FINAL REPORT

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LDP-EBD-RE1

Renewable and Low Carbon Energy Assessment

Flintshire County Council

July 2019

FINAL REPORT

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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 is a requirement for the UK to reduce net UK greenhouse gas emissions by 80% 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 is currently in the process of establishing its own carbon budgets.

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 aim of The Environment (Wales) Act 2016 is to secure reduced 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 Flintshire County Council (FCC) planning officers, the intention is that the renewable energy opportunities identified will also be useful in assisting FCC to fulfil its role as a community leader, leading by example through its actions.

1.3 Method employed by this REA

This REA is compiled based on the method set out in the Welsh Government guidance document 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners' September. 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 'Flintshire 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 FCC's evidence base in support of its approach to securing renewable energy developments. The policy mechanisms to be employed by FCC have been developed through consideration of this study revision.

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

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

facilitating partnerships and taking forward delivery of the opportunities identified for FCC.

1.4.1 Wider corporate role

All local authorities including FCC have objectives and requirements for mitigating the effect of and adapting to climate change. This REA enables FCC 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 FCC 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: this assessment has informed Development Management policies with the detail supplied in Renewable Energy SPG to be developed.

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

Additionally, the 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.

[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/EnergySaving-Trust-advice-centre-Wales
[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.

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]"*

The definition employed in PPW[10] (Paragraph 12.8.7) is as follows:

> *"Renewable energy is the term used to cover those sources of energy, other than fossil fuels or nuclear fuel, which are continuously and sustainably available in our environment. This includes wind, water, solar, geothermal energy and plant material (biomass)."*

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

[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 (Edition 9, November 2016)

[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.

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 FCC.

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 European 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 was 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

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 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 Flintshire County Council planning officers deliver the national planning policy expectations as set out in Planning Policy Wales, namely:

- **5.7.6** Planning applications for onshore generating projects in Wales which have an installed generation capacity of between 10MW and 50MW (there is no upper limit for onshore wind generating stations) are made directly to the Welsh Ministers under the Developments of National Significance (DNS) process.
- **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 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.

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

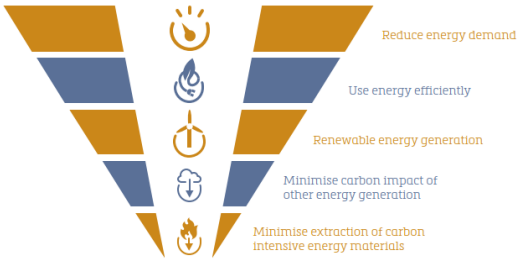
[18] Planning for Renewable and Low Carbon Energy – A Toolkit for Planners – Welsh Government, September 2015

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:
    - For Wales to generate 70% of its electricity consumption from renewable energy by 2030;
    - For one Gigawatt of renewable electricity capacity in Wales to be locally owned by 2030; and
    - 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.

2.3.1 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-term 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.

2.3.2 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

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

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 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 Flintshire includes areas of land both inside and outside of the SSA.

2.3.3 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]

2.3.4 National Development Framework 2020 - 2040 Consultation Draft: 7 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.

2.3.5 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.

2.4 Local Policy

2.4.1 Currently Adopted Flintshire Unitary Development Plan 2007 - 2022

2.4.1.1 Introduction

The currently adopted Unitary Development Plan (UDP) forms the policy that is currently implemented by Flintshire County Council[21]. It should be noted that a new Local Development Plan (LDP) for 2015 - 2030 is currently undergoing a consultation process, with a view of being implemented by the Council.

2.4.1.2 The Vision and Strategic Aims

The currently adopted UDP is underpinned by four main themes, which the UDP states together set a consistent agenda for the plan. The four themes are as follows:

- Sustainable development
- Biodiversity
- Integrating Land Use and Transport
- Community Needs

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

[21] Currently Adopted Flintshire Unitary Development Plan 2007 - 2022, Flintshire County Council, 2011

From these four themes, the UDP states that the overriding vision for the plan is:

> *'To nurture sustainable development capable of improving the quality of life in Flintshire without causing social, economic, resource or environmental harm to existing or future generations'.*

The UDP dictates a series of strategic aims have been created which the policies in the UDP have been derived from. The relevant strategic aims that could influence the methodology and outcomes Renewable Energy Assessment include the following:

c. Health – to promote and facilitate the development of a safe and healthy environment.

e. Natural Environment – To conserve and enhance the natural environment and its diversity – landscape, nature conservation and biodiversity.

f. Built Environment – To conserve, regenerate and enhance the built and historic environment.

g. Energy – To stabilise and ultimately reduce non renewable energy consumption and encourage appropriate renewable energy.

h. Resources – To make the most prudent and efficient use of resources, including land and buildings, and encourage the use of recycled and secondary rather than primary resources.

i. Pollution – To stabilise and ultimately reduce the potential of pollution.

j. Waste – To stabilise and ultimately reduce waste generation and disposal utilising waste management measures.

m. Tourism – to facilitate appropriate tourism development which meets the needs of visitors without harming the natural and cultural assets on which tourism is based.

n. Proximity Principle – To apply the proximity principle whereby problems are solved locally rather than passing them on to other places or to future generations.

o. Respect for Environmental Limits – To ensure that resources are not irrecoverably depleted or the environmental irreversibly damaged.

2.4.1.3 Policy STR10: Resources

The policy dictates that developments will be required to make the best use of resource through making the most efficient and practicable use of buildings and land in terms of density, siting and layout. Policy STR10 also details that developments are required to utilising clean, renewable and sustainable energy generation where environmentally acceptable in preference to non renewable energy generation and incorporating energy efficiency and conservation measures in new development.

2.4.1.4 Policy D1: Design Quality, Location and Layout

Policy D1 dictates the conditions that development will allow development to be permitted. This includes maximising the efficient use of resources, minimising the use of non-renewable resources and minimising the generation of waste and pollution. The policy goes on to state that good design should ensure that new development mitigates the causes of climate change.

The policy also dictates that development will only be permitted only if it relates well to local topography, aspect, microclimate, street pattern, orientation and views. The policy aims to ensure the careful siting and design of new buildings, to help make the most efficient use of land, minimise travel and energy consumption, protect the character and appearance of the landscape, and establish a pleasing sense of place for inhabitants and visitors.

2.4.1.5 Policy EWP1: Sustainable Energy Generation

The currently adopted UDP states that there will be a presumption in favour of renewable energy schemes to them meeting the other relevant requirements of the Plan. Policy EWP1 encourages the development of renewable sources of energy to meet national targets for reducing the release of greenhouse gas emissions by 40% by 2020 and for expanding renewable energy, offsetting the use of fossil fuels by 15% by 2020. The policy goes on to state that proposals for fossil fuel based energy systems will be discouraged.

2.4.1.6 Policy EWP3: Renewable Energy in New Development

Policy EWP3 details the requirement of all major new residential and non-residential developments to incorporate renewable energy production equipment on site to reduce predicted carbon emissions by a minimum of 10%. The exceptions to this would be due to renewable energy not being viable given the type of development, location and design; where on-site renewable energy equipment would have an adverse effect on amenity, outweighing the benefits of the technology; or whereby it is not possible to incorporate renewable energy production to achieve the full 10%.

The policy identifies the following renewable energy technologies as potential solutions offering significant potential:

- Passive Solar Design
- Solar Water Heating
- Photovoltaic Cells
- Wind Turbines
- Combined Heat and Power Schemes
- Community Heating Schemes

The renewable energy technologies included could be as a part of a community scheme or alternatively be integral to individual dwellings or buildings, depending on the development proposed.

2.4.1.7 Policy EWP4: Wind Turbine Development

The Wind Turbine Development policy sets out a series of criteria that proposals for individual wind turbines, wind clusters or wind farms will be required to meet, as follows:

a. The development is not sited within, nor would have a significant adverse impact on, a sensitive area of national or regional environmental, landscape or heritage importance;

b. The development, in conjunction with other wind turbine developments, will not have a detrimental cumulative impact upon the landscape;

c. The impact of the development upon agriculture, forestry, recreation and other land uses is minimised to permit existing uses to continue unhindered;

d. The turbines will be appropriately designed so as to avoid, or mitigate against, unacceptable environmental impacts, including noise, light reflection, shadow flicker and impact on wildlife;

e. Sufficient steps are taken to avoid or, where possible, to mitigate electro-magnetic interference to any existing transmitting or receiving systems;

f. Where the development of associated ancillary buildings is required the structures are sensitively designed to enhance the character and quality of the locality; and

g. Adequate provision has been made in the scheme for the restoration and aftercare of the site on the cessation of use.

Policy EWP4 states that the Council will make every effort to ensure that the proposals are sensitive to the needs of the local community and that the local community benefits from such developments. An example of this, as referenced in the policy, is commuted sum payments to support community schemes.

The aim of this policy is to encourage wind turbine development, whilst protecting designated areas and other sites, features and species of acknowledged interest. It is likely that wind turbine proposals will be required to be accompanied by an environmental statement.

