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LDP Renewable Energy Assessment

Report for

Pembrokeshire County Council

April 2017

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1. Study background and brief

Background to this Renewable Energy Assessment

The Welsh Government's Well-being of Future Generations (Wales) Act 2015 places a duty on public bodies to do things in pursuit of the economic, social, environmental and cultural well-being of Wales in a way that accords with the sustainable development principle. It requires sustainable development to be embedded in strategic decision making and risk assessment up to and beyond 2050.

Planning Policy Wales Edition 9 (2016) paragraph 12.8.9 states that local planning authorities should facilitate the development of all forms of renewable and low carbon energy to move towards a low carbon economy. Local planning authorities should consider the contribution their area can make and ensure development plan policies enable this contribution to be delivered.

The Welsh Government also states that it is imperative that the planning system identifies and protects areas with renewable energy generation potential for the long term, irrespective of any short term decisions on financial support and regulatory regimes which are being taken by the UK Government. Renewable Energy Assessments should inform policies, areas of search and allocations which guide local authority scale (5MW – 25MW) renewable energy schemes or other low carbon technologies to the most appropriate locations.

To assist in this process, the Welsh Government published a Renewable Energy Toolkit for Planners in 2010 to help local authority planning officers prepare a robust evidence base to underpin local development plan policies that can support and facilitate the deployment of renewable and low carbon energy systems. This was subsequently updated and published in 2015[1].

The Toolkit provides guidance on how the translations between evidence and policies should be achieved, and its use in the LDP process will be scrutinised by the Welsh Government when LDPs are passed to the Government for comment. The methodology provided by the Toolkit has been used to produce this Renewable Energy Assessment (REA).

Pembrokeshire context

Pembrokeshire County Council (PCC) adopted the Local Development Plan (LDP) for the County in February 2013. The LDP currently forms the development plan for the County (excluding the area contained within the Pembrokeshire Coast National Park) and is the basis for decisions on land use planning in this area. The Council published a Renewable Energy Assessment in December 2010 as its evidence base for the renewable energy related policies within the LDP.

As significant contextual changes have occurred in respect of renewable and low carbon energy policies since the adoption of the LDP, the Council has sought expert consultancy support to prepare a robust evidence base in the form of an updated REA to inform the review of the LDP (LDP2). It is anticipated that this will cover the period from 2018 to 2032 (subject to

[1] Planning for Renewable & Low carbon Energy – A Toolkit for Planners – Welsh Government Practice Guidance – September 2015

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confirmation). This REA is part-funded by Welsh Government Environment and Sustainable Development Revenue Grant Funding to Local Authorities, 2016-17.

➢ Wider policy context

In the Climate Change Act 2008, the UK Government set legally binding targets to reduce greenhouse gas emissions by at least 34% of 1990 levels by 2020 and at least 80% of 1990 levels by 2050. The UK also has a target to obtain 15% of its energy from renewable sources by 2020 under the Renewables Directive 2009. The Renewable Energy Roadmap, published in 2011, presents a framework and set of actions for the delivery of renewables against this target.

The Welsh Government set out its own approach to tackling the causes and effects of climate change in the Climate Change Strategy for Wales in October 2010. This Strategy and the associated Delivery Plans on Emission Reduction and Adaptation set ambitious targets to reduce greenhouse gas emissions in Wales by 3% every year and to achieve at least a 40% reduction on 1990 levels by 2020. The delivery plans include a specific action to ensure that land use and spatial planning consider future climate impacts and promote sustainable development and the transition towards a low carbon economy. The Government's commitment to cutting emissions has since been reinforced by the Environment (Wales) Act 2016, which places a duty on Welsh Ministers to ensure that net emissions are at least 80% lower than 1990 levels by 2050.

In terms of renewable and low carbon energy, the Welsh Government set out how Wales will move from fossil fuel based energy generation to a wider mix of energy sources in the policy Energy Wales: A Low Carbon Transition, published in March 2012. This policy presented the Welsh Government's ambition to take full advantage of the transition to a low carbon economy, with a focus on three key areas: (1) providing leadership to ensure Wales has a clear and consistent framework for investors, regulators and decision makers, and the infrastructure, coordination and stability required for business to flourish; (2) maximising economic benefits and job creation, while ensuring benefits to communities are sustained over the long term; and (3) securing Wales' long term energy future by supporting innovation, research, development and commercialisation in areas offering the greatest potential long term benefits for Wales.

