access. They also tend to be located

on industrial estates which offer opportunities to co-locate complementary businesses.

The maps within this Renewable Energy Assessment do not show off-gas areas due to lack of access to data. The data available indicates that the majority of properties outside of the larger settlements are 'off-gas'.

### 12.2.4 Mapping residential heat demand and density

A report for BEIS (formerly DECC[72]) suggests that DHNs are not feasible unless a heat demand of at least 3MW/km$^2$ is present.

'Density' of heat demand refers to kilowatt hour (kWh) / square kilometre (km$^2$) of heat energy consumed in dwellings.

Information relating to heat densities can be used to inform:

- The identification of AHLs by providing, or adding to, a viable opportunity for the introduction of renewable heat
- A mix of buildings and energy uses which, together, represent a potential complementary energy demand profile (dwellings providing evening, weekend and night time energy demands as opposed to the normal weekday energy demands of commercial organisations)
- The identification of opportunities relating to social housing providers who are often tasked with achieving greater than the minimum environmental performance standards.

When allocating quantities of energy to dwellings or other types of buildings it is a useful check to look at national sources of data to ensure figures are broadly supported and to check whether annual energy consumptions are above or below national averages. Above national average consumption may indicate a lack of energy saving education or a higher proportion of poorly insulated buildings, etc.

When allocating energy consumptions to existing residential buildings, the Active template 3[73] from the Planning for renewable and low carbon energy: a toolkit for planners is used, the template makes use of publicly available domestic gas consumption estimates per Lower Super Output Area (LSOA) for 2012 to allocate each area a heat density figure and quantifies the heat demand.

For the new residential buildings, data from previous AECOM's DHN studies are used to benchmark the heat demand.

The importance of identifying residential heat demand and density pertains to:

- The potential demand for heat in any one particular area;
- Contributing to the identification of AHLs;
- Feeding into the analysis of potential LZC solutions.

Map DHN 1 in the accompanying document 'Carmarthenshire Renewable and Low Carbon Energy Assessment 2019 – Maps' shows the residential heat densities in Carmarthenshire which presents potentials in larger settlements, the Social Housing data received from CCC is presented on the identified cluster maps.

### 12.2.5 Identifying areas of high fuel poverty

Fuel poverty is a key concern of national governments and local authorities alike. Local authorities, including Carmarthen County Council, produce reports relating to the number of people or households regarded as 'fuel poor'.

Often, it is those living in rural parts of the country who suffer disproportionately from fuel poverty and this is attributable to a number of factors. For example, typically, wages are lower than for those employed in more urban areas, there is often a higher proportion of unemployed and fewer job opportunities, etc.

A greater proportion of households are not connected to mains services and pay higher prices for fuels such as Liquefied Petroleum Gas (LPG) and heating oil. The combination of factors means that energy bills can constitute a greater proportion of the household costs than for many urban households.

A contributory factor of fuel poverty can also be the lack of energy infrastructure in rural locations. Often gas networks have not been connected in very rural areas due to high capital cost in relation to revenue generated. This means that residents of rural locations are forced to seek alternatives to natural gas such as LPG, heating oil or some form of solid fuel. The upside is that where the installation of a renewable energy technology is considered in such locations the economic payback and the potential $CO_2$ reductions

[72] The Potential and Costs of District Heating Networks. A Report to the Department of Energy and Climate Change, April 2009

[73] https://gov.wales/local-development-plans-guidance-renewable-and-low-carbon-energy

are proportionately better than when considered against natural gas.

Map DHN 2 in the accompanying document 'Carmarthenshire Renewable and Low Carbon Energy Assessment 2019 – Maps' shows fuel poverty in Carmarthenshire and is prepared in order to assist the local authority in their targeting of resources.

#### 12.2.6 Map locations of strategic new development sites

This involves mapping location of the strategic sites using GIS, heat demands from the selected candidate sites from the new Carmarthenshire LDP are estimated and added to the maps.

## 12.3 Identifying existing DHN & CHP schemes and sources of waste heat

It is important to establish the nature of the existing energy infrastructure as it may provide opportunities for expanded connectivity or increased efficiency/ viability. Identification of current utilisation of renewable energy resources is covered by this Renewable Energy Assessment.

The utilisation of current sources of waste heat can provide opportunities to improve fuel efficiency and secure $CO_2$ emission reductions. Extending existing infrastructure to additional users can increase the viability of a particular scheme.

#### 12.3.1 What is a DHN

A District Heating Network (DHN) is the term given to a distribution system providing multiple individual buildings with heat generated from a single source. The plant is generally housed in a building known as an energy centre in which heat can either be generated from traditional fossil fuels (from a boiler or a Combined Heat & Power unit) or from a low carbon source such as biomass.

Heat can be transmitted as hot water, or in some cases steam, along buried pipes to a number of buildings in the local area. The pipes are known as heat mains. A heat exchanger located in each building enables the delivery of heat. New controllers are provided (very similar to those fitted and linked with gas boilers) to operate the system and buildings can usually retain their internal distribution system (e.g. radiators).

Heat is metered and billed to consumers in much the same way that gas or electricity is. This is combined with a service charge to cover maintenance of the shared distribution system (electricity and gas bills also incorporate a charge for these services).

#### 12.3.2 What is CHP?

Combined heat and power (CHP) is simply where the energy centre produces heat as a by-product of electricity generation. The heat is used to supply the DH network in the conventional way, whilst the electricity is either sold locally or onto the wholesale electricity market.

The heat from CHP units can also be used to meet cooling demands via the use of absorption chillers. This can involve either a centralised chiller, distributing "coolth" via a chilled water network, or decentralised absorption chillers in individual buildings. This approach is sometimes referred to as "tri-generation" or CCHP (Combined Cooling Heat and Power).

#### 12.3.3 Existing DHN and CHP schemes in Carmarthenshire

There are no existing DHN schemes in Carmarthenshire.

The Nant y Caws Landfill site has the potential to provide approximately 5MW of heat however its location is not conducive to the development of a heat network. There is a CHP at Amman Valley Comprehensive School/ Leisure Centre (details not known); Tesco Store, Carmarthen (0.238); Queen Elizabeth School (0.07); and a small CHP located at a Tesco Store in Ammanford (details not known).

## 12.4 Heat Opportunity Plan for DHNs

The bringing together of various data layers described above, together with the location of candidate sites for new development, informs the development of a 'Heat Opportunities Plan'.

Circle sizes on the heat maps provide an estimate of potential which is useful for comparing the relative size of different energy loads. The mapping informs a very high-level assessment of potential viability using an equation which links the value of potential energy sales with the length of pipe.

The radius of each circle is calculated based on the rule of thumb for the length of capital investment in a heat network and that which the revenue from heat sales to that load could support.

The equation used is:

$$R \approx \frac{AHL \times HP \times Y}{C}$$

Where:

- R = radius of circle, in metres
- AHL = annual heat demand, in kWh
- HP = price at which heat is sold, assumed to be £0.04/kWh
- Y = number of years of revenue, assumed to be 10 years[74]
- C = estimate of cost of installing heat pipe per m of trench, assumed to be £1000/m for this exercise

The size of the circle indicates the relative size of the heat load in question and allows for easily identifiable comparisons to be made between different heat loads. This methodology also provides an indication of the viability of connecting a heat load. If there are large gaps between circles, it suggests that connecting loads may not be viable. Conversely, if circles overlap, connecting them may be more viable.

### 12.4.1 Evaluation of District Heating Network Opportunities

The development of the energy opportunity plans for Carmarthenshire County Council has enabled the identification of clusters of sites with potential to be technically feasible and economically viable. Four scenarios were identified that have potential for a heat network, namely:

- Carmarthen Cluster
- Llanelli Cluster 1
- Llanelli Cluster 2
- Ammanford Cluster

[74] In practice, a heat/electricity supply contract to an anchor load may last for 20 to 25 years, but the use of 10 years reflects the fact that the revenue over 25 years would roughly need to be twice the initial capital costs to cover the operation and maintenance costs for the network