2.4.1.8 Policy EWP5: Other Forms of Renewable Energy Generation

Policy EWP5 details the mandatory requirements for renewable energy generation proposals by means other than wind turbines. These include the following policy requirements:

a. The proposed development, including scale, siting, design and materials, should not have an unacceptable effect on its surroundings in terms of landscape, visual amenity, nature conservation or heritage importance;

b. The impact of the development upon agricultural land will be minimised with appropriate installations sited within existing complexes and on existing hard surfacing;

c. In sensitive areas where above ground connections have unacceptable adverse effect on the landscape, connection lines and pipes are located underground; and;

d. The development will utilise the existing transport network and will not have an adverse impact on the local road network, and traffic will be restricted to operating during appropriate hours of the day.

The objective of this policy is to stimulate the development of renewable energy sources, such as biomass, water, geothermal and solar wherever possible.

The policy recognises that often the most economically viable location for renewable energy generation schemes is in areas considered as more environmentally sensitive. In response to this, the policy states that in all cases development will be permitted only if the Council are satisfied that sufficient care has been taken to minimise visual intrusion through appropriate siting and design.

An environmental impact assessment is only necessary for larger scale developments or in developments with a significant effect on the environment. However, where a statement is not required, policy EWP5 states that it will still be necessary to submit a detailed study of issues such as noise or visual impact with the planning application.

2.4.2 Draft Flintshire Deposit Local Development Plan 2015 - 2030

2.4.2.1 Introduction

The draft Flintshire Deposit Local Development Plan[22] (LDP) is currently undergoing consultation with a view of being implemented by Flintshire County Council. This document differs slightly to the currently adopted UDP (see Section 2.4.1) in the methodology of how it is prepared, with the LDP process incorporating an opportunity for engagement with a variety of stakeholders from early in the process.

2.4.2.2 Objectives

There are three overriding objectives of the Draft Deposit LDP, as follows: Enhancing Community Life (Objectives 1-7); Delivering Growth and Prosperity (Objectives 8-14) and; Safeguarding the Environment (Objectives 15-19).

The third overriding objective (Safeguarding the Environment) has been detailed in the LDP in the following objectives:

b. Minimise the causes and impacts of climate change and pollution.

c. Conserve and enhance Flintshire's high quality environmental assets including landscape, cultural heritage and natural and built environments.

d. Maintain and enhance green infrastructure networks.

e. Promote good design that is locally distinct, innovative and sensitive to location.

f. Support the safeguarding and sustainable use of natural resources such as water and promote the development of brownfield land.

These objectives and the aforementioned key issues have helped to form the policies that constitute the LDP. The policies that pertain to and inform the Renewable Energy Assessment have been detailed in the following sections.

2.4.2.3 Policy STR4: Principles of Sustainable Development, Design and Placemaking

A constituent part of STR4 is the necessity to incorporate where possible on-site energy efficiency and renewable energy generation. The policy references the national targets for the production of energy from renewable sources (see Section 2.3), and states that the incorporation of renewable energy technologies should be considered, with the aim of all developments seeking to attain the highest level of energy efficiency possible.

2.4.2.4 Policy STR14: Climate Change and Environmental Protection

Policy STR14 details the council's desire to mitigate the effects of climate change and ensure environmental protection in the county. As a part of this, the policy states that energy efficient development, including the following measures will be encouraged:

- Environmentally acceptable renewable and zero / low carbon energy generation;
- Combined heat and power;
- Communal / district heating networks

The LDP encourages renewable energy generation where appropriate, subject to a range of material planning considerations. The policy makes reference to the Welsh Government Toolkit, which identifies specific areas of search or the potential for particular types of renewable and low / zero carbon energy.

2.4.2.5 Policy PC4: Sustainability and Resilience of New Development

This policy states that development should ensure that it incorporates renewable energy technologies and carbon sinks where appropriate.

2.4.2.6 Policy EN12: New Development and Renewable and Low Carbon Energy Technology

Policy EN12 sets out the requirement for new development to maximise the potential for renewable or low carbon energy technology to meet the energy needs of the proposal.

For any prospective residential development site of 100 units or more and for non-residential developments with a floorspace of 1000m^2 or more, an Energy Assessment will be required. The policy dictates that the Energy Assessment should determine the feasibility

[22] Draft Flintshire Deposit Local Development Plan 2015 - 2030, Flintshire County Council, 2019

of incorporating low carbon or renewable energy technology or connecting to nearby renewable or low carbon energy sources and networks.

The policy states that opportunities for linking with district heating networks and where appropriate sharing renewable energy should be explored.

2.4.2.7 Policy EN13: Renewable and Low Carbon Energy Development

This policy sets out what renewable or low carbon generation development will be permitted for. This includes:

a. Solar farms (5MW to 50MW) within the solar local search area identified on the proposals map;

b. Wind farms (5MW to 25MW) within the wind search area defined on the proposals map;

c. Small scale and/or community based proposals (less than 5MW) for wind, solar, biomass, energy from waste, anaerobic digestion and hydropower in appropriate locations.

The policy dictates that land for solar farms is specifically allocated at Crumps Yard, Connah's Quay and at Castle Park, Flint.

The policy states that all renewables or low carbon energy proposals will be permitted provided the following criteria are met:

- The siting, design, layout, type of installation and materials used do not have a significant adverse effect on the character and features of the proposed location;
- There would not be unacceptable loss of public amenity or accessibility to the area;
- The impact of the development upon agriculture, forestry, recreation and other land uses is minimised to permit existing uses to continue unhindered;
- There would be no individual or cumulative significant adverse effect on the landscape, particularly the AONB;
- Any associated ancillary buildings or structures are sensitively sited and designed to minimize their impact on the character and quality of the locality;
- In sensitive areas where above ground connections will have an unacceptable adverse effect on the landscape, connection lines and pipes should be located underground;
- Adequate provision has been made in the scheme for the restoration and aftercare of the site on the cessation of use.

The policy goes on to state the specific requirements for wind energy proposals, as follows:

- The turbines are appropriately designed so as to avoid, or mitigate against, unacceptable environmental impacts, including noise, light reflection and shadow flicker;
- Sufficient steps are taken to avoid or, where possible, to mitigate electro-magnetic interference to any existing transmitting or receiving systems.

The County does not fall within one of the Strategic Search Areas (SSAs) identified by the Welsh government, and therefore this REA will focus on the potential for identifying Wind Local Search Areas (WLSA), which are suitable to accommodate smaller scale wind farms of between 5MW and 25MW, as stated in Policy EN13.

The policy also dictates that this REA will focus on the potential for identifying Solar Local Search Areas (SLSA) which are suitable to accommodate solar farms of between 5MW and 50MW.

3. Calculating the energy consumption in Flintshire in 2020 and 2030

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.

The electricity and thermal consumption for Flintshire during 2008 was reported as 1,100GWhe and 3,200GWht (see Table 3).

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

	Electricity (GWh)	Thermal (GWh)
UK	304,625	815,624
Wales	16,267	55,657
Flintshire	**1,100**	**3,200**

Electricity consumption across the Flintshire represented circa 7% of Wales total reported electricity consumption, and circa 0.36% of the UK's total reported electricity consumption in 2008.

Thermal consumption across Flintshire represents circa 6% of Wales total reported thermal consumption, and circa 0.39% 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%.

FCC's current Local Development Plan period runs until 2030. Using the UK RES to derive annual rate of change (from 2008 to 2020), this REA therefore comprises a projection of energy consumption in Flintshire to 2030. Thus, the predicted electrical and thermal annual energy consumption across Flintshire in 2030 is 1,094GWhe, and 2,340GWht respectively (see Table 4).

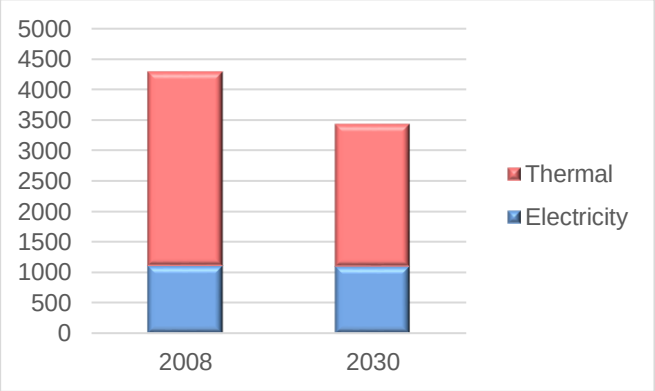
Table 4: *Predicted energy consumption for Flintshire in 2030.*

	Electricity (GWh)	Thermal (GWh)
Energy consumed in 2008	**1,100**	**3,200**
Projection to 2020[23]	99.7%	84.2%
Predicted energy consumed in 2020	1,097	2,694
Annual rate of change between 2008 and 2020	-0.025%	-1.32
Total percentage change from 2020 to 2030	-0.25%	-13.32%
Predicted energy consumption in 2030	**1,094***	**2,340***

**Numbers are rounded down to whole GWh.*

Figure 2 below illustrates the predicted change in energy consumption in Flintshire between 2008 and 2030 with total electricity consumption reducing by circa 6GWh, and total heat consumption reducing by circa 860GWh.