➢ Purpose and approach

This REA provides a robust evidence base to inform the review of the LDP and presents the potential generation capacity for renewable and low carbon energy across the county.

Its purpose is threefold:

(1) To support officers in carrying out development management functions and in making decisions on planning applications. It does this by providing a resource to assist officers when discussing options for district heating and use of waste heat with developers making applications for new development sites; assessing the potential for applications for large scale new generation schemes to incorporate supply of heat to new or existing developments; and considering reasons behind locations chosen in applications for new wind or solar developments.

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(2) To inform the development of planning policies and land allocations within the LDP, and to provide an evidence base for renewable policy and other guidance within the LDP framework.

(3) To enable officers to proactively assess renewable and low carbon energy opportunities, supporting the Council to show community leadership and to set an example by facilitating the use and generation of renewable and low carbon energy.

The assessment is structured in terms of the four key evidence base options contained within the Renewable Energy Toolkit for Planners. Firstly, an area wide renewable energy assessment is presented in Section Three, which explores accessible renewable energy resources and the outputs of electricity or heat from different technologies used to utilise those resources. This is followed in Section Four by an assessment of the likely uptake in building integrated renewables. Section 5 maps opportunities for exploiting heat resource in the county. Section 6 provides a summary of potential energy generating contributions from the area wide energy assessment, and section 7 provides information and guidance on the role that Council could take in supporting community renewables within Pembrokeshire.

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2. Policy Context

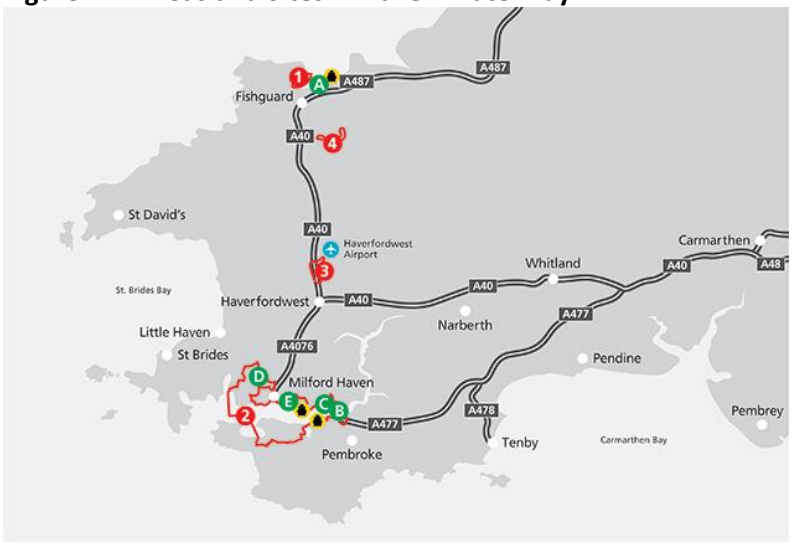
Pembrokeshire County Council (PCC) adopted the Local Development Plan (LDP) for the County in February 2013. The LDP currently forms the development plan for the County (excluding the area contained within the Pembrokeshire Coast National Park) and is the basis for decisions on land use planning in this area.

The current LDP has a general policy for guiding decisions on renewable energy, namely **Policy GN.4**: **'Resource Efficiency and Renewable and Low-carbon Energy Proposals'**. This states that development proposals "*which enable the supply of renewable energy through environmentally acceptable solutions will be supported".* Supporting paragraph 6.28 of the LDP states that Pembrokeshire has significant potential to provide further energy from all renewable sources, and that *"This policy aims to encourage further use of renewables to produce energy, which will help to meet Government targets for generating power from renewable sources".* In addition, paragraph 6.34 states that for major development sites, *"proposals will be expected to consider the potential for reuse of waste heat and power in, for example District Heating Networks".*

The LDP also contains a Strategic policy, Policy SP2 encouraging energy related development at the ports of Milford Haven and Fishguard. This covers both renewable, low carbon and non-renewable energy.

More recently, although not planning policy related, the Welsh Government has supported and funded the Haven Waterway Enterprise Zone, one of eight Zones in Wales. Building upon on the area's established energy industry base, the Zone supports new energy development as well as commercial enterprises such as food and tourism businesses with their supply chains; life sciences; ICT, and manufacturing firms. The Zone boundaries and sites are shown in Figure 2.1.