## 12.5 Carmarthen Cluster District Heating Networks Evaluation

**Figure 9**: *Carmarthen Cluster West – Heat Map.*

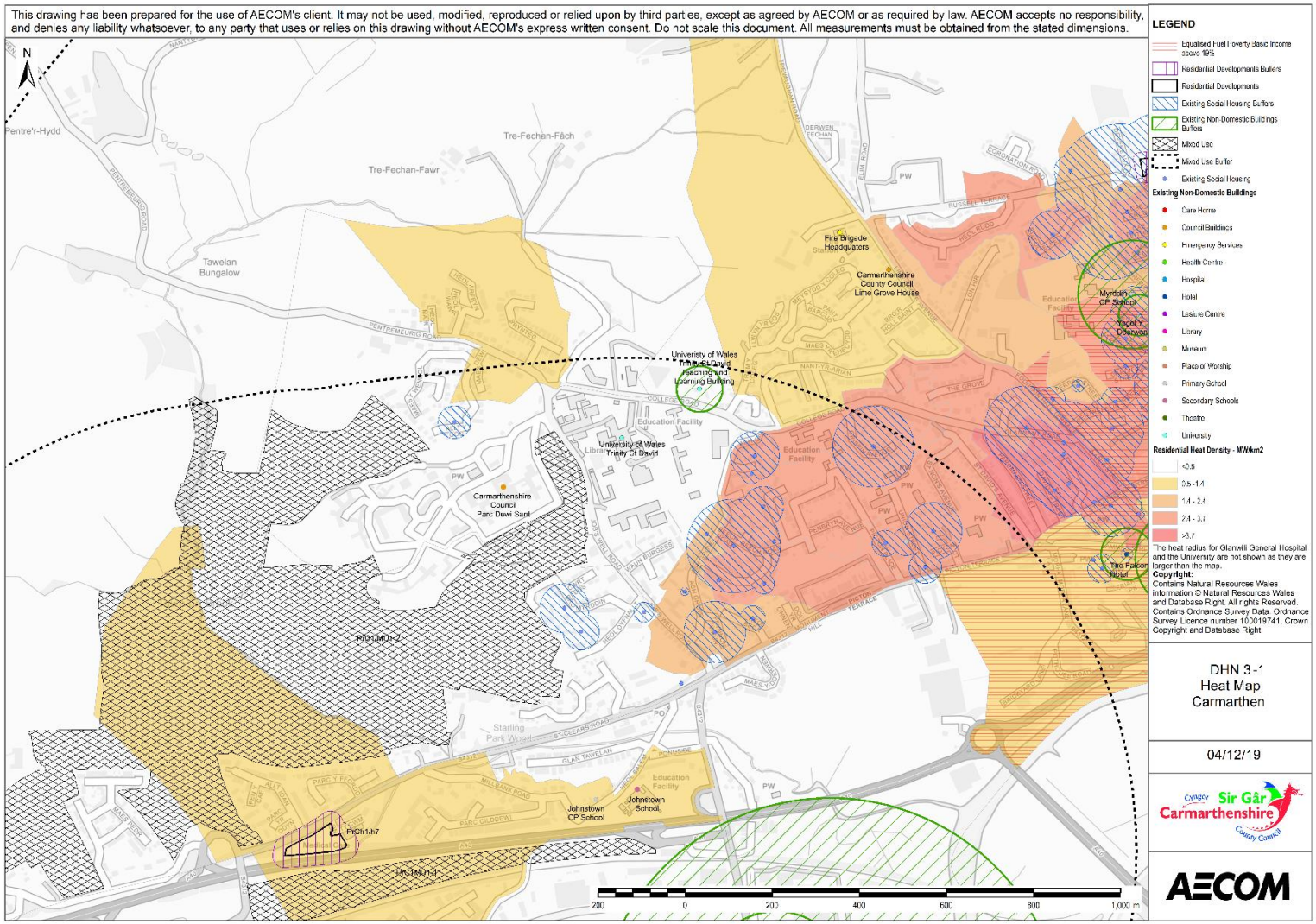


**Figure 10**: *Carmarthen Cluster East - Heat Map.*

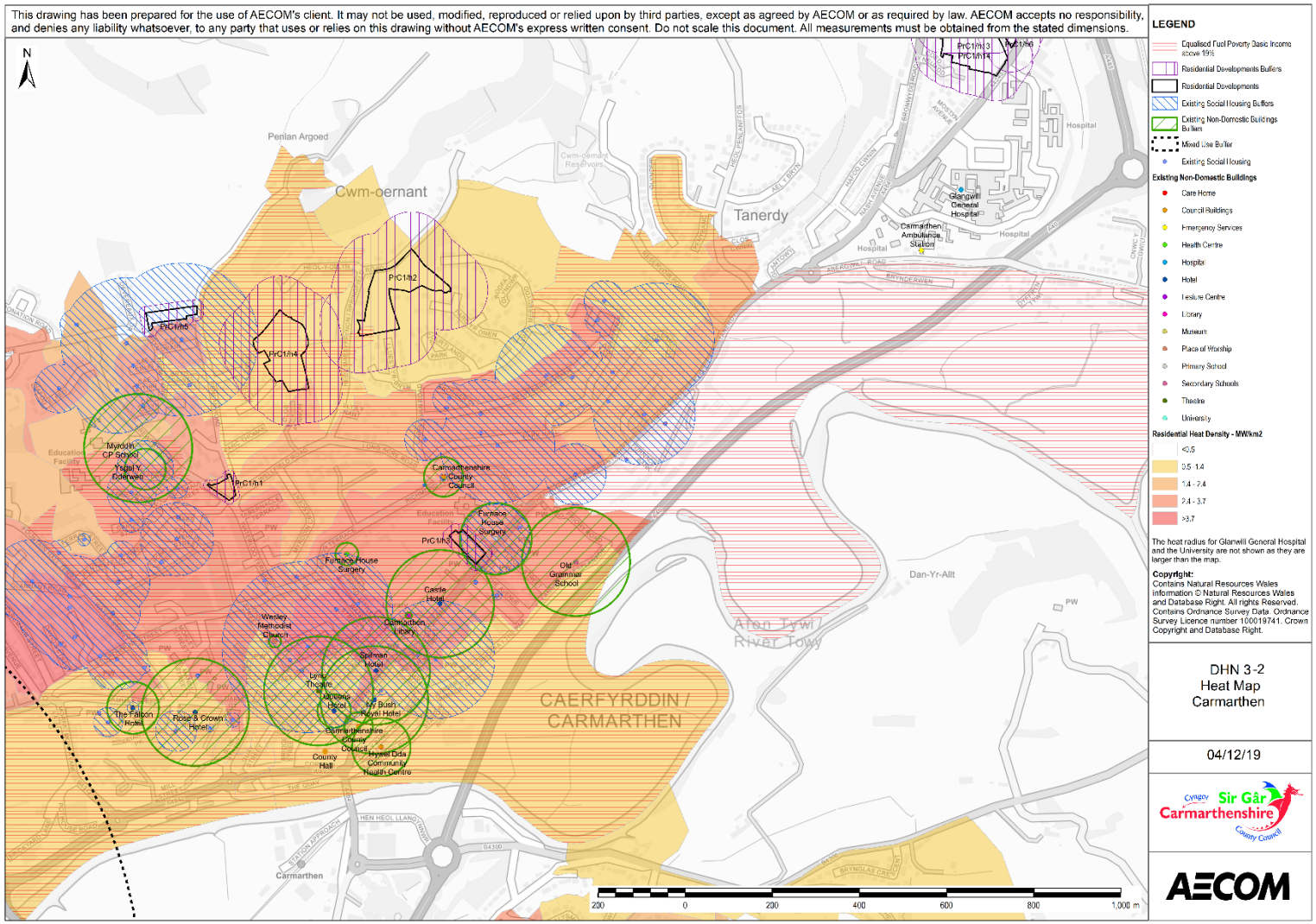
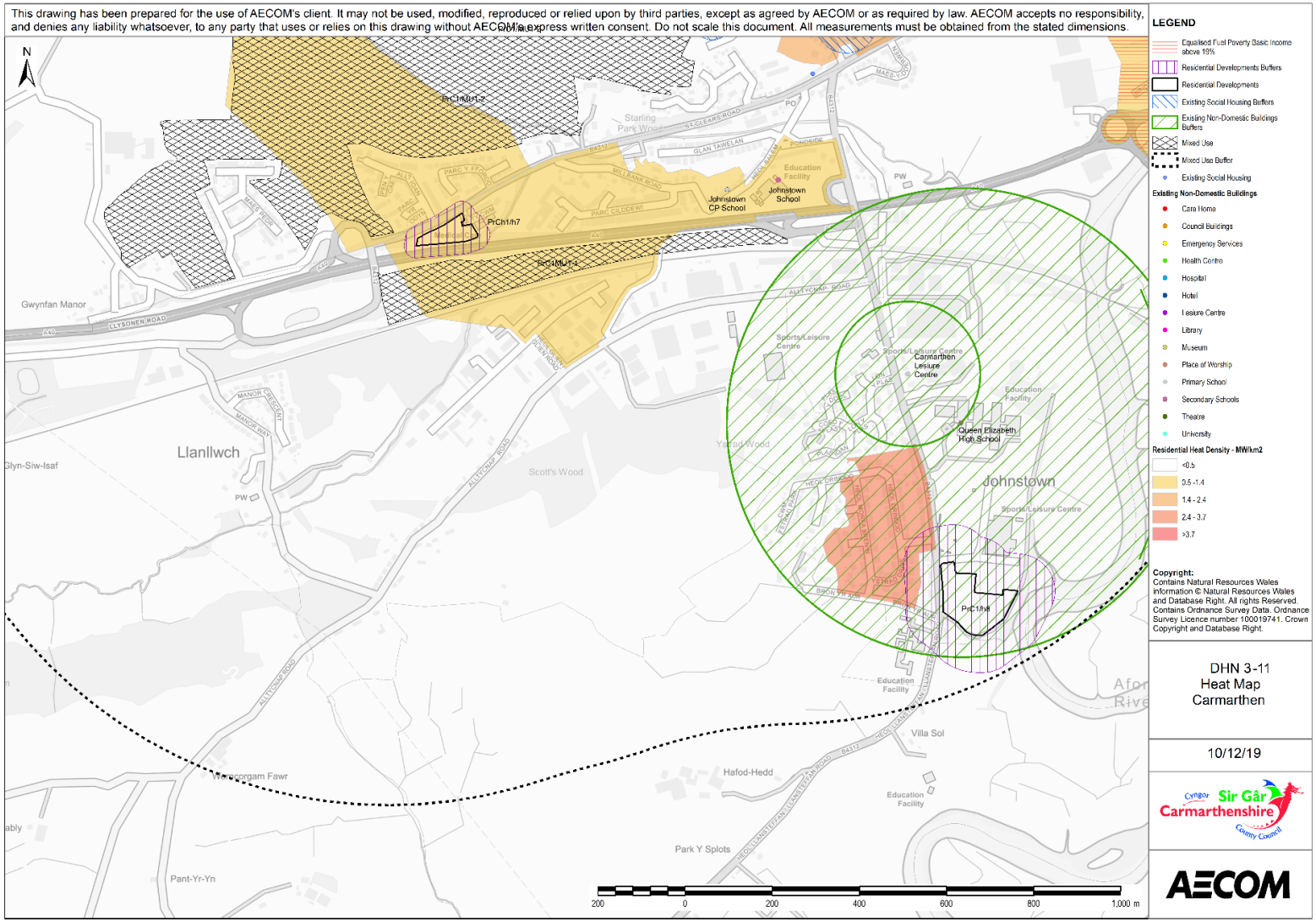


**Figure 11**: *Carmarthen Cluster South – Heat Map.*



### 12.5.1 SWOT Analysis

Table 37 below provides an overview of existing and potential buildings in Carmarthen, including any phasing and timing issues. In addition, details of the key opportunities and constraints within the site that could have an impact on the technical or commercial viability, or the practical delivery of a network are summarised, as well as the potential for future expansion of a heat network.

**Table 37***: Carmarthen Cluster –heat network assessment*

| **SWOT Analysis** | | |
|---|---|---|
| **Existing buildings** | **Potential Buildings** | **Phasing /timing issues** |
| Key potential anchor heat loads:<br>▪ Glangwili General Hospital<br>▪ University of Wales Trinity Saint David<br>▪ Queen Elizabeth High School<br>▪ Carmarthen Leisure Centre<br>▪ Carmarthenshire County Council Parc Myreddin<br>▪ Carmarthenshire County Council County Hall<br>▪ Lyric Theatre<br>▪ Myrddin CP School<br>▪ Old Grammar School<br>Other non-residential public buildings:<br>▪ Hywel Dda Community Health Centre<br>▪ Carmarthen Ambulance Station<br>▪ Ysgol Y Dderwen<br>▪ Carmarthenshire County Council Spilman St.<br>▪ Parc-Y-Rhun CP School<br>▪ Carmarthen Library | Key sites:<br>▪ PrC1/MU1-2 700 dwellings & 61.0ht employment<br>▪ PrC1/Mu1-1 5.8ht employment<br>▪ PrC1/h8 46 dwellings<br>▪ PrC1/h1: 5 dwellings<br>▪ PrC1/h2: 46 dwellings<br>▪ PrC1/h3: 8 dwellings<br>▪ PrC1/h4: 42 dwellings<br>▪ PrC1/h5: 8 dwellings<br>▪ PrC1/h6 30 dwellings<br>▪ PrC1/h13 25 dwellings<br>▪ PrC1/h14 31 dwellings | Detailed information on the phasing of the proposed sites is currently unknown. |
| **Site opportunities** | | |
| The close proximity of Myrddin CP School and Ysgol Y Dderwen to the proposed development sites on the north side of Carmarthen town centre provides a suitable anchor load for the northern developments and the surrounding social housing.<br>The Glangwili hospital provides a potential as an anchor load and energy centre location on the eastern end of the network to supply the social housing and public buildings on the south side of Carmarthen town centre.<br>The University provides a potential as an anchor load and energy centre location on the western end of the network to supply the new mixed development and social housing.<br>The Carmarthen leisure centre and the Queen Elizabeth High School provide potential anchor loads and energy centre locations on the southern section of the network to supply the new development PrC1/h8 in Johnstown. | | |
| **Site constraints** | | |
| The A484 provides the only direct route to connect the Glangwili hospital to the rest of the Carmarthen cluster.<br>The river Towy and the A40 are significant obstacles to any proposed extension of the network towards the development areas to the south of the A40 and the social housing at Tre-gynwr. | | |

### 12.5.2 List of key existing buildings for a proposed heat network.

**Table 38:** *Summary of key existing buildings in Carmarthen.*

| UPRN | Name | Annual Heat Demand (MWh) | Source |
|---|---|---|---|
| 10024020568 | Glangwili General Hospital | 1,244,799 | DEC |
| 10004885410 | University of Wales Trinity Saint David | 214,977 | DEC |
| 10092967877 | Queen Elizabeth High School | 1,346 | DEC |
| 10024018372 | Carmarthenshire County Council Parc Myrddin | 451 | Benchmark |
| 10004850349 | Carmarthen Leisure Centre | 416 | DEC |
| 10009167172 | Carmarthenshire County Council County Hall | Not Known | |
| 10004850214 | Carmarthenshire County Council Parc Dewi Sant | Not Known | |
| 10004866054 | Lyric Theatre | 312 | DEC |
| 200002957838 | Myrddin Cp School | 310 | Benchmark |
| 10092966292 | Old Grammar School | 310 | Benchmark |
| 100100151296 | Spilman Hotel | 308 | Benchmark |
| 100101008330 | Castle Hotel | 308 | Benchmark |
| 100101008704 | Rose & Crown Hotel | 308 | Benchmark |
| 200002957809 | Ivy Bush Royal Hotel | 308 | Benchmark |
| 10090703020 | Hywel Dda Community Health Council | 167 | Benchmark |
| 10024018434 | The Falcon Hotel | 148 | Benchmark |
| 10090705036 | Carmarthen Ambulance Station | 136 | Benchmark |
| 200001853319 | Ysgol Y Dderwen | 117 | DEC |
| 10009167749 | Queens Hotel | 96 | Benchmark |

| | | | |
|---|---|---|---|
| 10009551366 | Carmarthenshire County Council Spilman Street | 81 | DEC |
| 200002957929 | Furnace House Surgery | 65 | DEC |
| 200001858303 | Carmarthen Library | 34 | DEC |
| | Social Housing | 10 | Benchmark |
| | **Total** | **1,465,007** | |

### 12.5.3 List of potential buildings

**Table** 39**:** *Proposed buildings and estimated year of build out at Carmarthen.*

| Reference | Name | Maximum number of dwellings | Non residential floor area (hectare) | Estimated build out year |
|---|---|---|---|---|
| PrC1/MU1-2 | West Carmarthen | 700 | 61.0 | Unknown |
| PrC1Mu1-1 | West Carmarthen | | 5.8 | Unknown |
| PrC1/h2 | Springfield Road | 46 | | Unknown |
| PrC1/h8 | Llansteffan Road | 46 | | Unknown |
| PrC1/h4 | Land off Parc y Delyn | 42 | | Unknown |
| PrC1/h14 | Bronwydd Road (south) | 31 | | Unknown |
| PrC1/h6 | Dolgwili Road | 30 | | Unknown |
| PrC1/h13 | Land south of Pant Glas, Bronwydd Road | 25 | | Unknown |
| PrC1/h3 | 113 Priory Street | 8 | | Unknown |
| PrC1/h5 | East of Deveraux Drive | 8 | | Unknown |
| PrC1/h1 | Former Health Authority Buildings, Penlan Road | 5 | | Unknown |
| | **Total** | **941** | **66.8** | |

### 12.5.4 Potential District Heating Network Routes

Indicative district heating network route[s] that could be taken forward for further review based on an evaluation of site opportunities and constraints as identified above are illustrated in the GIS map overleaf.