Figure 2: *Predicted change in energy consumed in Flintshire between 2008 and 2030.*



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

3.3 LZC energy technologies in Flintshire in 2017

To understand the progress being made with the development of Low and Zero Carbon (LZC) technologies, the existing capacity (correct at 15/07/2019) of LZC technologies in Flintshire 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 FCC, BEIS (formerly DECC)[24] and Ofgem[25]. 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 2017

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) of 'stand-alone' renewable energy technologies in Flintshire was calculated as 87.9MWe and 80.4MWt (see Table 5).

Table 5: *Renewable energy generation from 'stand-alone' installations in Flintshire on the 15/07/ 2019*

Technology	Electricity (MWe)	Thermal (MWt)
Biomass	0.5	23.2
Hydropower	0.005	-
Landfill Gas	1.9	3.8
Wind Power	2.3	-
Solar PV Farms	56.5	
Other (EfW & Anaerobic Digestion)	26.7	53.4
Total	**87.9**	**80.4**

Of the above total for electricity generation, solar PV farms 56.5MWe, energy from waste (EfW) accounts for 26MWe, wind energy 2.3MWe, biomass 0.5MWe, , landfill gas 1.9MWe anaerobic digestion 0.19MWe and the remaining 0.005MWe hydro. Of the 80.4MWt thermal generation, the EfW plant at Deeside accounts for 52MWth, biomass 23.2MWth, landfill gas CHP 3.8MWth and anaerobic digestion 0.38MWt.

In the context of overall Welsh Government renewable energy targets as set out in the Energy Policy Statement[26], and including operational, under construction and consented, in Flintshire could be contributing approximately 0.05% of the target of 2GW of electrical energy associated with onshore wind.

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

As outlined in Table 6 below, the total installed capacity of 'building-integrated' renewable energy installations in Flintshire (as at 15/07/2019) was calculated as 19.1MWe, and 12.2MWt. Photovoltaic systems accounted for circa 19.0MWe, with micro-wind generating 0.1MWe.

The breakdown of technology types is unknown for renewable heat generation but the RHI register identifies 52 'non-domestic' renewable heat installations with installed capacity of 10.8MWt. 270 domestic renewable heat installations are also

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

[25] Ofgem (2011) *Renewables & CHP – Accredited Stations,* https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.a spx?ReportVisibility=1&ReportCategory=0 .

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

identified but with no installed capacities: we have assumed 5kW per dwelling producing a total additional figure of 1.35MWt, giving a total of 12.20MWt under other.

Table 6: *Renewable energy generation from 'building-integrated' installations in Flintshire in 2019*

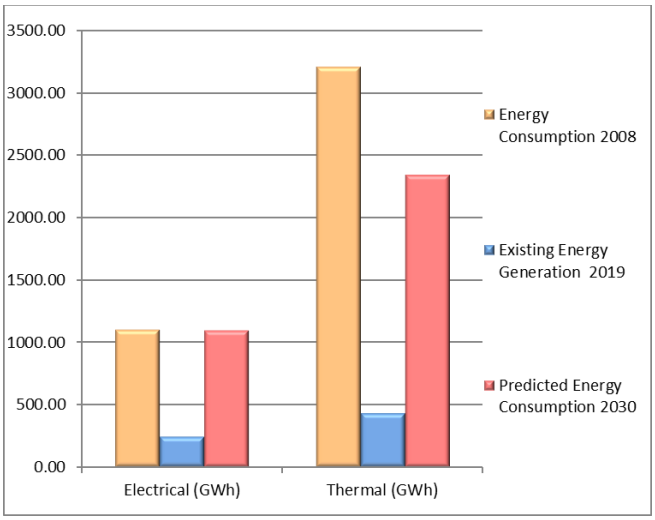
Technology	Electricity (MW)	Thermal (MW)
Hydropower	-	-
CHP	-	-
Photovoltaic	19.0	-
Other	-	12.2
Wind Power	0.1	-
Total	**19.1**	**12.2**

The total existing renewable installed capacity in Flintshire in 2019 was calculated as 107.0MWe of electrical power, and 92.60MWth 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 section 12.3 'Setting LPA wide renewable energy contributions'. Based on typical capacity factors, the total theoretical renewable energy generation in Flintshire as at 15/07/2019 is calculated as 295GWhe (295,215 MWhe), and 374GWht (373,526 MWht).

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 Flintshire in 2030.

Figure 3: *Difference between the renewable energy generation (GWh) of current (2019) installations and predicted consumption (in 2030)*



4. Wind Energy Resource

4.1 Introduction

The focus of this section of the REA is on establishing the potential wind resource across Flintshire.

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.

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 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 Flintshire 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 'Flintshire 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 Flintshire

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 Flintshire 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 Flintshire's 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 Flintshire, 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 Methodology.

There are numerous constraints when considering wind energy development to establish the maximum potential wind resource across Flintshire, 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) a 7km buffer is applied
- National Parks (already constrained in Map 1) a 7km buffer is applied

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 Flintshire.

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[27] to maintain consistency with the Welsh Government guidance contained in 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners'[28]. 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)
- Tan 8 Strategic Search Areas, existing and consented (but not yet constructed) wind farms and those proposed in the planning system as of 15/07/2019 (7km)[29]
- Watercourses – including major, secondary and minor rivers, canals and lakes.
- Woodlands –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

[27] It should be noted that this does not preclude the potential development / deployment of larger or smaller wind turbines across in Flintshire.

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

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

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
- Country Parks
- RIGS
- Wildlife Sites
- 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 15/07/2019 (7km)[30]
- Woodlands – All other woodlands

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[31] 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[32], 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[33].

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.

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

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

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

[33] 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.

4.2.13 Step 7 – Local Search Areas

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 Flintshire. Assuming that over the course of a year a 2 MW wind turbine will only generate energy for 27%[34] of the time (2,365 hours), the total potential energy (GWh) has been calculated.

Table 7: *Theoretical maximum potential wind resource (km^2) for Flintshire 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 Flintshire, 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 FCC could be:

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

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

6. Biomass Energy Resource

6.1 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 two large biomass plants in Flintshire. One located at the UPM Shotton Paper Mill where a biomass boiler consumes 468,759 tonnes of biomass per year. Off this 205,432 tonnes is waste from the paper mill and 263,327 tonnes is a mixture of chips, logs and brash bundles. The boiler produce 25MW thermal of which 14MWt is provided by wood and 10MWt from onsite waste. The other is located at Warwick International and consist of a biomass CHP producing 1MW of electricity and 0.5MW of heat. There have also been a small number of domestic/residential applications to install biomass boilers.

6.2 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 Flintshire 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.

6.3 Energy Crops

6.3.1 Usable land and crop yield

The principal constraint to harvesting energy crops across Flintshire 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[35], which is not constrained by environmental or historical protected areas.

The 34% of agricultural land across Flintshire 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 Flintshire is identified as 55.72 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

[35] 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.

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 Flintshire s 5.57 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 Flintshire County Council is 6,686 odt per annum.

6.3.2 Technologies

6.3.2.1 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 Flintshire.

Table 8: *Total potential energy crop resource for Flintshire.*

	Energy Crop
Available area (km^2)	55.72
Usable area (km^2)	5.57
Yield (odt per km^2)	1,200
Yield (odt)	6,686
Required yield per MWe	6,000
Potential installed capacity (MWe)	**1.11**
Heat to power ratio	2:1
Potential installed capacity (MWt)	**2.23**

6.4 Wood Fuel

6.4.1 Usable land and yield

The total area of national forest across Flintshire as identified by the National Forestry Inventory (NFI) database is 43.66 km^2, of which 2.02 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 Flintshire is

2,620odt per annum, of which 121odt 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.

6.4.2 Technologies

6.4.2.1 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 below confirms the maximum potential biomass resource for Flintshire County Council.

Table 9: *Total potential energy resource from wood fuel for Flintshire.*

	Wood fuel
Available area (km^2)	43.66
Usable area (km^2)	43.66
Yield (odt per km^2)	60.0
Yield (odt)	2,620
Required yield per MWt	660
Potential installed capacity (MWt)	**4.0**

Of the potential 4.0 MWt that could be derived from woodland residue across Flintshire, 0.2 MWt could be derived from NRW owned land.

Due to the large miss match in biomass heat generation capacity at Shotton Paper mill (22.2MW) against the available resource in Flintshire (4MW). It has been assumed that Shotton Paper Mill is obtaining the wood supply for its biomass boilers from outside Flintshire and the whole of the biomass resource from wood is therefore available. It should be noted that AECOM has not been able to verify where Shotton Paper Mill is obtaining its wood supply for the biomass boilers from.

6.5 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.

6.6 Potential opportunities for future development

In relation to biomass energy generation, potential opportunities for FCC 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.

7. Energy from Waste

7.1 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 FCC 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[36] 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%[37].

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.

7.2 Commercial and Industrial Waste

The total predicted C&I waste across Flintshire in 2030, 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 used to produce the waste projections see Appendix D. **It has been calculated as 1,782 tonnes.**

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 Flintshire is 535 tonnes in 2030.

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.

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 Flintshire would be 0.05MWe (535/10,320) and 0.10MWt for 2030.

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

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

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.

Table 10*: Commercial and Industrial waste resource for Flintshire in 2030*

Commercial & Industrial Waste	2030
Total waste (tonnes)	1,782
Total residual waste (tonnes)	535
Required wet tonnes per 1MWe	10,320
Potential installed capacity (MWe)	0.05
Total renewable element (35%)	35%
Potential installed capacity (MWe)	**0.02**
Heat to power ratio	2:1
Potential installed capacity (MWt)	**0.04**

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 Flintshire for C&I waste would be 0.02MWe and 0.04MWt for 2030**, as shown in Table 10.