Figure 2.1: Areas and Sites in Haven Waterway



Source: https://businesswales.gov.wales/enterprisezones/zones/haven-waterway

Zone Boundaries

1. Goodwick
2. Haven Waterway
3. Haverfordwest Airport / Withybush Industrial Park
4. Trecwn

Other Strategic Sites

A. Fishguard Ferry Port
B. Milford Haven Port
C. Pembrokeshire Science and Technology Park
D. Priory Park Industrial Estate - Thornton
E. Waterston / Blackbridge

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As highlighted earlier in this report (page 3), the Council published a Renewable Energy Assessment in December 2010 as part of the evidence base for renewable policy and guidance within the current LDP framework. The document was informed by the Welsh Government funded, "Renewable Energy – Pembrokeshire Pilot Study" published earlier in July 2010.

More recently the Council has produced supporting documents as good practice guidance for the consideration of renewable energy developments within the county. In April 2013, in partnership with the Pembrokeshire Coast National Park Authority and Carmarthenshire County Council, the council published a consultancy assessment and guidance on the cumulative impact of wind turbines on landscape and visual amenity within the three local planning authority areas[2].

In 2016, the Council and the National Park Authority published the Solar Array Survey Report – September 2016. This provides information on the location and status of free-standing solar arrays in Pembrokeshire, enabling potential cumulative landscape impacts relating to new proposals to be assessed.

In October 2016 the Council published Supplementary Planning Guidance on renewable energy in Pembrokeshire for use alongside the adopted LDP. The purpose of the document is to elaborate on Plan policies seeking to balance the benefits that renewable energy development can have against the need to protect the natural and historic environment. It focusses primarily on solar, wind and biomass energy, but the principles and considerations are equally applicable to other renewable energy technologies. It provides an overview of permitted development rights for renewables; planning application considerations in terms of relevant planning policies and key documents; key information required from applicants including consideration of proximity to the Pembrokeshire Coast National Park. It includes guidance on assessing a proposal's impact upon landscape, including cumulative effects, and upon biodiversity, noise and other environmental considerations.

[2] Cumulative Impact of Wind Turbines on Landscape and Visual Amenity Guidance, White Consultants, April 2013

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3. Toolkit Task E1: Area wide renewable energy assessment

This section details the accessible renewable energy resources in the Pembrokeshire County Council area, the variation in technologies that may need to be employed to utilise these resources and the different outputs (electricity and/or heat) for each technology.

This section is laid out in accordance with the Welsh Government Toolkit methodology and includes:

- Existing energy and future energy baseline
- Existing and proposed LZC energy technologies
- Wind Energy Resource
- Biomass Energy Resource
- Energy from Waste
- Hydropower Energy Resource
- Solar PV Resource

3.1 Existing and future energy baseline

The basis of the analysis is DECC Updated Energy & Emissions Projections - November 2015 and BEIS Sub-national total final energy consumption in the United Kingdom (2005-2014).

The DECC Updated Energy and Emissions Projections November 2015 reports the past and future energy consumption across the UK for industry sectors. To report the data in line with the Toolkit the data below is reported in the three main energy sectors: electricity, heat and transport. It is not possible from the source data to split the proportion of heat and electricity that will be met by renewable energy sources so this is reported as a combined figure. The transport data does not include aviation fuel.

Table 3.1.1: Pembrokeshire - Total final energy consumption to 2032

	2016		2032	
	All Energy (Twh)	Renewable Energy (Twh)	All Energy (Twh)	Renewable Energy (Twh)
Electricity	314	46	361	79
Heat	639		589	
Transport	624	12	625	33
Total Final Energy Consumption	**1577**	**58**	**1575**	**112**

Table 3.1.1 above indicates that total final energy consumption will remain relatively static between 2016 and 2032 with only a 0.1% decrease. With electricity consumption increasing by 14.8%, heat consumption decreasing by 7.7% and transport increasing by 0.1%.

The total proportion of renewable energy generated by each key energy sector is anticipated to increase by a total of 92.5%, with electricity and heat increasing by a total of 70.8%, and renewable energy from transport increasing by 176.1%.

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Existing Energy Consumption

The BEIS Sub-national total final energy consumption in the United Kingdom (2005-2014) reports the total energy consumption across the UK, Wales and at a regional level.