**Figure 12:** *Carmarthen West – Potential District Heating Network Routes*

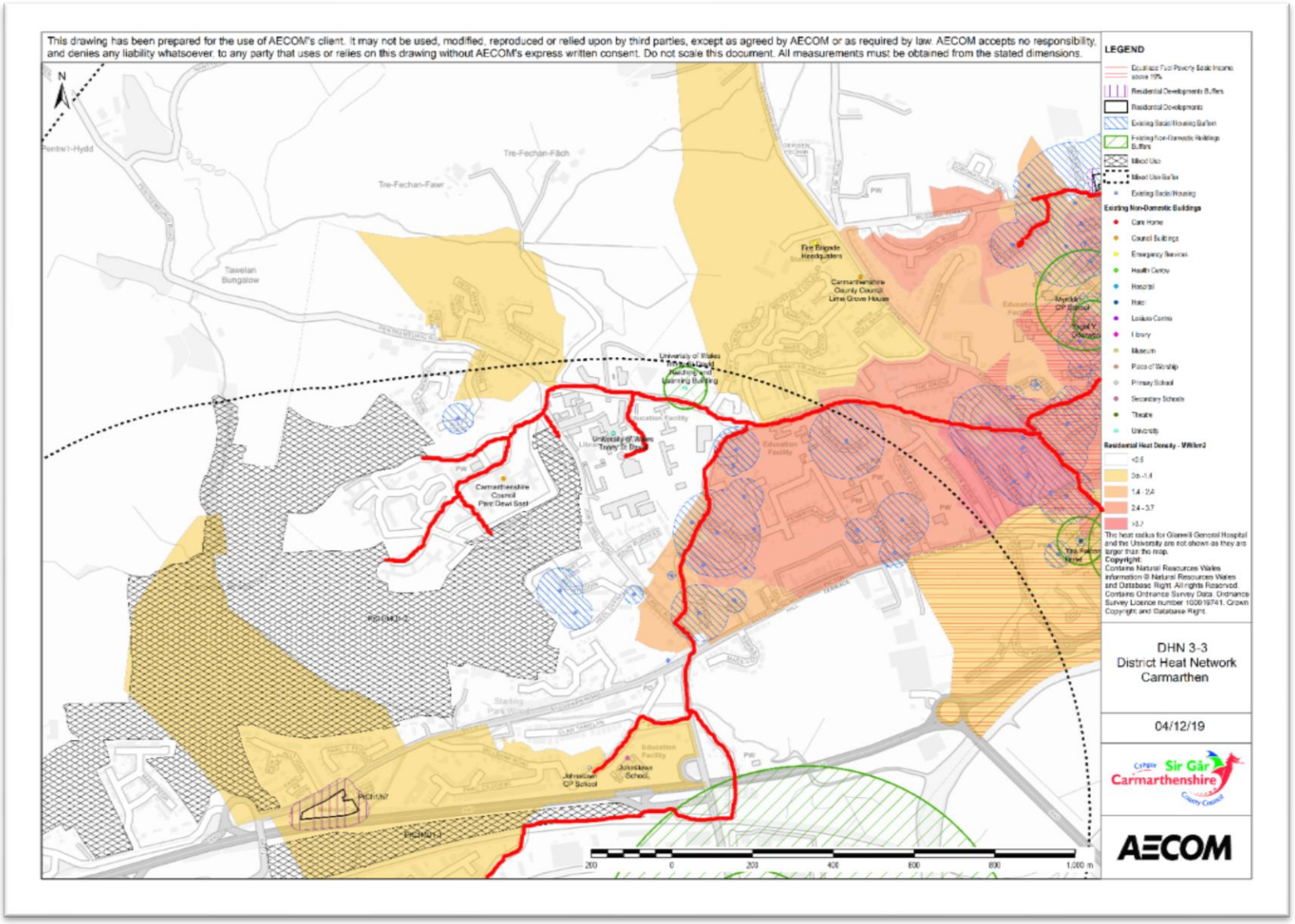


**Figure 13:** *Carmarthen East – Potential District Heating Network Routes*

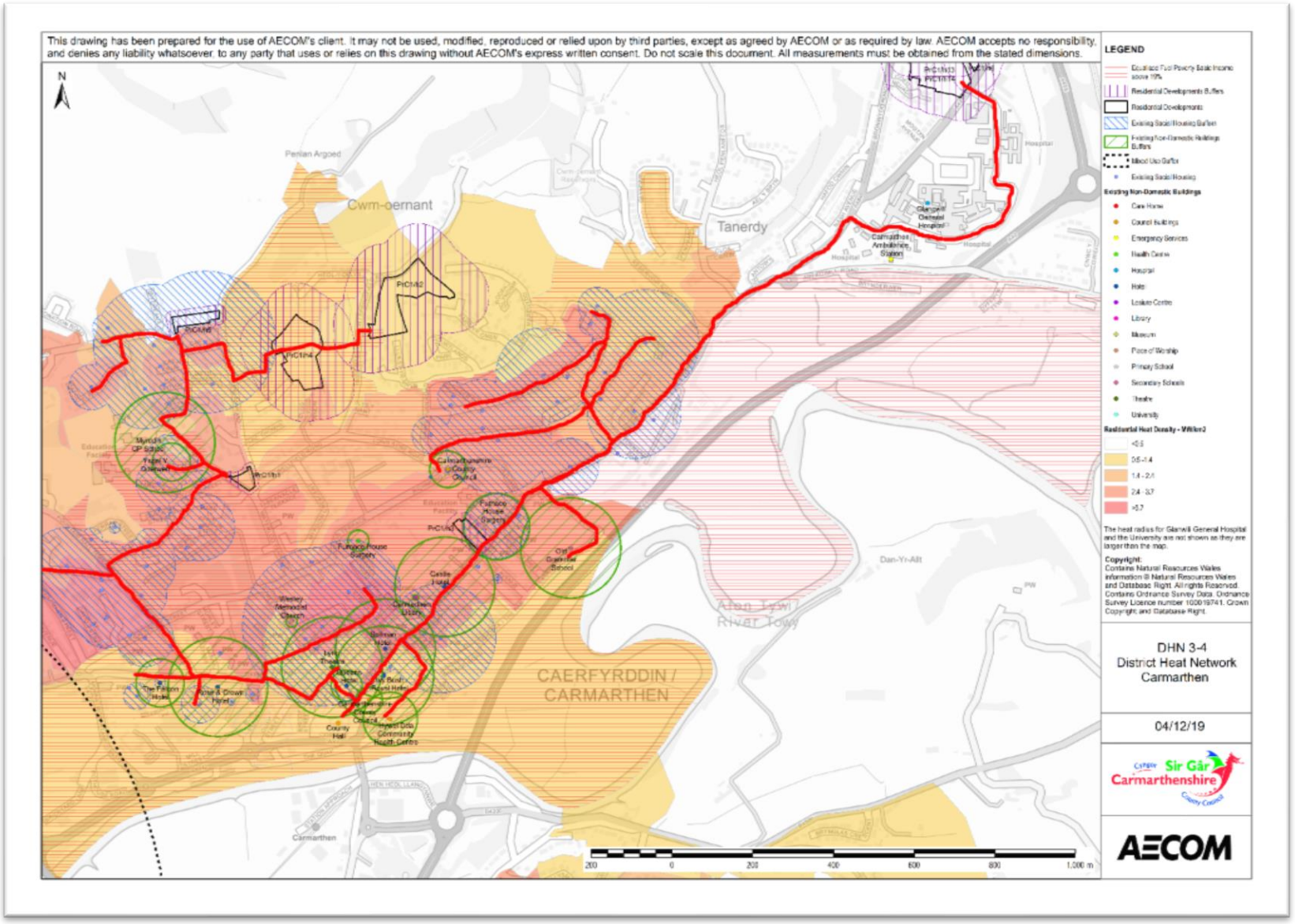
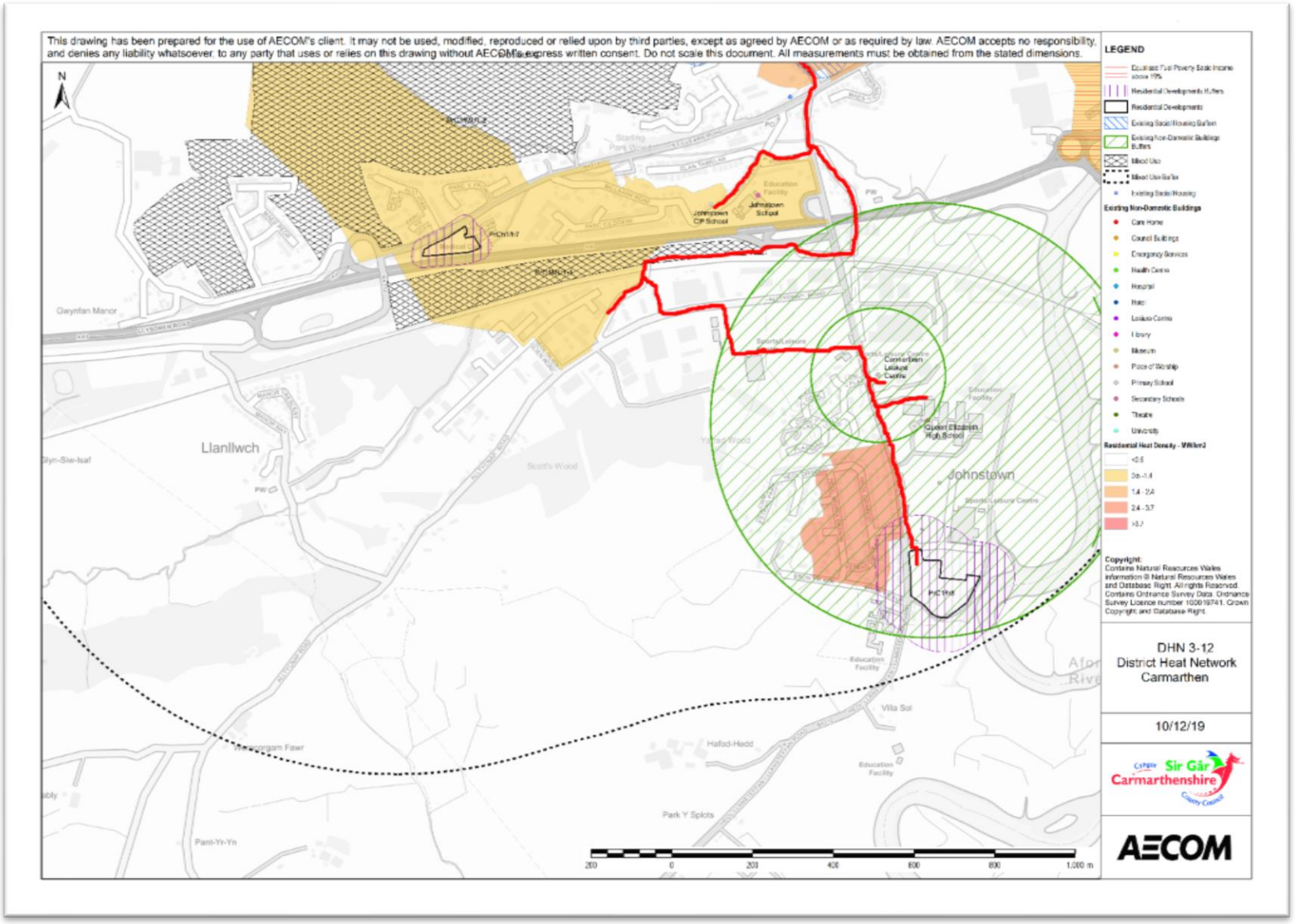
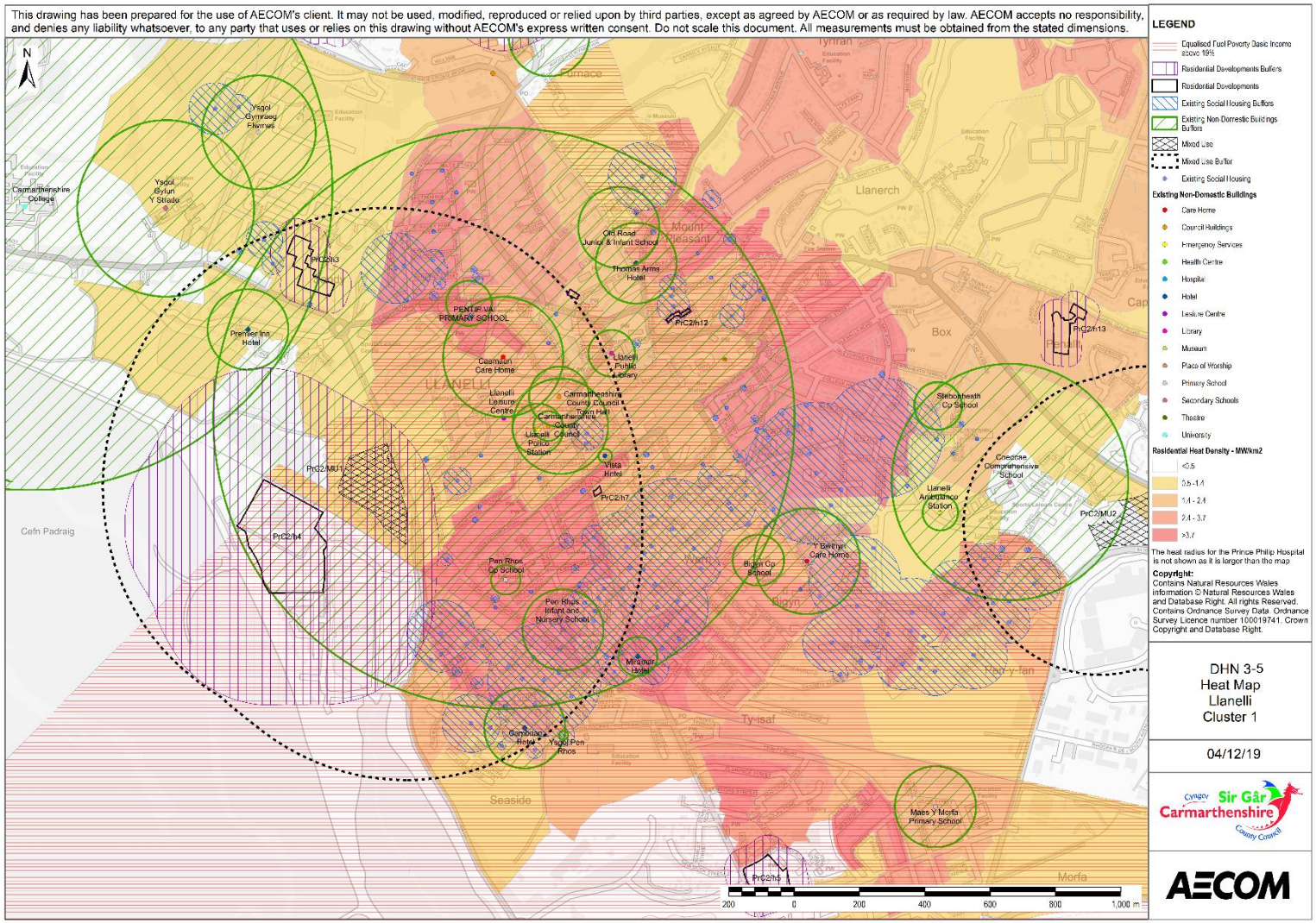


**Figure 14:** *Carmarthen South – Potential District Heating Network Routes*



## 12.6 Llanelli Cluster 1 District Heating Networks Evaluation

**Figure 15**: *Llanelli Cluster 1 –Heat Map*



### 12.6.1 SWOT Analysis

Table 46 below provides an overview of existing and potential buildings in Llanelli Cluster 1, including any phasing and timing issues. In addition, details of the key opportunities and constraints within the site that could have an impact on the technical or commercial viability, or the practical delivery of a network are summarised, as well as the potential for future expansion of a heat network.