Flintshire County Council have an EfW plant at Parc Adfer, Deeside which takes all of Flintshire existing residual waste. As the residual waste is projected to go down there is no scope for additional EfW plants in Flintshire.

7.3 Municipal Solid Waste

The total predicted MSW across Flintshire in 2030, 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 used to produce the waste projections see Appendix D. **It has been calculated as 51,080 tonnes.**

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 Flintshire is 15,324 tonnes in 2030.

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 same time from the waste heat, the total potential capacity that could be supported by the MSW waste stream in Flintshire would be 1.48MWe and 3.71MWt for 2030.

However, under the requirements of the EU Renewable Energy Directive[41], 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

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

be about 35%, compared to a current nominal level of about 50%[42] [43].

Therefore assuming that 35% of the power and energy output of any waste facility count as renewable, **the renewable electricity and heat capacity across Flintshire for waste would be 0.52MWe and 1.04MWt in 2030 respectively**, as shown in Table 11.

Flintshire County Council have an EfW plant at Parc Adfer, Deeside which takes all of Flintshire existing residual waste. As the residual waste is projected to go down there is no scope for additional EfW plants in Flintshire.

Table 11*: Municipal Solid Waste resource for Flintshire in 2030*

MSW	2030
Total waste (tonnes)	51,080
Total residual waste (tonnes)	15,324
Required wet tonnes per 1MWe	10,320
Potential installed capacity (MWe)	1.48
Total renewable element	35%
Potential installed capacity (MWe)	**0.52**
Heat to power ratio	2:1
Potential installed capacity (MWt)	**1.04**

7.4 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 Flintshire in 2017/18 was 4,428 tonnes. Flintshire's population in 2017 was 155,155, producing 0.029 tonnes of composted food waste per annum per person. Given that Flintshire's population is expected to rise by 0.09% per annum it has been estimated that **Flintshire will generate 4,478 tonnes of food waste in 2030.**

Food waste from Flintshire is processed at a facility in Denbighshire and this arrangement will continue for the length of time of the local development plan (up to 2030). The food waste is therefore already accounted for as existing generation within Denbighshire and there is no available resource from food waste in Flintshire.

Table 12*: Potential installed capacity from total available food waste resource in Flintshire in 2030.*

Resource from Food Waste	2030
MSW food waste (tonnes)	4,478
Required tonnes per MWe	20,000
Potential installed capacity (MWe)	**0.22**
Heat to power ratio	1.5:1
Potential installed capacity (MWt)	**0.34**

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

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

7.5 Agricultural Waste

7.5.1 Animal Manure

It is assumed that the farming mix will not change over the time period to 2030 and therefore energy generated from agricultural waste will be the same as the current scenario.

Utilising the latest statistics (2015), the total numbers of cattle and pig across the Flintshire have been calculated as 34,374 and 95 respectively[44].

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[45] the total annual tonnage of available manure across Flintshire is: 206,301.

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 Flintshire is 51,575 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: **0.23 MWe and 0.34 MWt** (Table 13).

Table 13*: Potential installed capacity from total available animal slurry resource in Flintshire in 2022 and 2031*

Animal slurry	
Total livestock (Cattle & Pigs)	34,469
Total slurry (tonnes)	206,301
Usable slurry (tonnes)	51,575
Required wet tonnes per MWe	225,000
Potential installed capacity (MWe)	**0.23**
Heat to power ratio	1.5:1
Potential installed capacity (MWt)	**0.34**

7.5.2 Poultry Litter

It is assumed that the farming mix will not change over the time period to 2030 and therefore energy generated from agricultural waste will be the same as the current scenario.

Utilising the latest statistics (2015), the total number of poultry recorded across Flintshire have been calculated as 3,094[46].

To allow for losses due to the economics associated with wide spatial distribution of poultry farms across Flintshire, 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[47]. This suggests a

[44] Welsh Governments Agricultural small area statistics - http://gov.wales/statistics-and-research/agricultural-small-area-statistics/?lang=en (May 2018).

[45] Assuming that livestock will only be kept under cover for, approximately, 6 months of the year.

[46] Welsh Governments Agricultural small area statistics - http://gov.wales/statistics-and-research/agricultural-small-area-statistics/?lang=en (May 2018).

[47] 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

figure of 42 tonnes of litter per year per 1,000 birds[48].

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: 0.006 MWe and 0.012 MWt respectively.

Table 14: *Potential installed capacity from poultry litter in Flintshire in 2030*

Poultry litter	
Total poultry[49]	3,094
Accessible Poultry (50%)	1,547
Total litter (tonnes)	65
Required tonnes of litter per MWe	11,000
Potential installed capacity (MWe)	**0.006**
Heat to power ratio	2:1
Potential installed capacity (MWt)	**0.012**

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 0.236MWe and 0.352MWt, the resource could be combined with animal slurry to support an anaerobic digestion facility of 0.236MWe**, especially in partnership with neighbouring authorities.

[48] Based on the figure for laying hens, which is 3.5 tonnes per month

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

7.6 Sewage Sludge

The population of Flintshire in 2030, based StatsWales projections, is 159,899.

Assuming that the average amount of sewage produced per person per year is 0.03tonnes (t) the total sewage sludge across Flintshire in 2030 equates to circa 4,707 t.

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 0.17MWe and 0.26MWt respectively in 2030.

The Queensferry treatment works has a 0.19MWe anaerobic digester and CHP engine. As this accounts for more than the total potential from sewage sludge and most of Flintshire is rural **it has been assumed that there is no resource available for further energy generation form sewage sludge.**

Table 15: *Potential installed capacity from total available sewage sludge resource in Flintshire in 2030*

Sewage Sludge	2030
Flintshire Population[50]	156,899
Sewage per person (tonnes)	0.03
Total sewage (tonnes)	4,707
Required tonnes of sewage per MWe	13000
Potential installed capacity (MWe)	**0.17**
Heat to power ratio	1.5:1
Potential installed capacity (MWt)	**0.26**

[50] The based on StatsWales figures for projected population of Flintshire.

7.7 Waste Summary

A summary of the potential outputs from utilising the waste resource in Flintshire 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.

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

The existing Parc Adfer EfW plant currently processes all of the residual waste in Flintshire.

Aside from the 0.38MWt digester processing sewage sludge, there is currently no other Anaerobic Digestion facility within Flintshire.

FCC confirm that a supplier is appointed to which all domestic food waste is exported for processing via anaerobic digestion facilities that operate outside of the LPA area.

Therefore, the only likely AD facility within Flintshire is likely to utilise slurries.

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.

Table 16: *Summary of Energy from Waste*

	Reason for adjustment / change of technology			Post consideration of likelihood of utilisation for RE Generation			
Resource	**Technology**	**2030**			**Technology**	**MWe**	**MWt**
		MWe	**MWt**				
C&I Waste (Table 10)	EfW with CHP	0.02	0.04	Currently recycled. Non-recyclable material is used within the Parc Adfer EfW plant & therefore is already counted as existing generation.	None	-	-
MSW (Table 11)	EfW with CHP	0.52	1.04	Currently recycled. Non-recyclable material is used within the Parc Adfer EfW plant & therefore is already counted as existing generation.	None	-	-
Food Waste (Table 12)	AD with CHP	0.22	0.34	Food waste is currently exported out of county to AD & therefore counted as existing generation elsewhere.	None	-	-
Animal Slurry (Table 13)	AD with CHP	0.23	0.34	Combined with Poultry Litter	AD with CHP	0.24	0.35
Poultry Litter (Table 14)	Bespoke plant with CHP	0.01	0.01	Not likely to be enough resource for bespoke plant. Combines with Animal slurry.	None	-	-
Sewage Sludge (Table 15)	AD with CHP	0.17	0.39	0.19MWe already generated: assumed the economically viable opportunities are already exploited.	None	-	-
Potential installed capacity		**1.17**	**2.15**			**0.24**	**0.35**

8. Hydro Power Energy Resource

8.1 Introduction

Existing hydro power installations across Flintshire have a combined total installed electrical capacity of 0.005MWe.

The Environment Agency published a study[51] into the potential for small scale hydro power generation across England and Wales in 2010[52]. Table 17 confirms the total potential hydropower capacity according to each of the potential hydropower sites' sensitivity to exploitation, in the Flintshire. 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 Flintshire according to environmental sensitivity.*

Environmental sensitivity	Installed capacity (MWe)
Low	0
Medium	0
High	0.11
Total	**0.11**
Proportion High Sensitivity included	25%
Potential Hydro Power Resource	**0.03**

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 Flintshire 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 0.03 MWe in total.

The existing (as of 1507/2019) installed capacity of 0.005MWe is not located at any of the sites indicated within the EA study. The total potential hydroelectric capacity in Flintshire is therefore 0.115MWe with 0.11MW 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 0.03MWe.**

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

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

9. Solar PV Farms

9.1 Introduction

This section provides a summary assessment of the potential for Solar PV Farms in Flintshire.

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 defines 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.