Table 3.1.2 below shows that electricity demand in Pembrokeshire is lower than that for heat demand which is typical across the UK and Wales. Electricity demand in Pembrokeshire in 2014 formed 0.35% of electricity demand in the UK and 6% in Wales. Heat demand in Pembrokeshire formed 1.5% of heat demand in the UK and 20.5% in Wales.

Table 3.1.2: Annual energy demand (2014) for the UK, Wales and Pembrokeshire

	Total Energy 2014 (GWh)		
Sector	**UK**	**Wales**	**Pembrokeshire**
Electricity	295325	16826	1037
Heat	712170	51963	10682
Transport	439419	21942	804

Table 3.1.3 provides a breakdown of energy consumption for the UK, Wales and Pembrokeshire by sector in 2014. The highest consumption by sector in Pembrokeshire is for petroleum products used for industrial and commercial purposes within the county.

Table 3.1.3: Total energy consumption for UK, Wales and Pembrokeshire by sector in 2014

	Total Energy 2014 (GWh)		
Sector	**UK**	**Wales**	**Pembrokeshire**
Coal (Industrial/Commercial)	21624	1823	61
Coal (Domestic)	4811	621	30
Manufactured fuels (Industrial/Commercial)	43180	13536	2133
Manufactured fuels (Domestic)	2898	207	3
Petroleum products (Industrial/Commercial)	114059	10700	7607
Petroleum products (Domestic)	29942	2944	323
Petroleum Products (Road Transport)	431571	21572	793
Petroleum products (Rail)	7848	370	11
Natural gas (Industrial/Commercial)	187824	8280	138
Natural gas (Domestic)	307832	13851	387
Electricity (Industrial/Commercial)	186155	11644	797
Electricity (Domestic)	109170	5182	240
Renewables & Waste	36599	5279	198

Note: Natural gas (industrial/commercial) and natural gas (domestic) and electricity (Industrial/commercial) and electricity (domestic) figures are reported on a Great Britain level and no not include Northern Ireland.

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Table 3.1.4 below shows how energy demand is predicted to change in Pembrokeshire from 2014 to 2032. The demand for electricity is predicted to increase by almost 15% with heat demand reduced by almost 8%. As already highlighted earlier in relation to Table 3.1.1, over 70% of the electricity and heat predicted to be consumed in Pembrokeshire by 2032 is expected to be generated by renewable energy.

Table 3.1.4: An example of future energy demand for Pembrokeshire

	Pembrokeshire		
Sector	**Total Energy 2014 (GWh)**	**Predicted % change to 2032**	**Total Energy 2032 (GWh)**
Electricity	1037	14.8	1191
Heat	10682	-7.7	9860
Transport	804	0.1	805

3.2 Existing and proposed renewable energy technologies

To demonstrate the progress being made in renewable energy generation, and to establish a baseline of installed capacity to inform future potential and target setting, the capacity of Low and Zero Carbon [LZC] energy technologies already installed within the Pembrokeshire local planning authority area has been assessed.

Where LZC energy technologies already exist, the installed capacities [measured in MW] have been recorded and incorporated as a contribution to overall final targets. This assessment of existing capacity covers electricity and heat generation, from large scale down to 'Building Integrated Renewables' [BIR] micro generation scale. For larger schemes, it also includes those that have received planning consent, but are not yet built.

The information for existing larger scale projects has been derived from Pembrokeshire County Council, and Ofgem. Care has been taken to ensure double counting has not taken place, primarily through discussion with Pembrokeshire County Council officers. Where duplicates occurred, the data from Pembrokeshire County Council and then Ofgem was given preference over the other sources.

In addition, microgeneration data for Pembrokeshire was obtained from the most recent Feed-in-Tariff installation report[3]. This enabled calculation of the installed capacities of domestic microgeneration installations.

Existing renewable electricity capacity

The current total capacity (operational, under construction or consented) of large-scale and or stand-alone renewable energy technologies in Pembrokeshire is calculated as 269 MW of electrical power and 6.2 MW of heat energy. Compared to the respective capacities assessed in 2010 to be 5.24 MW of electrical power and 3.14 of renewable heat, there has been considerable increase in renewable electricity generating capacity within the county within the past seven years, and a more modest growth in renewable heat capacity. This growth is a result of government incentives since 2010 in the form of changes to Permitted Development rights and subsidies for renewables in the form of the Feed in Tariff (FIT)

[3] Source: OFGEM Feed in tariff installation report – 31st December 2016

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and Renewable Heat Incentive (RHI). More recently, the government has significantly reduced these financial incentives which have resulted in a dramatic reduction in the renewable energy installations.