**Table 40**: *Llanelli Cluster 1 –heat network assessment*

| **SWOT Analysis** | | |
|---|---|---|
| **Existing buildings** | **Potential Buildings** | **Phasing /timing issues** |
| Key potential anchor heat loads:<br>▪ Llanelli Leisure Centre<br>▪ Carmarthen College<br>▪ Coedcae Comprehensive School<br>▪ Ysgol Gyfun Y Strade<br>▪ Caemaen Care Home<br>▪ Ysgol Gymraeg Ffwrnes<br>▪ Y Bwthyn Care Home<br>▪ Pen Rhos Infant and Nursery School<br>▪ Old Road Junior & Infant School<br>▪ Carmarthenshire County Council Town Hall<br>Other non-residential public buildings:<br>▪ Bigyn Cp School<br>▪ Llanelli Police Station<br>▪ Stebonheath Cp School<br>▪ Llanelli Public Librarys<br>▪ Pentip Va Primary School<br>▪ Llanelli Ambulance Station<br>▪ Pen Rhos Cp School<br>▪ Carmarthenshire County Council<br>▪ Ysgol Pen Rhos | Key sites:<br>▪ PrC2/h4: 185 dwellings<br>▪ PrC2/h3: 28 dwellings<br>▪ PrC2/MU2: 35 dwellings & 24.5ha employment<br>▪ PrC2/MU1: 35.6ha employment | Detailed information on the phasing of the proposed sites is currently unknown. |
| **Site opportunities** | | |
| Llanelli Leisure Centre makes an ideal anchor load to the network and potential location for an energy centre for a network supplying the social housing to the south and the new developments to the west. The Coedcae Comprehensive School provides an anchor load to the east side of the proposed network and the development area PrC2/MU2. Likewise, Carmarthen College provides anchor load to the north western end of the proposed network. | | |
| **Site constraints** | | |
| The railway line may provide an obstacle to connecting the development area PrC2/h4 and the social housing to the south of the railway as there are a limited number of bridge crossings. This is due to the likelihood that pipework crossing points may be restricted to existing crossings and bridges over the rivers, unfavourably lengthening any proposed network route. The need to uses a section of the A484 may also constrain the north western section of the proposed network. | | |

### 12.6.2 List of key existing buildings

**Table 41:** *Summary of key existing buildings at Llanelli Cluster 1.*

| UPRN | Name | Annual Heat Demand (MWh) | Source |
|---|---|---|---|
| 200002956547 | Carmarthenshire College | 2,307 | DEC |
| 200002956524 | Llanelli Leisure Centre | 2,224 | DEC |
| 100101031269 | Coedcae Comprehensive School | 905 | DEC |
| 10004853595 | Ysgol Gyfun Y Strade | 676 | DEC |
| 10004853964 | Caemaen Care Home | 459 | DEC |
| 10092964672 | Ysgol Gymraeg Ffwrnes | 436 | Benchmark |
| 200002956347 | Y Bwthyn Care Home | 405 | DEC |
| 10004853925 | Ty Elwyn, Town Hall Square | 365 | DEC |
| 200002956466 | Pen Rhos Infant and Nursery School | 311 | Benchmark |
| 200002956489 | Old Road Junior & Infant School | 311 | Benchmark |
| 100101000058 | Cambrian Hotel | 309 | Benchmark |
| 100101031253 | Thomas Arms Hotel | 309 | Benchmark |
| 10090704194 | Premier Inn Hotel | 309 | Benchmark |
| 10004853923 | Carmarthenshire County Council Town Hall | 230 | DEC |
| 200002956406 | Bigyn Cp School | 197 | DEC |
| 100101000850 | Llanelli Police Station | 195 | DEC |
| 200001853273 | Stebonheath Cp School | 183 | DEC |
| 10004853935 | Llanelli Public Library | 178 | DEC |
| 200002956522 | Pentip Va Primary School | 173 | DEC |
| 100100999168 | Miramar Hotel | 149 | Benchmark |
| 100100999422 | Llanelli Ambulance Station | 136 | Benchmark |
| 200002956454 | Pen Rhos Cp School | 113 | DEC |
| 10024018537 | Vista Hotel | 52 | Benchmark |
| 10092966226 | Ysgol Pen Rhos | 34 | Benchmark |
| | Social Housing | 24 | Benchmark |
| | **Total** | **10,990** | |

### 12.6.3 List of potential buildings

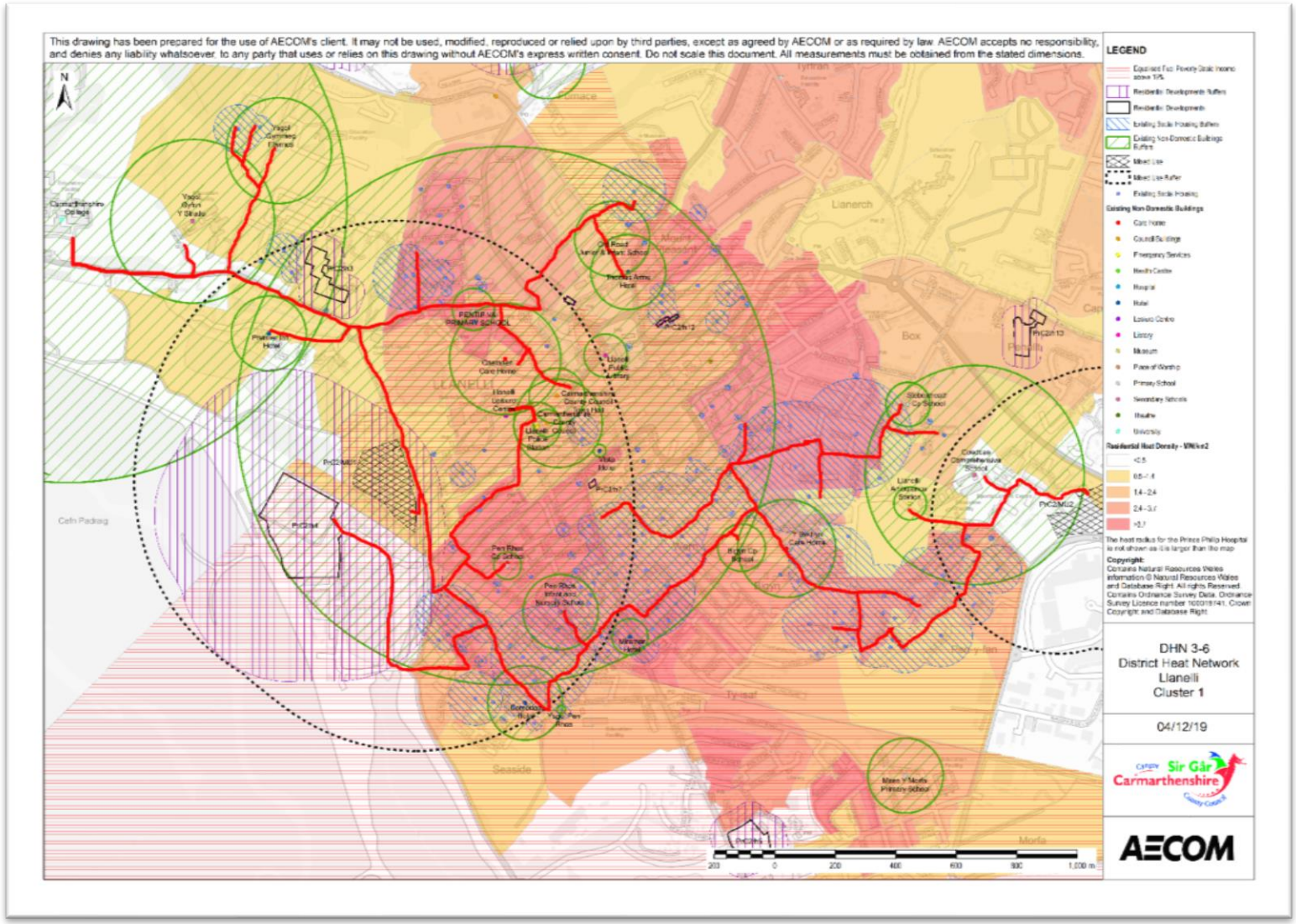
**Table 42:** *Proposed buildings and estimated year of build out at Llanelli Cluster 1.*

| Reference | Name | Maximum number of dwellings | Non residential floor area ($m^2$) | Estimated build out year |
|---|---|---|---|---|
| PrC2/h3 | Parc y Strade, Llanelli West | 28 | | Unknown |
| PrC2/h4 | North Dock | 185 | | Unknown |
| PrC2/MU2 | Trostre Gateway | 35 | 2.45 | Unknown |
| PrC2/MU1 | Former Old Castle Works | 0 | 3.56 | Unknown |
| **Total** | **-** | **250** | 6.01 | **-** |

### 12.6.4 Potential District Heating Network Routes

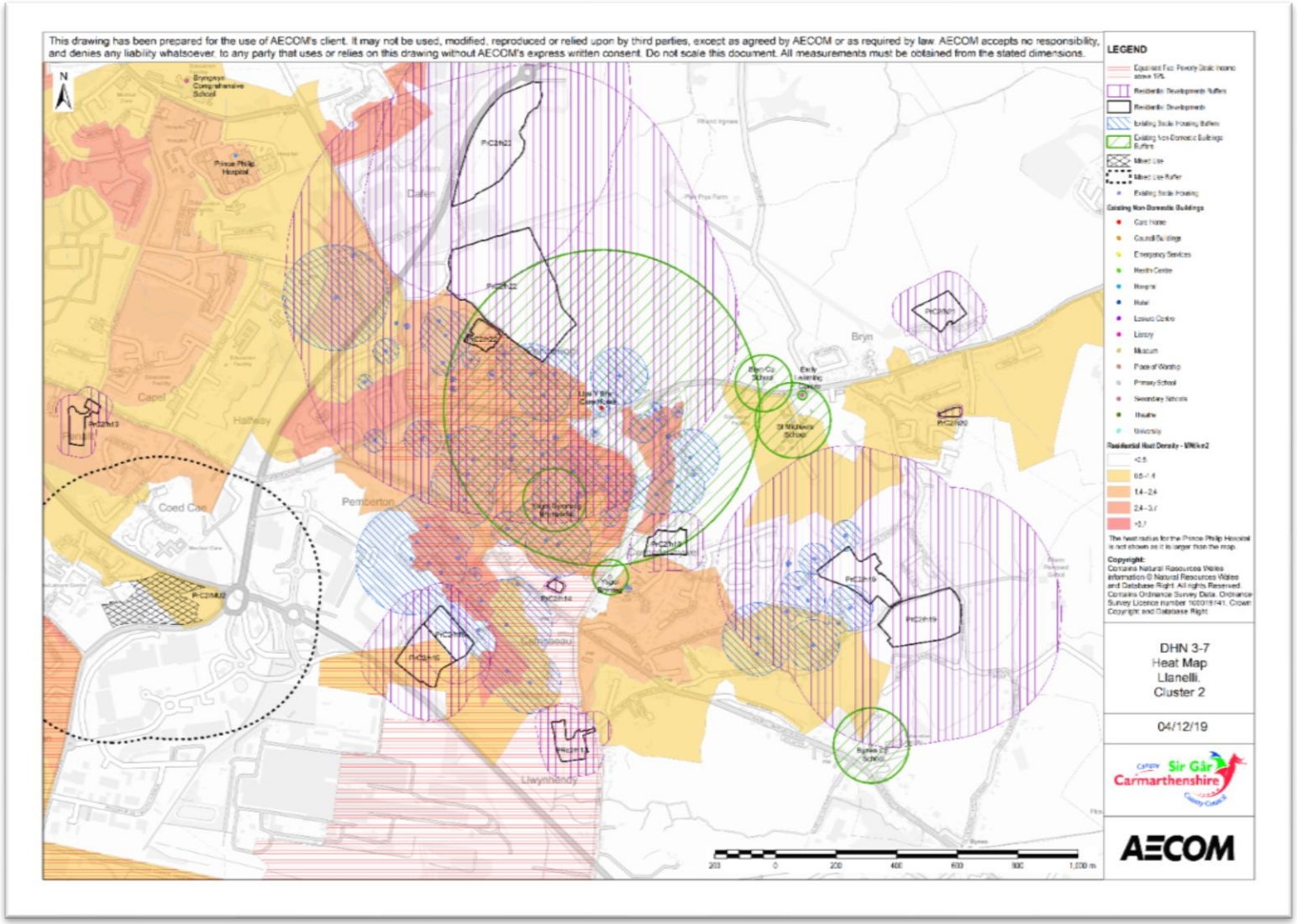
Indicative district heating network route[s] that could be taken forward for further review based on an evaluation of site opportunities and constraints as identified above are illustrated in the GIS map overleaf.

**Figure 16**: *Llanelli Cluster 1 - Potential District Heating Network Routes*



## 12.7 Llanelli Cluster 2 District Heating Networks Evaluation

**Figure 17***: Llanelli Cluster 2 – Heat Map.*



### 12.7.1 SWOT Analysis

Table 43 below provides an overview of existing and potential buildings in Llanelli Cluster 2, including any phasing and timing issues. In addition, details of the key opportunities and constraints within the site that could have an impact on the technical or commercial viability, or the practical delivery of a network are summarised, as well as the potential for future expansion of a heat network.

**Table 43: Llanelli Cluster 2 –heat network assessment**

| **SWOT Analysis** | | |
|---|---|---|
| **Existing buildings** | **Potential Buildings** | **Phasing /timing issues** |
| Key potential anchor heat loads:<br>▪ Prince Philip Hospital<br>▪ Bryngwyn Comprehensive School<br>▪ Llys Y Bryn Care Home<br>Other non-residential public buildings:<br>▪ St Michaels School<br>▪ Ysgol Gymraeg Brynsierfel<br>▪ Bryn Cp School<br>▪ Ysgol Brynteg<br>▪ Early Learning Centre | Key sites:<br>▪ PrC2/h22: 289 dwellings<br>▪ PrC2/h19: 179 dwellings<br>▪ PrC2/h23: 158 dwellings<br>▪ PrC2/h15: 61 dwellings<br>▪ PrC2/h16: 41 dwellings<br>▪ PrC2/h18: 29 dwellings<br>▪ PrC2/h17: 29 dwellings<br>▪ PrC2/h13: 21 dwellings | Detailed information on the phasing of the proposed sites is currently unknown. |
| **Site opportunities** | | |
| The Prince Philip Hospital makes an ideal anchor load to the network and potential location for an energy centre for a network supplying the social housing and the new developments. The Llys Y Bryn Care Home provides a significant anchor load within the social housing. | | |
| **Site constraints** | | |
| A significant proportion of private housing may be problematic with regard to pipe routing due to issues surrounding land ownership and owner appetite for inclusion in any proposed network(s). | | |

### 12.7.2 List of key existing buildings

**Table 44:** *Summary of key existing buildings in Llanelli Cluster 2.*

| URN | Name | Annual Heat Demand (MWh) | Source |
|---|---|---|---|
| 10024020613 | Prince Philip Hospital | 72,804 | DEC |
| 10009171496 | Bryngwyn Comprehensive School | 544 | DEC |
| 10004855436 | Llys Y Bryn Care Home | 1,303 | DEC |
| 100101031363 | St Michaels School | 311 | Benchmark |
| 200002956276 | Ysgol Gymraeg Brynsierfel | 260 | DEC |
| 10009172497 | Bryn Cp School | 234 | DEC |
| 10009551415 | Ysgol Brynteg | 145 | DEC |
| 10004855861 | Early Learning Centre | 37 | Benchmark |
| | Social Housing | 11 | Benchmark |
| | **Total** | **75,648** | |