9.2 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 'Flintshire 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:

9.2.1 Step 1:

9.2.2 Map Reference & Title: S1 – Solar Resource in Flintshire

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[53], AECOM has created a data layer for Flintshire 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 Flintshire's boundary.

9.2.3 Step 2:

9.2.4 Map Reference & Title: S2 – Statutory and Strategic Constraints

Constraints were applied to establish the maximum potential resource for solar PV farms across Flintshire. A comprehensive table of the sources and assumptions used is given in Appendix E. The constraints applied in the maps are discussed below.

[53] Ordnance Survey, Terrain 50 dataset

9.2.4.1 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;
- National Parks (already constrained in Map 1) a 3.5km buffer is applied

9.2.4.2 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[54].

The other non-statutory designations considered are:

- Ancient Woodlands
- Major and minor transport infrastructure – No buffer is applied - extent only;
- Existing buildings – no buffer is applied to existing buildings, however settlements are constrained at their boundary as supplied by FCC.
- TAN 8 Strategic Search Areas existing and consented (but not yet constructed) wind farms, including those proposed through the planning system as off 15/07/2019[55];
- Watercourses – including major, secondary and minor rivers, canals and lakes: extent only – no additional buffer is applied;
- Woodlands – broad leaved woodland and ancient woodlands extent only.;
- Areas of thick peat.

9.2.5 Step 3

9.2.6 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 Flintshire, 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 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 31.7km^2

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

[55] This includes wind development outside of the boundary of the county where the development/proposals extend inside Flintshire.

9.2.7 Step 4:

9.2.8 Map Reference & Title: S4 – Local Constraints

The following additional local non-statutory constraints are applied:

- Local Nature Reserves
- Country Parks
- RIGS
- Wildlife Sites
- Conservation Areas
- 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 15/07/2019 (3.5km)[56]
- Woodlands – All other woodlands

9.2.9 Step 5

9.2.10 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 15.2km^2

9.2.11 Step 6

9.2.12 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[57] 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[58], 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[59].

The remaining land available for solar PV farms at this stage of the assessment equates to 15.2km^2

9.2.13 Step 7

9.2.14 Map Reference & Title: S7 – Solar PV Farm initial Local Search Areas

Remaining land parcels, following steps 1 to 6, are grouped together to define the indicative solar PV LSA's.

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

- 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);

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

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

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

[59] 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.

- 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;

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', hence, the amount of land 'available' for solar PV farm development has increased following stage 6 (grid connection assessment) though the generation capacity from this area has remained the same at 632MW.

Maximum available solar PV farm resource

The assumptions about the PV array are:

Rated output: 5MW

Area of Land Required[60]: circa 0.12km^2

The figure of 0.12km^2 (this equates to 12Ha or c30acres) has been utilised to identify potential sites. Areas of land less than 0.12km^2 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 554MWh.

The maximum energy resource from solar PV is therefore 632MW producing 554MWh per annum of electricity.

It should be noted that planning will further constrain this maximum due the landscape impact of schemes and accumulative impact of schemes i.e. restrictions on how close together solar PV farms can be built.

9.3 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;

9.4 Potential opportunities for future development

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

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

[60] 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 0.024km^2).

10. Building Integrated Renewable Energy Uptake

10.1 Introduction

This section provides an assessment of the potential building integrated renewable (BIR) energy technology uptake in Flintshire. The work sheets 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)[61]'.

10.2 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

10.3 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 simplified method for calculating BIR, as per the aforementioned Toolkit.

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

This section utilises the Flintshire County Borough Council Draft Flintshire Deposit Local Development Plan 2015-2030 (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)).

This calculation is to report the total predicted new and existing BIR RE capacity for Flintshire broken down as follows:

- By 2030
- Renewable heat and electricity.

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

10.4 BIR uptake in existing buildings

10.4.1 Existing building stock

Using Welsh Statistics, a snapshot of the building stock in the Flintshire in 2015/2016 was obtained. By understanding the age of the existing stock, and their heat demand, it is possible to recognise the increased benefits of installing renewable heat to older properties that are not as well insulated, for example. The age of the building stock as it was in 2016 is demonstrated in Figure 4.

Figure 4 shows that 76% of the 2016 housing stock was built before 1982. Combined with the anticipated number of new homes in Flintshire in the LDP plan period[62], by the end of the plan period in 2030 the pre-1980 homes will account for 68% of Flintshire housing stock. Therefore, finding a low carbon solution for the older homes in Flintshire will be vital in reducing the overall CO_2 emissions of Flintshire by 2030.

10.4.2 Results: BIR uptake in existing buildings

The results show that by 2030, the uptake of BIR in existing buildings in Flintshire would equate to 52.7MW, which consists of 34.9MWt from renewable heat and 17.8MWe from renewable electricity. Table 19 summarises this uptake for the key year of 2030.

Figure 4: *Age of residential stock in Flintshire (2016)*

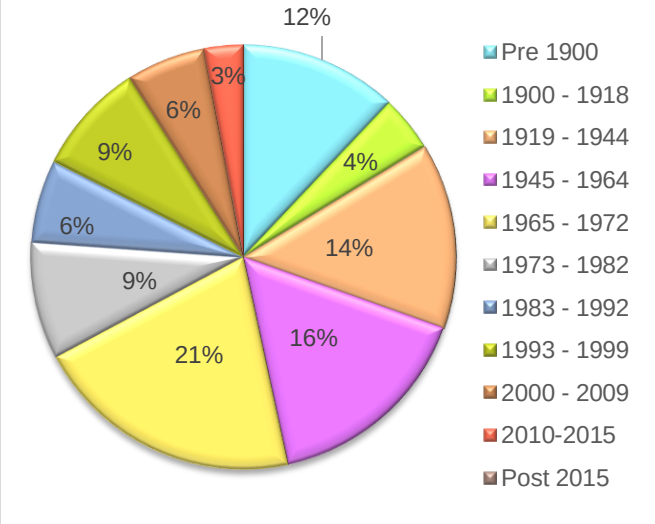


Figure 5: *Rural / Urban residential split in Flintshire (2004)*

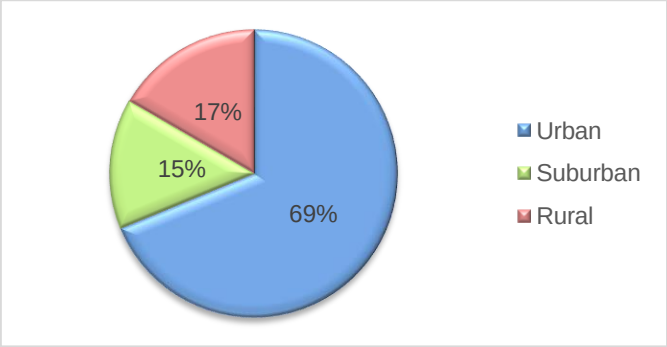


Figure 6: *BIR uptake (cumulative) in existing buildings*

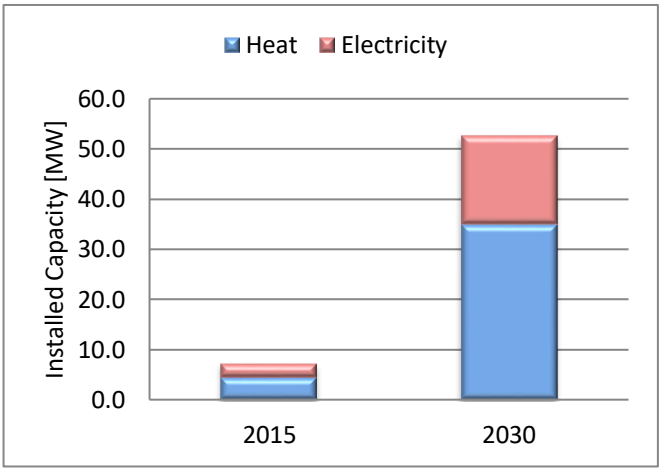


Table 19: *BIR uptake (cumulative) in existing buildings*

Building	2015	2030
Heat (MW)		
Existing dwellings and non-residential buildings	4.4	34.9
Electricity (MW)		
Existing dwellings and non-residential buildings	2.9	17.8
Total	7.3	52.7

[62] Approximately 7,950 new homes between 2015-2030 based on Strategic Policy STR1 from Draft Flintshire Deposit Local Development Plan (2015-2030).

10.5 Future new buildings

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.

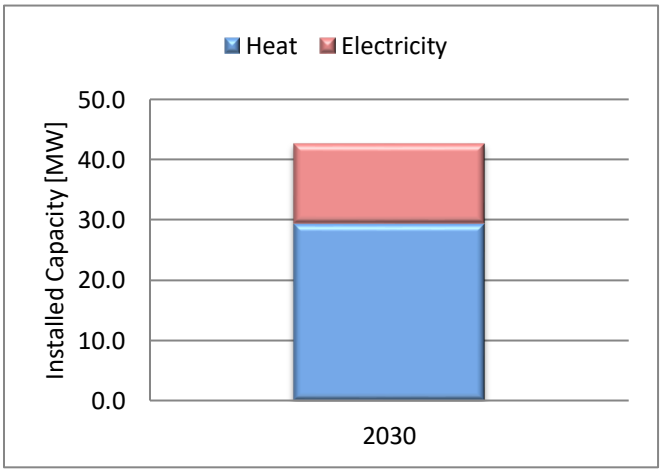
The Building Regulations Wales 2014 (Part L) AD1A (new homes) can currently be met through the design of fabric and services alone: compliance does not require the installation of low and zero carbon energy technologies.