### 12.7.3 List of potential buildings

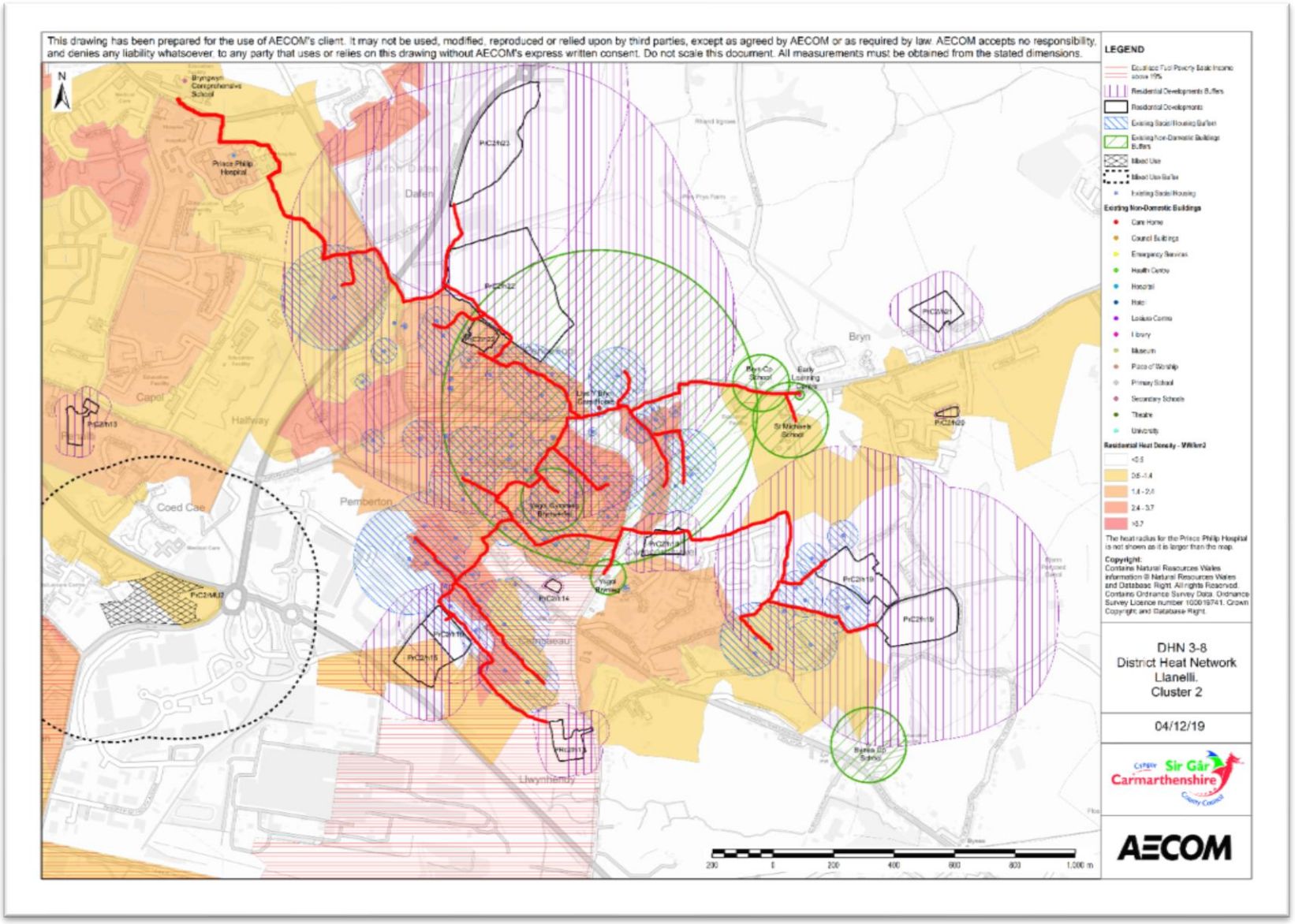
**Table** 45**:** *Proposed buildings and estimated year of build out in Llanelli Cluster 2.*

| Reference | Name | Maximum number of dwellings | Non residential floor area ($m^2$) | Estimated build out year |
|---|---|---|---|---|
| PrC2/h22 | Cwm y Nant, Dafen | 289 | | Unknown |
| PrC2/h19 | Genwen Road, Bryn | 179 | | Unknown |
| PrC2/h23 | Dafen East Gateway | 158 | | Unknown |
| PrC2/h15 | Maesarddafen Road / Erw Las, Llwynhendy | 61 | | Unknown |
| PrC2/h16 | Ynys Las, Cefncaeau | 41 | | Unknown |
| PrC2/h18 | Dylan, Trallwm | 29 | | Unknown |
| PrC2/h17 | Adjacent 73 Parc Gitto, Llwynhendy | 29 | | Unknown |
| PrC2/h13 | Land off Frondeg Terrace | 21 | | Unknown |
| | **Total** | **807** | | |

### 12.7.4 Potential District Heating Network Routes

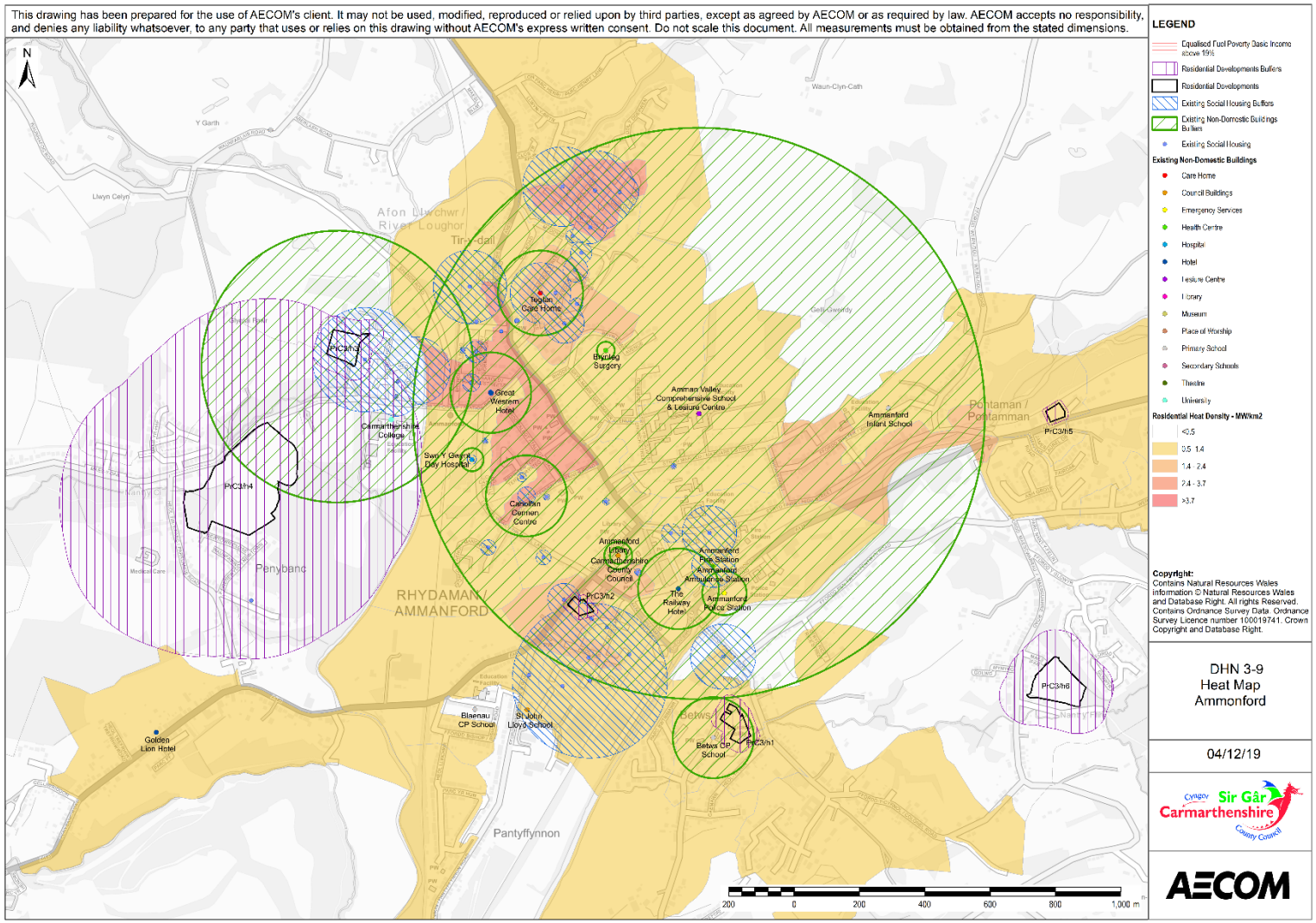
Indicative district heating network route[s] that could be taken forward for further review based on an evaluation of site opportunities and constraints as identified above are illustrated in the GIS map overleaf.

**Figure 18**: *Llanelli Cluster 2 - Potential District Heating Network Routes*



## 12.8 Ammanford Cluster District Heating Networks Evaluation

**Figure 19**: *Ammanford Cluster –Heat Map*



### 12.8.1 SWOT Analysis

Table 46 below provides an overview of existing and potential buildings in Carmarthen, including any phasing and timing issues. In addition, details of the key opportunities and constraints within the site that could have an impact on the technical or commercial viability, or the practical delivery of a network are summarised, as well as the potential for future expansion of a heat network.

**Table 46**: *Ammanford Cluster –heat network assessment*

| **SWOT Analysis** | | |
|---|---|---|
| **Existing buildings** | **Potential Buildings** | **Phasing /timing issues** |
| Key potential anchor heat loads:<br>▪ Amman Valley Comprehensive School & Leisure Centre<br>▪ Tegfan Care Home<br>▪ Betws CP School<br>▪ Canolfan Cennen Centre<br>▪ Carmarthenshire College<br>Other non-residential public buildings:<br>▪ Ammanford Police Station<br>▪ Ammanford Libary<br>▪ Swn Y Gwynt Day Hospital<br>▪ Carmarthenshire County Council<br>▪ Ammanford Fire Station<br>▪ Ammanford Ambulance Station | Key sites:<br>▪ PrC3/h4: 205 dwellings<br>▪ PrC3/h3: 23 dwellings<br>▪ PrC3/h1: 15 dwellings<br>▪ PrC3/h2: 7 dwellings | Detailed information on the phasing of the proposed sites is currently unknown. |
| **Site opportunities** | | |
| Both Amman Valley Comprehensive School and Leisure Centre; and Carmarthenshire College make ideal anchor loads to the network and potential locations for an energy centre for a network supplying Ammanford and the developments to the west. Ammanford Leisure Centre is also operating a CHP unit.<br>The network would also connect to a significant amount of social housing in Ammanford. | | |
| **Site constraints** | | |
| The rivers Loughor and Amman may provide an obstacle to any proposed pipework of a district heating network. This is due to the likelihood that pipework crossing points may be restricted to existing crossings and bridges over the rivers, unfavourably lengthening any proposed network route.<br>In order to reach the new development sites to the west of Ammanford town centre the railway acts as a constraint with a level crossing on the most direct route. Bridges do cross the railway further north and south, but these are both a significant detour.<br>A relatively high proportion of private housing may be problematic with regard to pipe routing due to issues surrounding land ownership and owner appetite for inclusion in any proposed network(s). | | |

### 12.8.2 List of key existing buildings

**Table 47:** *Summary of key existing buildings at Ammanford*

| UPRN | Name | Annual Heat Demand (MWh) | Source |
|---|---|---|---|
| 200002956547 | Carmarthenshire College | 2,307 | DEC |
| 10004860683 | Amman Valley Comprehensive School & Leisure Centre | 2,188 | DEC |
| 10004859535 | Tegfan Care Home | 325 | DEC |
| 10009551410 | Betws Cp School | 311 | Benchmark |
| 10090701945 | Canolfan Cennen Centre | 311 | Benchmark |
| 10004859267 | Great Western Hotel | 309 | Benchmark |
| 100101005442 | The Railway Hotel | 309 | Benchmark |
| 10004860982 | Ammanford Police Station | 170 | DEC |
| 10004859986 | Ammanford Library | 107 | Benchmark |
| 10004859943 | Swn Y Gwynt Day Hospital | 89 | DEC |
| 10009545220 | Carmarthenshire County Council | 64 | Benchmark |
| 200002956984 | Ammanford Fire Station | 5 | DEC |
| 200002956985 | Ammanford Ambulance Station | 5 | DEC |
| | Social Housing | 6 | Benchmark |
| | **Total** | **6,506** | |