For AD2A (non-domestic buildings) however, buildings are 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 Flintshire, the Draft Deposit Local Development Plan[63] sets out a total of 6,950 homes are required over the LDP period 2015 to 2030. This equates to around 470 homes per year.

Figure 7: *BIR uptake (cumulative) in future new buildings*



10.5.1 Results – BIR uptake in future new buildings

The results of the assessment show that by 2030, the uptake of BIR in new buildings in Flintshire could equate to 40.5MW, which consists of 12.1MWt from renewable heat and 28.4MWe from renewable electricity.

Figure 7 and Table 20 summarise this uptake over the key year of 2030 for a build out rate of 470 homes per year.

Table 20: *BIR uptake (cumulative) in future new buildings*

Building	2030
Heat (MW)	
Residential	10.4
Non Residential	1.7
Sub-total	**12.1**
Electricity (MW)	
Residential	10.4
Non Residential	18.0
Sub-total	**28.4**
Total	**40.5**

[63] Approximately 7,950 new homes between 2015-2030 based on Strategic Policy STR1 from Draft Flintshire Deposit Local Development Plan (2015-2030).

10.5.2 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 Flintshire for 2030 is circa 47.0MWt for Heat and 46.2MWe for Electricity. 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 Flintshire in year 2030 is shown in Table 21.

Table 21: *Total potential BIR uptake (cumulative) across Flintshire*

Building	2015	2030
Heat (MW)		
Existing building (Table 19)	4.4	34.9
Future new building (Table 20)	-	12.1
Sub-total	**4.4**	**47.0**
Electricity (MW)		
Existing building (Table 19)	2.9	17.8
Future new building (Table 20)	-	28.4
Sub-total	**2.9**	**46.2**
Total	**7.3**	**93.2**

11. Summary of Potential Renewable Energy Solutions

The maximum potential renewable electrical and thermal installed capacity across Flintshire excluding that which is already installed, was calculated as circa 679.8MWe and circa 53.6MWt for 2030. These figures exclude the consideration of deliverability.

The total potential electrical capacity is dominated by potential building integrated renewable technologies (e.g. roof-mounted solar PV) with contributions from Biomass CHP, Anaerobic Digestion plants and hydro power sites.

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

The total potential thermal capacity across Flintshire in 2030 is dominated by building integrated renewables, primarily this will be biomass boilers and heat pumps for heating at circa 47.0MWt.

Table 22: *Potential renewable energy resource in Flintshire in 2022 and 2031*

Resource	2030	
	Electricity (MWe)	**Thermal (MWt)**
Biomass Energy Crop (CHP) (Table 8)	1.1	2.2
Biomass Boilers, Wood (Table 9)		4
Energy from Waste with CHP (Table 16)	-	-
Hydropower (Table 17)	0.03	-
Landfill Gas	-	-
Wind	-	-
Solar PV Farms	632.3	-
Other including food waste, animal slurry, poultry litter and sewage sludge. (AD with CHP) (Table 16)	0.2	0.4
Building Integrated (Table 21)	46.2	47.0
Total	**679.8**	**53.6**

12. 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 Flintshire 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 23.

Table 23: *Capacity factors for renewable and low and zero carbon technologies*

Technology	Capacity Factor[64]
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

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

12.1 Energy generated from existing renewable sources

The total electrical energy that is currently being generated across Flintshire (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 292GWhe.

This equates to circa 27% of the total electrical consumption across Flintshire in both 2008; and 2030.

Electricity generation from large scale solar PV accounts for circa 49GWhe, 4% of total electrical consumption across Flintshire in 2008; 5% of predicted electrical consumption across Flintshire in 2030.

The total thermal energy that is currently being generated across Flintshire from renewable and low and zero carbon energy technologies is circa 374GWht, which equates to circa 12% of the total thermal consumption across Flintshire in 2008 and 16% of the total predicted thermal consumption across Flintshire in 2030.

12.2 Energy generated from existing and potential renewable sources

The maximum potential electrical energy that could be generated across Flintshire from renewable and low and zero carbon energy technologies (including existing and potential) in 2030 circa 899GWhe. For 2030 this equates to circa 6% of the total electrical consumption across Wales in 2008.

The maximum potential thermal energy that could be generated across Flintshire from renewable and low and zero carbon energy technologies in 2030 circa 485GWht.

Table 24: *Existing and consented large scale renewable energy generated in Flintshire*

Technology	Electricity (MWh)	Thermal (MWh)
Wind Power	5,440	-
Biomass CHP	3,942	4,380
Biomass Boilers	-	97,236
Hydropower	16	-
Landfill Gas	9,986	16,644
Solar PV Farms	49,494	-
Other (Sewage Gas)	209,625	233,892
Total	**278,503**	**352,152**

Table 25: *Existing small-scale renewable energy generated in Flintshire*

Technology	Electricity (MWh)	Thermal (MWh)
Hydropower	-	-
CHP	-	-
Photovoltaic	16,632	-
Other	-	21,374
Wind Power	80	-
Total	**16,712**	**21,374**

Table 26: *Existing and potential renewable electricity generated in Flintshire in 2030*

Resource	2030	
	Electrical Capacity (MWe)	MWh generated
Wind	2.3	5,440
Biomass Energy Crop (CHP)	1.6	12,614
Energy from Waste with CHP	26.5	208,926
Hydropower	0.03	100
Landfill Gas	1.9	9,986
Solar PV Farms	688.8	603,345
Other including food waste, animal slurry, poultry litter, sewage sludge and sewage gas. (AD with CHP)	0.4	1,472
Building Integrated	65.3	57,183
Total	**786.8**	**899,066**

Table 27: *Existing and potential renewable heat generated in Flintshire in 2030*

Resource	2030	
	Thermal Capacity (MWt)	MWh generated
Biomass Energy Crop (CHP)	3.2	14,016
Biomass Boilers, wood	26.2	114,756
Energy from Waste with CHP	53.0	232,140
Other including food waste, animal slurry, poultry litter, sewage sludge and sewage gas. (AD with CHP)	0.8	3,416
Landfill Gas (with CHP)	3.8	16,644
Building Integrated	59.2	103,718
Total	**146.2**	**484,690**

12.3 Setting LPA wide renewable energy contributions

12.3.1 Summary

In accordance with the evidence, solar PV will be the primary strategy for delivering renewable energy generation in the Flintshire.

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

Flintshire also has limited potential to produce energy crop and although there is some potential for woody biomass the demand from existing biomass installations within Flintshire is significantly higher. This means that exploiting the woody biomass resource is likely to displace existing biomass supply chains rather than increasing the quantity of heat produced by biomass in Flintshire. This would however reduce the quantity of biomass imported into Flintshire reducing the carbon foot print of the supply chain.

12.3.2 Rationale for the setting of contributions

12.3.2.1 Electricity

The totals in Table 26 and Table 27 represent the theoretical maximum renewable energy resource that could be delivered by 2030, it may be that developers will not come forward to deliver or more detailed individual site studies will constrain the figures further.

Table 28 and Table 29 below detail the realistic renewable energy contributions that could be made towards meeting a proportion of the total demand for energy in Flintshire in 2030. The rationale is as follows:

- Whilst there is resource to supply biomass CHP there is insufficient heat demand in the county to justify the construction of new plant and ancillaries – hence the contribution for additional biomass CHP is set to zero;
- Flintshire has the EfW plant for the North Wales region and so the residual waste in Flintshire is already accounted for in the existing EfW generation. Therefore, there is no potential for additional EfW plant in Flintshire.
- The hydropower contribution is based on the (2010) Environment Agency report referring to win-win schemes in the county of Flintshire;
- 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 for this REA that there will be no restriction on solar PV development either from landscape assessment or accumulative impact and therefore the maximum potential identified in for the LSA's is included.
- It is assumed that the small number of non-solar PV 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;

12.3.2.2 Heat

- Whilst there is resource to supply biomass CHP there is insufficient heat demand in the county to justify the construction of the plant and ancillaries – hence the contribution is set to zero;
- It is assumed that reasonably sized biomass boilers (e.g. 100kW) are installed in one non-domestic building each year in Flintshire;
- Flintshire has the EfW plant for the North Wales region and so the residual waste in Flintshire is already accounted for in the existing EfW generation. Therefore, there is no potential for additional EfW plant in Flintshire.
- It is assumed that an Anaerobic Digestion plant will be constructed in the county utilising available animal slurry, with the heat usefully employed;

Table 28: *Resource summary table for renewable electricity in Flintshire in 2030.*