### 12.8.3 List of potential buildings

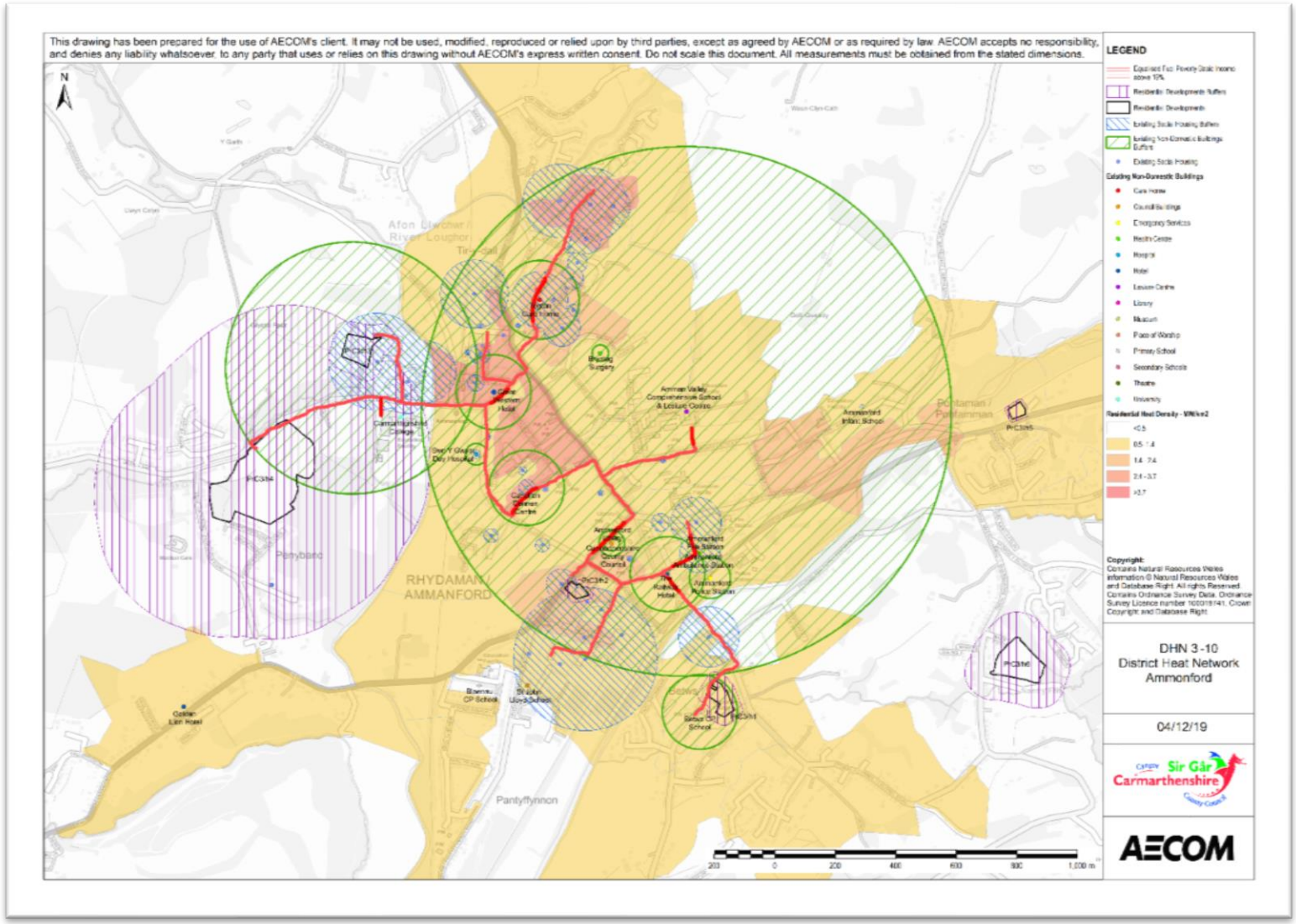
**Table** 48**:** *Proposed buildings and estimated year of build out at Ammanford.*

| Reference | Name | Maximum number of dwellings | Non residential floor area ($m^2$) | Estimated build out year |
|---|---|---|---|---|
| PrC3/h4 | Tirychen Farm | 205 | | Unknown |
| PrC3/h3 | Land at Gwynfryn Fawr | 23 | | Unknown |
| PrC3/h1 | Land at rear of 16-20 & 24-30 Betws Road | 15 | | Unknown |
| PrC3/h2 | Former Petrol Station, Wind Street | 7 | | Unknown |
| **Total** | **-** | **250** | | **-** |

### 12.8.4 Potential District Heating Network Routes

Indicative district heating network route[s] that could be taken forward for further review based on an evaluation of site opportunities and constraints as identified above are illustrated in the GIS map overleaf.

## Figure 20- Ammanford - Potential District Heating Network Routes



## 12.9 Conclusions

The high-level study undertaken is insufficient to propose targets for heat networks. It does however indicate that there are four potential schemes that require more in-depth analysis to identify which if any are financially viable.

- Carmarthen Cluster
- Llanelli Cluster 1
- Llanelli Cluster 2
- Ammanford Cluster

### 12.9.1 Carmarthen Cluster

The Carmarthen cluster has 1,465.01GWh of existing demand with large anchor loads from Glangwili General Hospital and University of Wales Trinity Saint David at either end of the network, these both provide potential sites for energy centres. A large development area of 700 dwellings and 61 hectares of employment land lies to the west of the university.

It should be noted that the build out of the development areas will have a significant impact on the viability of any scheme in Carmarthen.

There is also the potential to extend any network to the developments to the south east if a suitable location to cross the A40 and the river Towy can be identified.

### 12.9.2 Llanelli Cluster 1

Llanelli Cluster 1 has 10.99GWh of existing demand with Llanelli Leisure Centre providing the largest anchor load and a potential site for the energy centre. Development areas have the potential to add 250 dwellings and 6.01 hectares of employment land. The Llanelli Cluster 1 also has the potential to provide affordable heat to a significant amount of social housing in Llanelli that is in fuel poverty.

It should be noted that the build out of the development areas will have an impact on the viability of any scheme.

There is also the future potential to connect Llanelli Cluster 1 up to Llanelli Cluster 2.

### 12.9.3 Llanelli Cluster 2

Llanelli Cluster 2 has 75.65GWh of existing demand with the majority being the anchor load from The Prince Phillip Hospital (72.8GWh) which would be the prefer location for the energy centre. Llys Y Bryn Care home is the second largest anchor load at 1.3Gwh. There is also a significant amount of new development 807 dwellings the majority of which lies to the east of the hospital. As with Cluster 1 there is the potential to provide affordable heat to a significant amount of social housing in Llanelli that is in fuel poverty.

It should be noted that the build out of the development areas will have an impact on the viability of any scheme.

There is also the future potential to connect Llanelli Cluster 2 up to Llanelli Cluster 12.

### 12.9.4 Ammanford Cluster

The Ammanford cluster has 6.51GMWh of existing demand primarily from Amman Valley Comprehensive School and Leisure Centre; and Carmarthenshire College. A large development area of 205 dwellings lies to the west of Ammanford.

It should be noted that the build out of the development areas will have an impact on the viability of any scheme and this is compounded by the difficulty in crossing the railway line. The most direct route being over a level crossing. Due to the location of the anchor loads it is however possible to split the network into two with a large anchor load on either side of the railway line.

## 12.10 Next Steps

The next steps in the development of heat networks in Carmarthenshire are:

- Identify appetite of anchor loads for the connection to a DHN
- Survey of potential anchor loads to confirm compatibility with a heat network and age of existing heating plant
- Obtain current annual meter readings of anchor loads.
- Undertake a techno-economic viability assessment of potential clusters and network routes.

# Appendix A : Existing Large Scale Low and Zero Carbon Energy Technologies

**Table 49**: *Existing Large Scale Low and Zero Carbon Energy Technologies*

| Technology | Site | Installed Capacity [MWe] | Installed Capacity [MWt] | Source |
|---|---|---|---|---|
| Wind | Nantycaws Landfill | 0.5 | - | CCC |
| Wind | Brechfa Forest East Wind Farm | 23 | - | CCC/ OFGEM |
| Wind | Blaengwen Farm | 20 | - | CCC/ OFGEM |
| Wind | Dyffryn Brodyn Wind Farm | 5.5 | - | CCC /OFGEM |
| Wind | Mynydd Y Betws | 34.5 | - | CCC/ OFGEM |
| Wind | Blaen Bowi | 3.9 | - | CCC/ OFGEM |
| Wind | Parc Cynog Farm | 8.4 | - | CCC/ OFGEM |
| Wind | Mynydd Pencarreg | 4.6 | - | CCC/ Renewable Energy Public Database q1 2019 |
| Wind | Land At Pant Y Celyn, Cwmann, Lampeter, SA48 8HE | 0.5 | - | CCC |
| Wind | Land at Rhydygwydd Farm, Salem, Llandeilo, SA19 7NE | 0.5 | - | CCC |
| Wind | Land At Maescadog, Caio, Llanwrda, Carmarthenshire, SA19 8PP | 0.5 | - | CCC |
| Wind | Land at Drefach Farm, Henllan Amgoed, Whitland, SA34 0SP | 0.5 | - | CCC |
| Wind | Brechfa Forest West | 56.8 | - | CCC |
| Wind | Land at Blaenlliedi Farm, Pontyberem, Llanelli, SA15 5NN | 0.5 | - | CCC |
| Wind | White Lion Farm, Tavernspite, Ciffig, SA34 0PA | 0.5 | - | CCC |
| Wind | Rhydgoch Field, Blaenwaun, SA34 0DT | 0.5 | - | CCC |
| Wind | Land at Wern, Pencader, SA39 9AL | 1 | - | CCC |
| Wind | Blaenpant, Meidrim, Carmarthen, SA33 5PX | 0.500 | - | CCC |
| Wind | Land North West of Gilfach Farm, Cwmbach, Whitland, SA34 0DN | 0.500 | - | CCC |

| Technology | Site | Installed Capacity [MWe] | Installed Capacity [MWt] | Source |
|---|---|---|---|---|
| Wind | Land at Bwlchgwynt, Llanboidy Road, Meidrim, Carmarthen, SA33 5QY | 0.500 | - | CCC |
| Wind | Land at Castell Toch Farm, Pendine, SA33 4PX | 0.500 | - | CCC |
| Wind | Land north of Llygad Enwyn Farm, Llanybydder | 0.900 | - | CCC |
| Solar PV | Ffos Las, Trimasaran, Carms | 5.000 | | OFGEM |
| Solar PV | National Botanic Garden of Wales | 0.500 | | OFGEM |
| Solar PV | Land South Of Bryn Cyrnau Isaf (resubmission) | 5.900 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Bryncoch Solar Farm | 19.000 | | CCC/ Renewable Energy Public Database q1 2019 |
| Solar PV | Parc Cynog | 5.000 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Rhas Fach Farm | 1.200 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Pistyllgwyn Farm | 1.500 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Morfa Ynys Farmlands | 3.000 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Dura Park Bynea Industrial Site | 1.400 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Land East Of Saron Road And North Of Dyffryn Road, Saron, Ammanford, SA18 3TW | 5.000 | | CCC |
| Solar PV | Land At Pen Y Cae, Saron, Ammanford, SA18 3BJ | 5.000 | | CCC |
| Solar PV | Land At Former Cynheidre Shafts 3 & 4, Cynheidre, Llanelli | 3.000 | | CCC |

| Technology | Site | Installed Capacity [MWe] | Installed Capacity [MWt] | Source |
|---|---|---|---|---|
| Solar PV | Pentre Farm, Llannon, Llanelli, Carms, SA14 6AP | 6.122 | | Renewable Energy Public Database q1 2019 |
| Solar PV | Land At Clawdd Du, Pontardulais Road, Tycroes, Ammanford, SA18 3RE | 12.000 | | CCC |
| Solar PV | Land Forming Part Of Brynteg Farm Adjacent To The B4309, Five Roads, Llanelli, SA15 4ND | 16.200 | | CCC |
| Solar PV | New Lodge Farm, Pontardulais Road, Cwmgwili, Llanelli, SA14 6PW | 3.000 | | CCC |
| Solar PV | Land adjacent and to the north of Pontardulais Road (A483), Tycores, Ammanford | 1.000 | | CCC |
| Solar PV | Land At Caeremlyn Farm, Henllan Amgoed, Whitland, SA34 0SS | 15.000 | | CCC |
| Solar PV | Land At Eynons Down, Laugharne, Carmarthen, Carms | 1.420 | | CCC |
| Solar PV | Land At Blaen Bowi, Capel Iwan, Newcastle Emlyn, Carmarthenshire, SA38 9NG | 8.000 | | CCC |
| Solar PV | Land At Redcourt Farm, Llysonnen Road, Carmarthen, SA33 5DR | 3.300 | | CCC |
| Solar PV | Land at Pen y Cae, Saron | 5.000 | | CCC |
| Hydro | Llyn Brianne Dam | 4.35 | | OFGEM |
| Hydro | FIT-031923 | 0.03 | | Feed-in Tariff Installation Report (1 January - 31 March 2019) - Part 1 |
| Hydro | Cynnant, Cynhordy, Llandovery SA20 0NB | 0.012 | | Feed-in Tariff Installation Report (1 January - 31 March 2019) - Part 1 |
| Hydro | Aberbranddu, Pumpsaint, Llanwrda SA19 8YE | 0.03 | | Feed-in Tariff Installation Report (1 January - 31 March 2019) - Part 1 |

| Technology | Site | Installed Capacity [MWe] | Installed Capacity [MWt] | Source |
|---|---|---|---|---|
| Hydro | Craig y Fuwch, Penrherber, Newcastle Emlyn SA38 9RW | 0.015 | | Feed-in Tariff Installation Report (1 January - 31 March 2019) - Part 1 |
| Hydro | Land at Tirelinor Farm, Betws, Ammanford SA18 2PF | 0.100 | | CCC |
| Hydro | Creigiau, Llandyfan, Ammanford SA18 2UD | 0.030 | | CCC |
| Hydro | Land north of Pont Rhyd-Felin, Rhandirmwyn, llandovery | 0.006 | | CCC |
| Hydro | Ystradffin Hydropwer Project, Rhandirmwyn | 1.800 | | CCC |
| Hydro | Cwm Lliedi Reservoir, Llannon Road, Llanelli | 0.100 | | CCC |
| Hydro | Alltcafan Mills, Pentrecwrt, Llandysul SA44 5BD | 0.100 | | CCC |
| Landfill Gas | Nant y Caws Landfill Site | 2.250 | - | OFGEM |
| Anaerobic digestion | Coomb Farm, Llangynog, Carmarthen SA33 5HP | 0.500 | - | Feed-in Tariff Installation Report (1 January - 31 March 2019) - Part 1 |
| Anaerobic digestion | Cilgell Isaf, Cwmann SA48 8DY | 0.150 | 0.23 | CCC |
| Anaerobic digestion | Nantycaws Landfill Site | 0.350 | - | CCC |

# Appendix B : Wind Energy Resource Methodology

The detailed data sources and assumptions can be found in the table below.

## MAP 2 – Statutory and Strategic Constraints

**Table 50**: *Wind Statutory and Strategic Constraints*

| Constraint | Source | Buffer | Reason |
|---|---|---|---|
| Special Protection Area (SPA)<br>*Towy and Loughor estuarys* | LIe | Extent + 600m<br>Typical disturbance buffer | **Statutory constraint** |
| Special Area of Conservation (SAC) | LIe | Extent only<br>(NB except *Towy and Loughor estuarys*) | **Statutory constraint** |
| RAMSAR<br>*Towy and Loughor estuarys* | LIe | Extent + 600m<br>Typical disturbance buffer | **Statutory constraint** |
| SSSI | LIe | Extent only | **Statutory constraint** |
| Marine Nature Reserve (MNR) | LIe | Extent + 500m | **Statutory constraint**<br>The MNR only covers the sea to the mean tide mark. The 500m buffer is added to constrain the shore |
| AONB | Protected Landscapes / LIe | Extent + 7km | **Protected Landscape / PPW**<br>To avoid impinging on views out of the AONB and relates to limitations of human sight / earth curvature. |
| National Nature Reserves | LIe | Extent only | **Statutory constraint** |
| Scheduled Monuments | LIe | Extent + turbine blade tip height & 10% | **Statutory constraint** |
| Listed Buildings | LIe | Extent + 500m | **Statutory constraint**<br>This aligns with building buffer. |
| Deep Peat | CCC | Extent only | **PPW** |
| CAA Airport Safeguarding Zone<br>*Broughton* | CAA | Point + 5kM | **UK Strategic Constraint** |
| MOD “red” and “amber” military low flying zones | DIO | Extent only | **UK Strategic Constraint** |
| NATS air traffic control safeguarded area inc military aerodrome traffic zones | NATS | Extent only based on appropriate turbine height | **UK Strategic Constraint**<br>120m to blade tip |
| Restricted Airspace | CAA | Extent only | **UK Strategic Constraint** |
| Aerodrome Locations | CAA | Point + 5km | **UK Strategic Constraint** |

| | | | |
|---|---|---|---|
| Infrastructure Topple distances (Motorways, Primary roads and Railways) | OS Mastermap | 170m Turbine blade tip height +50m | **Strategic Constraint / Toolkit** |
| Infrastructure Topple distances ("A" roads, Secondary "B" Roads and minor roads) | OS Mastermap | Turbine blade tip height +10% | **Strategic Constraint / Toolkit** |
| Buildings | LLPG/ OS Address Base | 500m buffer around all dwellings / settlement boundaries | **Toolkit**<br>Turbine gearbox noise |
| Watercourses<br>Lakes, canals, primary rivers, secondary rivers, minor rivers | OS Mastermap | Extent only | **Toolkit** |
| Ancient Woodland<br>*Rare habitat (PPW10)* | LIe | Extent only | **PPW** |
| Broadleaved Woodland | National Forest Inventory | Extent only | **Toolkit** |
| Tan 8 SSA | WG | Extent + 7km | **TAN 8 DNS inc para 8.4** to acknowledge acceptance of significant landscape character change immediately adjacent in terms of DNS<br>7km for accumulative impact |
| National Parks | LIe | Extent + 7km buffer | **Protected Landscape /** PPW duty to have regard to purpose of protected landscape |
| Meteorological radar | CCC | 1.7km | |

## MAP 4 – Local Constraints

**Table 51***: Wind Local Constraints*

| Constraint | Source | Buffer | Reason |
|---|---|---|---|
| Local Nature Reserves | LIe | Extent only | **PPW / TAN5 - Designated by LAs under the National Parks and Access to the Countryside Act 1949.** |
| Registered Landscapes of Special Historic Interest (ASIDOHL) | CADW | Extent only | **PPW constraint** |
| Other woodlands | OS Open Map - Local | Extent only | **PPW constraint** |
| Existing consented / operational windfarms >5MW installed capacity | FCC and surrounding authorities | Extent + 7km buffer to align with Toolkit wrt to cumulative impact | **Existing development**<br>7km for accumulative impact |

# Appendix C : Biomass Energy Resource Methodology

The detailed data sources and assumptions can be found in the table below:

**Table 52**: *Biomass Constraints*

| Constraint | Source | Buffer | Reason |
|---|---|---|---|
| Special Protection Area (SPA) *Towy and Loughor estuarys* | Lle | Extent Only (agreed with NRW) | **Statutory Constraint** |
| Special Area of Conservation (SAC) | Lle | Extent only | **Statutory Constraint** |
| RAMSAR *Towy and Loughor estuarys* | Lle | Extent only | **Statutory Constraint** |
| SSSI | Lle | Extent only | **Statutory Constraint** |
| National Parks | Lle | Extent + 3.5km (aligns with Wrexham & Powys REA) | **Protected Landscape / PPW duty to have regard to purpose of protected landscape** |
| National Nature Reserves | Lle | Extent only | **Statutory Constraint** |
| Registered Parks and Gardens | Lle | Extent only | **PPW** |
| Scheduled Monuments | Lle | Extent only | **Statutory Constraint** |
| Listed Buildings | CADW | Extent only | **Statutory Constraint** |
| BMV agricultural land grades 1, 2, 3a | Lle | Extent only | **PPW / TAN6 / Toolkit (loss of 0.2 sq km either in single development or cumulatively)** |

# Appendix D : Energy from Waste Resource Methodology

The 'Infrastructure and Markets Sector Plan' (Welsh Government 2013) provides estimates of residual waste levels for 2024-2025 and 2049-2050 for wales (Table 31) and 2024-2025 broken down by region (Table 32). The 'Infrastructure and Markets Sector Plan' states:

*'There is a fair degree of confidence that scenario 2 will be achieved as it is funded and the necessary interventions to achieve it are secured. At the other end of the scale scenario 4 is the most optimistic for 2024-25 and scenario 5 is the most optimistic for 2049-50'*

In order to produce a realist level of waste reduction for 2025 the scenario 3 figures are used. For the 2050 figures the mean of the scenario 3 and scenario 4 figures is used to ensure that waste reduces over time without being overly optimistic.

Towards Zero Waste Strategy Document (Welsh Government 2010) uses a base line of 2007 for waste projections to 2050. As the data for 2007 is not available proportions of waste produced in Welsh counties was calculated using the earliest available data set from Stats Wales which is 2012. It was assumed that all the Welsh counties would reduce waste at a similar rate and therefore the proportions calculated from 2012 would not be time dependent.

The figures from the 'Infrastructure and Markets Sector Plan' were combined with the ratios produced from the Stas Wales data to produce projected residual waste figures for the whole of Carmarthenshire. Following the method in the 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners' it is assumed that the residual waste is 30% of the total waste and this is used to provide projections of the total waste for Carmarthenshire for 2025 and 2050.

The average of the Stats Wales data for the quantity of waste produced in Carmarthenshire between 2012 and 2017 is then used to calculate an average annual reduction in waste production in Carmarthenshire between 2017 and 2025. If the average annual waste produced between 2012 and 2017 is less than the projected waste in 2025 it is assumed that there will be no further reduction in waste production between 2017 and 2025 and the waste produced in 2025 will equal the average annual waste produced between 2012 and 2017.

The estimated 2025 annual waste production is then used with the projected 2050 waste production to produce an average annual reduction in waste production between 2025 and 2050. If the estimated waste production for 2025 is less than the projected waste production for 2050 it is assumed that zero waste will be achieved no earlier than 2050.

**Figure 21**: *Table 31 of Infrastructure and Markets Sector Plan' (Welsh Government 2013)*

**Table 31: Predicted annual production of non-hazardous, non inert residual waste for 2024-25 and 2049-50**[32]

| Year | Scenarios | Annual production of non-hazardous, non inert residual waste (thousands of tonnes) | | | | |
|---|---|---|---|---|---|---|
| | | Industrial | Commercial | Municipal | C&D | Total |
| 2024-25 | 1.No additional recycling or prevention | 285 | 1,120 | 1,026 | 560 | **2,991** |
| | 2.LAMW recycling targets met, no additional prevention | 285 | 1,120 | 583 | 560 | **2,548** |
| | 3.Recycling targets met, no additional prevention | 146 | 482 | 583 | 247 | **1,458** |
| | 4.Recycling and prevention targets met | 146 | 321 | 512 | 203 | **1,182** |
| 2049-50 | 1.No additional recycling or prevention | 152 | 1,357 | 1,026 | 484 | **3,019** |
| | 2.LAMW recycling targets met, no additional prevention | 152 | 1,357 | 583 | 484 | **2,576** |
| | 3.Recycling targets met, no additional prevention | 78 | 585 | 583 | 213 | **1,459** |
| | 4.Recycling and prevention targets met | 78 | 196 | 352 | 109 | **735** |
| | 5. Zero Waste (100% recycling) goal met | 0 | 0 | 0 | 0 | **0** |

**Figure 22**: *Table 32 of Infrastructure and Markets Sector Plan' (Welsh Government 2013)*

**Table 32: Predicted arising of residual industrial, commercial and local authority municipal waste by sub-region for 2024-25**[33]

| Region | Scenario | Annual production of residual waste (000s tonnes) | | | |
|---|---|---|---|---|---|
| | | Industrial | Commercial | LAMW | Total |
| North Wales | 2.LAMW recycling targets met, no additional prevention | 92 | 287 | 170 | 549 |
| | 3.Recycling targets met, no additional prevention | 52 | 124 | 170 | 346 |
| | 4.Recycling and prevention targets met | 52 | 82 | 149 | 283 |
| South East Wales | 2.LAMW recycling targets met, no additional prevention | 114 | 512 | 245 | 871 |
| | 3.Recycling targets met, no additional prevention | 59 | 221 | 245 | 525 |
| | 4.Recycling and prevention targets met | 59 | 147 | 215 | 421 |
| South West Wales | 2.LAMW recycling targets met, no additional prevention | 79 | 321 | 168 | 568 |
| | 3.Recycling targets met, no additional prevention | 35 | 138 | 168 | 341 |
| | 4.Recycling and prevention targets met | 35 | 92 | 148 | 275 |
| Total | 2.LAMW recycling targets met, no additional prevention | 285 | 1,120 | 583 | 1,988 |
| | 3.Recycling targets met, no additional prevention | 146 | 482 | 583 | 1,211 |
| | 4.Recycling and prevention targets met | 146 | 321 | 512 | 979 |

**Table 53**: *Project MSW and Industrial & Commercial Waste for Carmarthenshire in Tonnes*

| Year | Carmarthenshire Total Waste | | Carmarthenshire Residual Waste | | Carmarthenshire LPA Total Waste | | Carmarthenshire LPA Residual Waste | |
|---|---|---|---|---|---|---|---|---|
| | MSW | Industrial & Commercial | MSW | Industrial & Commercial | MSW | Industrial & Commercial | MSW | Industrial & Commercial |
| 2012 | 67,885 | 3,303 | 20,366 | 991 | 67,168 | 3,268 | 20,151 | 980 |
| 2013 | 69,576 | 7,671 | 20,873 | 2,301 | 68,842 | 7,590 | 20,653 | 2,277 |
| 2014 | 69,786 | 8,038 | 20,936 | 2,411 | 69,252 | 7,976 | 20,775 | 2,393 |
| 2015 | 72,735 | 5,805 | 21,821 | 1,741 | 72,154 | 5,759 | 21,646 | 1,728 |
| 2016 | 75,680 | 8,076 | 22,704 | 2,423 | 75,049 | 8,009 | 22,515 | 2,403 |
| 2017 | 75,235 | 8,521 | 22,571 | 2,556 | 74,583 | 8,447 | 22,375 | 2,534 |
| 2018 | 71,816 | 6,902 | 21,545 | 2,071 | 71,166 | 6,840 | 21,350 | 2,071 |
| 2019 | 71,816 | 6,902 | 21,545 | 2,071 | 71,141 | 6,837 | 21,342 | 2,071 |
| 2020 | 71,816 | 6,902 | 21,545 | 2,071 | 71,117 | 6,835 | 21,335 | 2,071 |
| 2021 | 71,816 | 6,902 | 21,545 | 2,071 | 71,093 | 6,833 | 21,328 | 2,071 |
| 2022 | 71,816 | 6,902 | 21,545 | 2,071 | 71,071 | 6,831 | 21,321 | 2,071 |
| 2023 | 71,816 | 6,902 | 21,545 | 2,071 | 71,051 | 6,829 | 21,315 | 2,071 |
| 2024 | 71,816 | 6,902 | 21,545 | 2,071 | 71,031 | 6,827 | 21,309 | 2,071 |
| 2025 | 71,816 | 6,902 | 21,545 | 2,071 | 71,014 | 6,825 | 21,304 | 2,048 |
| 2026 | 71,325 | 6,626 | 21,397 | 1,988 | 70,512 | 6,551 | 21,154 | 1,988 |
| 2027 | 70,833 | 6,350 | 21,250 | 1,905 | 70,012 | 6,277 | 21,004 | 1,905 |
| 2028 | 70,342 | 6,074 | 21,103 | 1,822 | 69,515 | 6,003 | 20,854 | 1,822 |
| 2029 | 69,850 | 5,798 | 20,955 | 1,739 | 69,019 | 5,729 | 20,706 | 1,739 |
| 2030 | 69,359 | 5,522 | 20,808 | 1,657 | 68,525 | 5,456 | 20,558 | 1,657 |
| 2031 | 68,867 | 5,246 | 20,660 | 1,574 | 68,034 | 5,182 | 20,410 | 1,574 |
| 2032 | 68,375 | 4,970 | 20,513 | 1,491 | 67,544 | 4,909 | 20,263 | 1,491 |
| 2033 | 67,884 | 4,694 | 20,365 | 1,408 | 67,055 | 4,636 | 20,117 | 1,408 |
| 2034 | 67,392 | 4,417 | 20,218 | 1,325 | 66,569 | 4,363 | 19,971 | 1,325 |
| 2035 | 66,901 | 4,141 | 20,070 | 1,242 | 66,083 | 4,091 | 19,825 | 1,242 |
| 2036 | 66,409 | 3,865 | 19,923 | 1,160 | 65,597 | 3,818 | 19,679 | 1,160 |
| 2037 | 65,918 | 3,589 | 19,775 | 1,077 | 65,112 | 3,545 | 19,534 | 1,077 |
| 2038 | 65,426 | 3,313 | 19,628 | 994 | 64,628 | 3,273 | 19,388 | 994 |
| 2039 | 64,934 | 3,037 | 19,480 | 911 | 64,144 | 3,000 | 19,243 | 911 |
| 2040 | 64,443 | 2,761 | 19,333 | 828 | 63,658 | 2,727 | 19,098 | 828 |
| 2041 | 63,951 | 2,485 | 19,185 | 745 | 63,173 | 2,455 | 18,952 | 745 |
| 2042 | 63,460 | 2,209 | 19,038 | 663 | 62,687 | 2,182 | 18,806 | 663 |
| 2043 | 62,968 | 1,933 | 18,890 | 580 | 62,202 | 1,909 | 18,660 | 580 |
| 2044 | 62,477 | 1,657 | 18,743 | 497 | 61,716 | 1,636 | 18,515 | 497 |
| 2045 | 61,985 | 1,380 | 18,596 | 414 | 61,230 | 1,364 | 18,369 | 414 |
| 2046 | 61,493 | 1,104 | 18,448 | 331 | 60,745 | 1,091 | 18,223 | 331 |
| 2047 | 61,002 | 828 | 18,301 | 248 | 60,259 | 818 | 18,078 | 248 |

| Year | Carmarthenshire Total Waste | | Carmarthenshire Residual Waste | | Carmarthenshire LPA Total Waste | | Carmarthenshire LPA Residual Waste | |
|---|---|---|---|---|---|---|---|---|
| | MSW | Industrial & Commercial | MSW | Industrial & Commercial | MSW | Industrial & Commercial | MSW | Industrial & Commercial |
| 2048 | 60,510 | 552 | 18,153 | 166 | 59,774 | 545 | 17,932 | 166 |
| 2049 | 60,019 | 276 | 18,006 | 83 | 59,288 | 273 | 17,786 | 83 |
| 2050 | 59,527 | - | 17,858 | - | 58,803 | - | 17,641 | - |