Energy Technology	Capacity Factor Assumed	Existing		Additional Potential 2030		Total Installed Capacity 2030 (MW)	Total Energy Generated 2030 (MWh)
		Installed Capacity (MW)	Energy Generated (MWh)	Installed Capacity (MW)	Energy Generated (MWh)		
Wind Power (existing includes SSAs)	0.27	2.3	5,440	-	-	2.3	5,440
Existing Biomass (CHP)	0.90	0.5	3,942	-	-	0.5	3,942
Energy from Waste with CHP	0.90	26.5	208,926	-	-	26.5	208,926
Hydropower	0.37	0.005	16	0.03	62	0.03	78
Landfill Gas	0.60	1.9	9,986	-	-	1.9	9,986
Solar PV Farms	0.10	56.5	49,494	632.3	553,851	688.8	603,345
Other including animal slurry, poultry litter and sewage gas. (AD with CHP)	0.42	0.2	699	0.2	662	0.4	1,361
BIR	0.10	19.1	16,712	46.2	40,471	65.3	57,183
Total	**-**	**107.0**	**295,215**	**678.7**	**595,046**	**785.7**	**890261.0**
Electrical energy demand 2008			1,100,419	**Projected electrical energy demand**			**1,094,375**
Percentage electricity demand met by renewable energy resource			27%				**81%**

Table 29: *Resource summary table for renewable heat in Flintshire in 2030*

Energy Technology	Capacity Factor Assumed	Existing		Additional Potential 2030		Total Installed Capacity 2030 (MW)	Total Energy Generated 2030 (MWh)
		Installed Capacity (MW)	Energy Generated (MWh)	Installed Capacity (MW)	Energy Generated (MWh)		
Existing Biomass (CHP)	0.5	1.0	4,380	-	-	1	4,380
Biomass Boilers, Wood	0.5	22.2	97,236	-	-	22.2	97,236
Energy from Waste with CHP	0.5	53.0	232,140	-	-	53.0	232,140
Other including animal slurry, poultry litter and sewage gas. (AD with CHP)	0.5	0.4	1,752	0.4	1,150	0.8	2,902
Landfill Gas (with CHP)	0.5	3.8	16,644	-	-	3.8	16,644
BIR	0.2	12.2	21,374	47.0	82,344	59.2	103,718
Total	**-**	**92.6**	**373,526**	**47.4**	**83,494**	**140.0**	**457,020**
Thermal energy demand 2008			3,200,023	**Projected electrical energy demand**			**2,339,654**
Percentage thermal demand met by renewable energy resource			12%				**20%**

Appendix A : Existing Low and Zero Carbon Energy Technologies

Technology	Site	Installed Capacity [MWe]	Installed Capacity [MWt]	Source
Hydro	Wepre Park, Connah's Quay	0.005	-	FCC
Wind	Kingspan, Greenfield	1.8	-	FCC
Solar PV	Shotwick Solar Park	50.0	-	OFGEM
Solar PV	Flint landfill Site, Castle Park, Flint	2	-	FCC
Solar PV	Holywell	0.4		OFGEM
Solar PV	New Energy Business Solar Deeside	3.1		OFGEM
Solar PV	Brookhill Landfill Solar	0.3		OFGEM
Solar PV	Flintshire (Standard)	0.6	-	OFGEM
Solar PV	Boys and Boden Chester	0.2	-	OFGEM
Anaerobic Digestor	Queensferry CHP A, C, D, E	0.2	0.4	OFGEM
Landfill Gas	Brookhill Landfill Generation Station	1	2	OFGEM
Landfill Gas	Standard CH5 2UA	0.9	1.8	OFGEM
EFW	Former Grasser Works, Factory Road, Sandycroft	0.5	1	FCC
EFW	Warwick International Ltd, Coast Road, Mostyn	7	14	FCC
EFW	ERF Deeside Industrial Park, Weighbridge Road, Sealand	19	38	FCC
Biomass CHP	Warwick International, Coast Rd, Mostyn	0.5	1	FCC
Biomass CHP	CHP Shordley Farm	0.1	0.2	OFGEM
Biomass	Former Grasser Works Factory, Factory Road, Sandycroft	-	0.5	OFGEM

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

Constraint	Source	Buffer	Reason
Special Protection Area (SPA) *Dee Estuary – asked Ecologist re species foraging buffer*	LIe	**Extent + 600m** disturbance buffer as confirmed by NRW	**Statutory constraint** SPA qualifying species are the various wading birds and in this case it is a "disturbance buffer" rather than an inflight buffer which is required.
Special Area of Conservation (SAC) *Dee Estuary / Halkyn Mountain / Alyn Valley Woods / Berwyn Mountains / Deeside & Buckley Newts*	LIe	Extent only (NB except Dee Estuary)	**Statutory constraint**
RAMSAR *Dee Estuary*	LIe	**Extent + 600m** disturbance buffer as confirmed by NRW	**Statutory constraint** SPA qualifying species are the various wading birds and in this case it is a "disturbance buffer" rather than an inflight buffer which is required.
SSSI	LIe	Extent only	**Statutory constraint**
AONB (Clwydian Range & Dee Valley)	Protected Landscapes / LIe	**Extent + 7km** (NB aligns with Toolkit and Wrexham REA)	**Protected Landscape / PPW** 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**
Registered Parks and Gardens	LIe	Extent only	**PPW**
Scheduled Monuments	LIe	Extent + 500m if residential Extent + turbine blade tip height & 10% if tourism asset Otherwise extent only	**Statutory constraint**
Listed Buildings	LIe	Extent only	**Statutory constraint**
Deep Peat	FCC	Extent only	**PPW**
CAA Airport Safeguarding Zone *e.g. Broughton*	CAA	Extent + 5 km	**UK Strategic Constraint**
MOD "red" and "amber" military low flying zones	DIO	Extent only	**UK Strategic Constraint**
NATS air traffic control safeguarded area inc	NATS	Extent only based on appropriate turbine height	**UK Strategic Constraint** 120m to blade tip

military aerodrome traffic zones			
Restricted Airspace	CAA	Extent only	**UK Strategic Constraint**
Aerodrome Locations	CAA	Extent + 5 km	**UK Strategic Constraint**
Infrastructure Topple distances (Trunk Roads, Primary "A" roads and Secondary "B" Roads, Railways)	OS Mastermap	Turbine blade tip height +10%	**Strategic Constraint / Toolkit**
Buildings	LLPG/ OS Address Base	**500m** buffer around all dwellings / settlement boundaries	**Toolkit** Turbine gearbox noise
Watercourses Lakes, canals, primary rivers, secondary rivers, minor rivers	OS Mastermap	Extent only	**Toolkit**
Ancient Woodland *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)**
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
National Parks	LIe	Extent + 7km buffer	**Protected Landscape /** PPW duty to have regard to purpose of protected landscape

MAP 4 – Local Constraints

Constraint	Source	Buffer	Reason
Local Nature Reserves	LIe	Extent only	
Country Parks *Waen y Llyn (Hope Mountain) / Moel Fammau / Loggerheads*	FCC	Extent only	**TAN5 Designated by LAs under Countryside Act 1968**
Regionally Important Geological Sites (RIGS)	FCC / LIe	Extent only	**PPW / TAN5 constraint**
Wildlife Sites (Non-Statutory Sites of	FCC	Extent only	**PPW / TAN5 constraint**

Importance for Nature Conservation)			
Registered Landscapes of Special Historic Interest (ASIDOHL)	CADW	Extent only	**PPW constraint**
Conservation Areas	LIe	Extent only (NB will only be within settlement boundaries)	**LPA designated under Civic Amenities Act 1967 & Planning (Listed Buildings and Conservation Areas) Act 1990**
Other woodlands	OS Open Map - Local	Extent only	
Existing consented / operational windfarms >5MW installed capacity	FCC and surrounding authorities	Extent + 7km buffer to align with Toolkit wrt to cumulative impact	Existing development

Appendix C : Biomass Energy Resource Methodology

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

Constraint	Source	Buffer	Reason
Special Protection Area (SPA) *Dee Estuary – asked Ecologist re species foraging buffer*	Lle	Extent Only (agreed with NRW)	**Statutory Constraint**
Special Area of Conservation (SAC) *Dee Estuary / Halkyn Mountain / Alyn Valley Woods / Berwyn Mountains / Deeside & Buckley Newts*	Lle	Extent only	**Statutory Constraint**
RAMSAR *Dee Estuary*	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 Flintshire. 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 Flintshire for 2025 and 2050.