# Appendix E : Solar PV Farms

The detailed data sources and assumptions can be found in the table below:

## MAP 2 – Statutory and Strategic Constraints

**Table 54**: *Solar PV Statutory and Strategic Constraints*

| Constraint | Source | Buffer | Reason |
|---|---|---|---|
| Special Protection Area (SPA)<br>*Towy and Loughor estuarys* | Lle | Extent only<br>Typical disturbance buffer | **Statutory Constraint** |
| Special Area of Conservation (SAC) | Lle | Extent only | **Statutory Constraint** |
| RAMSAR<br>*Towy and Loughor estuarys* | Lle | Extent only<br>Typical disturbance buffer | **Statutory Constraint** |
| SSSI | Lle | Extent only | **Statutory Constraint** |
| Marine Nature Reserve (MNR) | Lle | Extent + 500m | **Statutory constraint**<br>The MNR only covers the sea to the mean tide mark. The 500m buffer is added to constraint the shore |
| AONB | Protected Landscapes / Lle | Extent + 3.5km | **Protected Landscape / PPW duty to have regard to purpose of protected landscape**<br>To avoid impinging on views out of the AONB and relates to limitations of human sight / earth curvature. |
| National Parks | Lle | Extent + 3.5km | **Protected** Landscape / PPW duty to have regard to purpose of protected landscape |
| National Nature Reserves | Lle | Extent only | **Statutory Constraint** |
| Scheduled Monuments | Lle | Extent only | |
| Listed Buildings | CADW | Extent + 500m | **Statutory Constraint**<br>This aligns with building buffer. |
| Buildings | LLPG/ OS Address base | 500m buffer around all dwellings / settlement boundaries | Operational noise and glare |
| Deep Peat | CCC | Point +5km | **PPW** |
| CAA Airport Safeguarding Zone (Glint and glare)<br>*e.g. Broughton* | CAA | Not Constrained | **UK Strategic Constraint** |
| Aerodrome Locations (Glint and glare) | CAA | Not Constrained | **UK Strategic Constraint** |

| | | | |
|---|---|---|---|
| NATS air traffic control safeguarded area inc military aerodrome traffic zones | NATS | Not Constrained | |
| Restricted Airspace | CAA | Extent only | |
| Infrastructure Glare and Glint distances (Trunk Roads, Primary "A" roads and Secondary "B" Roads, Railways) | OS Mastermap | Extent only | **Strategic Constraint / Toolkit** |
| Watercourses<br>Lakes, canals, primary rivers, secondary rivers, minor rivers | OS Mastermap | Extent only | **Toolkit** |
| Ancient Woodland<br>*Rare habitat (PPW10)* | LIe | Extent only | **PPW** |
| Broadleaved Woodland | National Forest Inventory | Extent only | **Toolkit** |
| BMV agricultural land grades 1, 2, 3a | LIe | Extent only | **PPW / TAN6 / Toolkit (loss of 0.2 sq km either in single development or cumulatively)** |
| SSA locations to avoid prejudicial conflicts with purpose of SSAs | WG | Extent + 3.5km | **TAN8**<br>3.5km for accumulative impact |
| C1 / C2 Flood Zone | LIe | Extent only | **PPW / TAN15 (vulnerable development)** |

## MAP 4 – Local Constraints

**Table 55**: *Solar PV Local Constraints*

| Constraint | Source | Buffer | Reason |
|---|---|---|---|
| Local Nature Reserves | LIe | Extent only | **PPW / TAN5 - Designated by LAs under the National Parks and Access to the Countryside Act 1949.** |
| Registered Landscapes of Special Historic Interest (ASIDOHL) | CADW | Extent | **PPW constraint** |
| Other woodlands | OS Open Map - Local | Extent | **PPW constraint** |
| Existing Consented / operational solar farms | CCC and surrounding authorities | Extent + 3.5km | **Existing development**<br>3.5km for accumulative impact. |

# Appendix F : Building Integrated Renewable Energy Uptake Modelling

This Appendix sets out the methodology and assumptions behind the micro generation uptake modelling. Renewable and low and zero carbon technologies are included in the calculation methodology in order to represent the decisions made by the building owners. However, the non-renewable uptakes are excluded from the totals presented in the main report.

## Micro generation uptake in existing stock

The potential uptake of renewable micro generation technologies in the existing housing stock and in the bulk of the existing non-residential building stock in was projected using a spreadsheet model developed by AECOM. This forecasts the uptake of micro generation technologies based on information about:

- The rates at which 'Primary' systems come up for necessary replacement and at which 'Discretionary' purchases are considered;
- The current housing stock and non-residential building stock;
- The identity and attributes of 'Primary' heating system options (including some renewable energy) and of 'Discretionary' renewable energy systems, and;
- The relationship between system attributes (including cost and 'nuisance' factors) and purchasing decision-making – the Choice Model.

Installations in new homes and new non-residential buildings are subject to different drivers and were considered separately in this Appendix.
The system attributes assumed to influence purchasing decisions are:

- Capital cost;
- Net annual energy costs: electricity & heating fuel costs (after any renewable energy savings) minus any incomes from feed in tariffs, renewable heat incentive and exports of electricity to the grid;
- Annual maintenance costs;
- Whether fuel storage is required (e.g. for biomass pellets or woodchip);
- Whether the garden needs to be dug up (for ground source heat pumps installation in homes); and
- Whether additional indoor 'cupboard' space is needed (for micro-CHP units in homes, as the technology is typically larger than the generator being replaced).

The model accounts for projected real (i.e. excluding inflation) changes in costs and prices over time.

### F.1.1. Rate of consideration for Primary and Discretionary systems

It is assumed in the model that householders or landlords may purchase micro generation technologies in one of two situations:

Firstly, as the 'Primary' heating system for a home, as a necessary replacement for a previous heat generator that has reached the end of its life. Once homes reach an age equal to the typical service life of a boiler, it is assumed that a fixed percentage of homes need a new primary heat generator each year. The replacement rate is assumed to be 6% per year. As the replacement is 'of necessity', it is assumed that one of the list of suitable heating options must be selected;

- Condensing gas boiler,
- Condensing oil boiler,
- Condensing LPG boiler,
- Direct electric heating,
- Ground source heat pump,
- Air source heat pump,
- Stirling engine CHP,
- Fuel cell CHP (non-residential only),
- Biomass pellet boiler, or
- Biomass woodchip boiler.

Secondly, as a 'Discretionary' purchase where the status quo is not to have a micro generator, and therefore one of the 'system' options is not to install one. By definition, Discretionary systems may be purchased at any time. The assumption made in the model is that 10% of households and businesses

consider purchasing a microgeneration system each year.

The following Discretionary generator options are included in the model:

- Micro-wind turbines;
- Small wind turbines;
- Solar water heating;
- Solar PV.

### F.1.2. Existing building stock

The rates of consideration are combined with data on the building stock to determine the number of primary heat generator replacements being selected and the number of discretionary purchases of micro generators being considered each year.

System suitability for non-residential buildings is assumed to depend only on building type. For homes, the suitability of technology options depends on:

- Home type (house or flat);
- Age (pre-1980, 1981 – 2005 or 2006 – 2016);
- Tenure (owner occupied, private rented, or social rented);
- Rurality (urban, suburban, or rural), and
- Gas connectivity (connected to mains gas or off-gas).

As such, the model requires data on:

- The current total number of homes, and the breakdown by type, age, tenure, rurality and gas connection, and;
- The number (and where possible the floor area) of non-residential buildings by type.

### F.1.3. Housing stock data

The modelling uses the most up to date and comprehensive data on house numbers and typology that were identified. Data on the numbers of homes were obtained from Welsh Statistics 'Dwelling Stock Estimates' (2010)[75].

For the purpose of this calculation, caravans were removed from the total. From the LSOA Household Spaces and Accommodation Type (KS16) Census (2001) data, caravans in Carmarthenshire equate to 0.7% of the total household spaces. However, the total does include vacant and second homes which accounts for 9% of the total household spaces.

The breakdown of the housing stock was arrived at as follows:

- The percentage split by home type (house or flat) was based on Household Spaces (UV56) Census 2001 data for Carmarthenshire County Borough Council;
- The percentage split by age was based on information provided directly from Welsh Statistics[76] for the 2008 dwelling stock in Carmarthenshire;
- Percentage by tenure was based on Households (UV63) Census 2001 data for Carmarthenshire County Borough Council, and compared against similar statistics reported in the Draft Population and Housing Topic Paper;
- The percentage split by rurality was based on rural-urban designation of Middle Super Output Areas obtained through a custom query on the Neighbourhood Statistics portal of the Office of National Statistics website;
- The percentage split by gas network connectivity was based on data published on http://www.energyefficiencywales.org.uk/targetwales.php for the Targeting Energy Efficiency in Wales project.

The housing stock classification adopted in the model results in 144 housing sub-types. The number of homes of each sub-type is assumed to be the total number of homes multiplied by the respective percentages for type, age, tenure, rurality and gas connectivity.

The total number of homes in the stock is assumed to decline at 0.02% per year, reflecting historical rates of demolition across Wales.

### F.1.4. Non-residential building stock data

The modelling uses available data on non-residential buildings, accepting that with the possible exception of

[75] http://www.statswales.wales.gov.uk/TableViewer/tableView.aspx?ReportId=18911

[76] Email from Huw Jones (SPF&P - SRD) on 30.08.11

Valuation Office Agency data on Bulk classes, the data are not comprehensive. The numbers of non-residential buildings by type were obtained as follows:

Bulk class types (Valuation Office Agency) [77]

- Retail
- Offices
- Warehouses
- Factories

Other types (LPA data, as available)

- Hospitality
- Health
- Schools
- Leisure centres

The total number of non-residential buildings is assumed to be constant for the purposes of the model.

### F.1.5. The Choice Model for projecting purchasing decisions

At the heart of the AECOM take-up model is a choice model for forecasting purchasing decisions given the attributes of alternative, competing system options. In outline, the choice model is based on the theory that consumers make decisions to maximise 'utility' – the net benefits as perceived by the consumer, and that consumers' utility calculations are based on differences in specific attributes of the available options.

Day-to-day utility calculations are largely implicit and evaluation varies from consumer to consumer. A particular type of market survey called a 'conjoint survey' was used to collect data in a way that can reveal the implicit utility calculations, given a set of what are assumed to be the key attributes. A statistical technique called 'conditional logit', a form of regression analysis, was then used to calculate the coefficients of the formulas that each group of consumers is implicitly using to make choices.

The survey distinguished owner-occupiers from landlords and non-domestic building owners and, as expected, found they valued attributes differently. The survey and analysis also distinguished between 'Primary' and 'Discretionary' choices and hence developed independent uptake models. The coefficients derived were highly statistically significant, showing that within the groups identified, consumer survey responses suggested strong similarity in the implicit calculation of utility.

The benefit of the use of conditional logit analysis is that the results can be used to forecast purchasing decisions given the attributes of alternative system options. For Primary decisions, the model calculates the proportion of consumers that will select each of the suitable system options, given their attributes. (Costs, fuel prices, etc. vary over time, while non-cost attributes stay constant.) The modelling principles are identical for Discretionary decisions with the notable inclusion of "do nothing" among the system options.

A detailed mathematical explanation of the choice model is outside the scope of this report but further information on the conjoint survey and conditional logit analysis underpinning the modelling is available in the original Element Energy research report used as the basis for the model. [78]

## Micro generation uptake in new development

Our analysis was based on standard assumptions about the renewable energy output that a range of technologies could deliver for different types of building. The micro generation technologies considered for new development were:

- Solar PV
- Solar water heating
- Air source heat pumps
- Ground source heat pumps
- Biomass boilers
- Small scale wind

We have assumed that 1,013 homes will be built annually across Carmarthenshire, based on the predicted increase over LDP plan period 2007 to 2022 of 15,195 homes.

[77] Hereditaments Floorspace and Rateable Value Statistics (2005 Revaluation), 2008

[78] The growth potential for Microgeneration in England, Wales and Scotland, Element Energy, TNS, Willis, K., Scarpa, R., Munro, A., 200

Typical development scenarios were derived from CLG research analysing the cost of Code for Sustainable Homes compliance.[79] These were used to break down homes in to different development types and estimate the mix of homes compared to flats.

Expected employment/job numbers were taken from the LDP. These were converted into potential area (in $m^2$) of new commercial development per building type.

The calculation model builds in a 2-year lag for the influence of the policy and regulation changes to affect the uptake of renewable energy e.g. for the increased BIR uptake due to the 2013 Part L changes are not applied until 2015.

For the purpose of assigning house types, an assumption is made on the different types of growth sites within Carmarthenshire. Namely, Brownfield, Greenfield, Edge of town or Urban (mixed) sites. This is based on our assessment of the growth strategy for Carmarthenshire. For each of these types of growth sites, a housing split is assumed as shown in Table 56.The table below shows the assumed gross internal area per workspace (Source: Planning for employment land, translating jobs into land, Roger Tyms and Partners, April 2010; and Employment Densities: A Full Guide, Arup Economics and Planning, July 2001.

The Table 57 shows the assumed gross internal area per building. This is an illustrative estimate only, based on the study team's experience of typical new planning applications. At the time of writing the study team was not aware of any readily data on the average floor areas for new developments for Carmarthenshire.

**Table 56**: *Assumed housing split*

| Size | Type | No. per ha | Flats | Ter | Semi | Det |
|---|---|---|---|---|---|---|
| Small | Brown | 80 | 10% | 65% | 20% | 5% |
| Small | Green | 40 | 10% | 60% | 20% | 10% |
| Small | Edge of town | 40 | 0% | 40% | 20% | 40% |
| Med | Urban (mixed) | 80 | 10% | 65% | 20% | 5% |

**Table 57**: *GIFA per workspace*

| Type of building | Area ($m^2$) |
|---|---|
| Offices B1 | 1,000 |
| Retail & Leisure | 2,000 |
| Industry | 2,000 |
| Storage | 2,000 |
| Health & Education | 5,000 |
| Other | 500 |

[79] Code for Sustainable Homes: A Cost Review, CLG, March 2010