The average of the Stats Wales data for the quantity of waste produced in Flintshire between 2012 and 2017 is then used to calculate an average annual reduction in waste production in Flintshire 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 8: *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 9: *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 30: *Project MSW and Industrial & Commercial Waste for Flintshire in Tonnes*

Year	Flintshire Total Waste		Flintshire Residual Waste	
	MSW	Industrial & Commercial	MSW	Industrial & Commercial
2012	58,798	8,446	17,639	2,534
2013	63,753	5,678	19,126	1,703
2014	61,752	3,441	18,526	1,032
2015	64,474	970	19,342	291
2016	67,026	2,362	20,108	709
2017	67,295	2,093	20,188	628
2018	63,850	2,228	19,155	668
2019	63,850	2,228	19,155	668
2020	63,850	2,228	19,155	668
2021	63,850	2,228	19,155	668
2022	63,850	2,228	19,155	668
2023	63,850	2,228	19,155	668
2024	63,850	2,228	19,155	668
2025	63,850	2,228	19,155	668
2026	61,296	2,139	18,389	642
2027	58,742	2,050	17,623	615
2028	56,188	1,960	16,856	588
2029	53,634	1,871	16,090	561
2030	51,080	1,782	15,324	535
2031	48,526	1,693	14,558	508
2032	45,972	1,604	13,792	481
2033	43,418	1,515	13,025	454
2034	40,864	1,426	12,259	428
2035	38,310	1,337	11,493	401
2036	35,756	1,248	10,727	374
2037	33,202	1,158	9,961	348
2038	30,648	1,069	9,194	321
2039	28,094	980	8,428	294
2040	25,540	891	7,662	267
2041	22,986	802	6,896	241
2042	20,432	713	6,130	214
2043	17,878	624	5,363	187
2044	15,324	535	4,597	160
2045	12,770	446	3,831	134
2046	10,216	356	3,065	107
2047	7,662	267	2,299	80

Year	Flintshire Total Waste		Flintshire Residual Waste	
	MSW	Industrial & Commercial	MSW	Industrial & Commercial
2048	5,108	178	1,532	53
2049	2,554	89	766	27
2050	1,788	62	0	0

Appendix E : Solar PV Farms

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

MAP 2 – Statutory and Strategic Constraints

Constraint	Source	Buffer	Reason
Special Protection Area (SPA) *Dee Estuary – asked Ecologist re species foraging buffer*	LIe	Extent Only (agreed with NRW)	**Statutory Constraint**
Special Area of Conservation (SAC) *Dee Estuary / Halkyn Mountain / Alyn Valley Woods / Berwyn Mountains / Deeside & Buckley Newts*	LIe	Extent only	**Statutory Constraint**
RAMSAR *Dee Estuary*	LIe	Extent only	**Statutory Constraint**
SSSI	LIe	Extent only	**Statutory Constraint**
AONB (Clwydian Range & Dee Valley)	Protected Landscapes / LIe	**Extent + 3.5km** (aligns with Wrexham & Powys REA)	**Protected Landscape / PPW duty to have regard to purpose of protected landscape**
National Parks	LIe	Extent + 3.5km (aligns with Wrexham & Powys REA)	**Protected Landscape / PPW duty to have regard to purpose of protected landscape**
National Nature Reserves	LIe	Extent only	**Statutory Constraint**
Registered Parks and Gardens	LIe	Extent only	**PPW**
Scheduled Monuments	LIe	Extent only	**Statutory Constraint**
Listed Buildings	CADW	Extent only	**Statutory Constraint**
Buildings	LLPG/ OS Address base	Extent only	
Settlements	FCC	Extent only	
Deep Peat	FCC	Extent only	**PPW**
CAA Airport Safeguarding Zone (Glint and glare) *e.g. Broughton*	CAA	Extent + 5km	**UK Strategic Constraint**
Aerodrome Locations (Glint and glare)	CAA	Extent + 5 km	**UK Strategic Constraint**
Infrastructure Glare and Glint distances (Trunk Roads, Primary “A” roads and Secondary “B” Roads, Railways)	OS Mastermap	Extent only	FCC discussion - Do not include
Watercourses	OS Mastermap	Extent only	**Toolkit**

Lakes, canals, primary rivers, secondary rivers, minor rivers			
Ancient Woodland *Rare habitat (PPW10)*	Lle	Extent only	**PPW**
Broadleaved Woodland	Lle	Extent only	**Toolkit**
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)**
SSA locations to avoid prejudicial conflicts with purpose of SSAs	WG	Extent + 3.5km	**TAN8**
C1 / C2 Flood Zone	Lle	Extent only	**PPW / TAN15 (vulnerable development)**

MAP 4 – Local Constraints

Constraint	Source	Buffer	Reason
Local Nature Reserves	Lle	Extent only	**PPW / TAN5 - Designated by LAs under the National Parks and Access to the Countryside Act 1949.**
Country Parks *Waen y Llyn (Hope Mountain) / Moel Fammau / Loggerheads*	FCC	Extent only	**TAN5 Designated by LAs under Countryside Act 1968**
Regionally Important Geological Sites (RIGS)	FCC / Lle	Extent only	**PPW / TAN5 constraint**
Wildlife Sites (Non- Statutory Sites of Importance for Nature Conservation)	FCC	Extent only	**PPW / TAN5 constraint**
Registered Landscapes of Special Historic Interest (ASIDOHL)	CADW	Extent only	**PPW constraint**
Conservation Areas	Lle	Extent only (NB will only be within settlement boundaries)	**LPA designated under Civic Amenities Act 1967 & Planning (Listed Buildings and Conservation Areas) Act 1990**
Other woodlands	OS Open Map - Local	Extent only	
Existing Consented / operational solar farms <0.5MW installed capacity	FCC and surrounding authorities	Extent	**FCC**
Existing Consented / operational solar farms >0.5MW installed capacity (1.2ha land area)	FCC and surrounding authorities	Extent +3.5km buffer	**Toolkit**

Appendix F : Building Integrated Renewable Energy Uptake Modelling

The building integrated renewable energy uptake is calculated using the 'Planning for Renewable and Low Carbon Energy – A Toolkit for Planners (2015)[65] toolkit's simplified method. The following are the work sheets produced using the simplified methodology.

Row No.	BIR Electricity		Units
1	**Existing dwellings and non-residential buildings**		
2	No. of existing dwellings in Pembrokeshire 2015	55,592.00	
3	No. of existing dwellings in Flintshire 2015	67,279.00	
4	Calculate EDR (divide row 3 by row 2)	1.21	
5	Predicted RE electricity capacity for Pembrokeshire by 2020	4.20	MWe
6	Predicted RE electricity capacity for Flintshire by 2020 (multiply row 5 by row 4)	5.08	
7	2015	2.88	
8	2030	17.77	
	Future dwellings		
9	No. of average net annual completions assumed for Pembrokeshire	585.00	
10	No. of average net annual completions planned for Flintshire	470.00	
11	Calculate NDR (divide row 10 by row 9)	0.80	
12	Predicted RE electricity capacity for Pembrokeshire by 2020	4.30	MWe
13	Predicted RE electricity capacity for Flintshire by 2020 (multiply row 11 by row 12)	3.46	
14	2030	10.37	
	Future non-residential buildings		
15	Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000.00	m² gross internal floor area
16	Future new non-residential average annual new plot area assumed for Flintshire by 2020	9.31	
17	Future new non-residential average annual new floor area assumed for Flintshire by 2020	31,658.53	
18	Calculate FNR (divide row 17 by 16)	0.57	
19	Predicted RE electrical capacity for Pembrokeshire by 2020	10.60	MWe
20	Predicted RE electrical capacity for Flintshire by 2020 (multiply row 18 by row 19)	5.99	
21	2030	17.98	
	TOTALS		
22	Total predicted new BIR RE electricity capacity for Flintshire by 2020 (sum of rows 6, 13, 20)	14.53	MWe
23	Total predicted new BIR RE electricity capacity for Flintshire by 2030 (extrapolate row 22 to 2030)	30.71	MWe
24	Existing BIR RE electricity capacity in Flintshire 2019	15.40	MWe
25	Total predicted new and existing BIR RE electricity capacity for Flintshire by 2030 (sum of rows 8, 14 and 21)	46.11	MWe

[65] http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/toolkitfor_planners/?lang=en

Row No.	BIR Heat		Units
1	**Existing dwellings and non-residential buildings**		
2	No. of existing dwellings in Pembrokeshire 2015	55,592.00	
3	No. of existing dwellings in Flintshire 2015	67,279.00	
4	Calculate EDR (divide row 3 by row 2)	1.21	
5	Predicted RE heat capacity for Pembrokeshire by 2020	9.90	MWt
6	Predicted RE heat capacity for Flintshire by 2020 (multiply row 5 by row 4)	11.98	
7	2015	4.41	
8	2030	34.91	
	Future dwellings		
9	No. of average net annual completions assumed for Pembrokeshire	585.00	
10	No. of average net annual completions planned for Flintshire	470.25	
11	Calculate NDR (divide row 10 by row 9)	0.80	
12	Predicted RE heat capacity for Pembrokeshire by 2020	4.30	MWt
13	Predicted RE heat capacity for Flintshire by 2020 (multiply row 11 by row 12)	3.49	
14	2030	10.37	
	Future non-residential buildings		
15	Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000.00	m^2 gross internal floor area
16	Future new non-residential average annual new plot area assumed for Flintshire by 2020	9.31	
17	Future new non-residential average annual new floor area assumed for Flintshire by 2020	25,326.83	
18	Calculate FNR (divide row 17 by 16)	0.45	
19	Predicted RE heat capacity for Pembrokeshire by 2020	1.23	MWt
20	Predicted RE heat capacity for Flintshire by 2020 (multiply row 18 by row 19)	0.56	
21	2030	1.67	
	TOTALS		
22	Total predicted new BIR RE heat capacity for Flintshire by 2020 (sum of rows 6, 13, 20)	15.99	MWt
23	**Total predicted new BIR RE heat capacity for Flintshire by 2030 (extrapolate row 22 to 2030)**	**34.75**	
24	Existing BIR RE heat capacity in Flintshire 2019	12.20	MWt
25	**Total predicted new and existing BIR RE electricity capacity for Flintshire by 2030 (sum of rows 8, 14 and 21)**	**46.95**	**MWt**