Figure 3.1: Renewable energy capacity gaining planning permission (MW capacity)

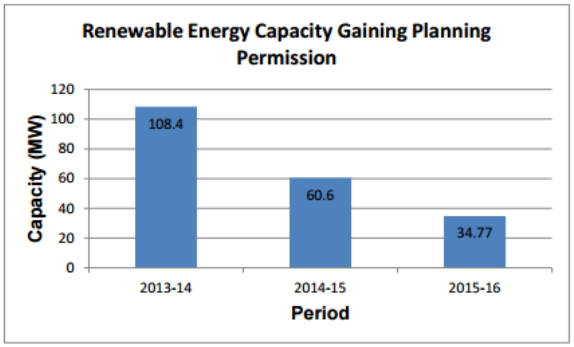
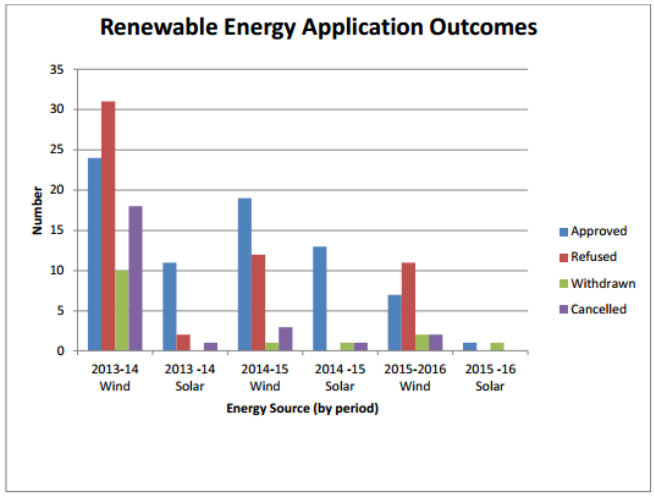


Figure 3.2 Renewable energy application outcomes



The Council's Annual Monitoring Report 2015/16 highlights this decline over the past three years at all scales of development shown in Figures 3.1 and 3.2. The current capacities for renewable electricity and heat are shown by technology type in Table 3.2.1 and Table 3.2.2 respectively.

Table 3.2.1: Existing Renewable electricity capacity

Technology	Capacity [MWe]
Landfill gas	1.4
Sewage gas	1.2
Anaerobic Digestion	2.2
Biomass	25
Hydro	1.08
PV > 1MW	203.79
PV < 1MW	1.181
Wind > 0.1MW	31.72
Wind <0.1MW	1.5018
Total	**268.9728**

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Solar PV is the largest generator (at 76 percent of the total), totalling almost 205MW. Wind energy is the second largest generator (12 percent) totalling 33.2MW. Biomass is the third largest generator (9 percent) produced by a new biomass power station at Trecwn, near Haverfordwest totalling 25MW.

Energy from waste accounts for almost 2 percent, totalling 4.7MW. The technology components of this are; landfill gas 1.4MW, sewage gas 1.2MW and anaerobic digestion 2.2MW. Micro hydro is the smallest contributor at 1.08MW.

Table 3.2.2: Existing Renewable heat generating capacity

Name of scheme	Technology	Capacity [MWt]
Trecwn, Haverfordwest	Biomass Power station	5
Pembrokeshire College	Biomass Boiler	0.35
Pembrokeshire Schools	Biomass Boiler	0.45
Crymych CP (Ysgol y Frenni)	Biomass Boiler	0.048
New Leisure Centre, Haverfordwest	Biomass Boiler	0.4
Total		**6.248**

Larger scale non-domestic biomass installations have increased slightly within the county. Most notable is the addition of the biomass power station at Trecwn with a heat generation capacity of 5MWt. This received planning permission in 2015 but has not yet been developed. A number of Council owned/run premises continue to use biomass boilers, although some have recently converted to gas or LPG for reasons of economy and/or practicality.

The locations of small, medium and large scale existing renewables in Pembrokeshire have been mapped for information on Map 3.2.1. Microgeneration installations are not included.

- **Building integrated renewables**

The availability of Government energy generation subsidies (Feed-in-Tariff and Renewable Heat Incentive) across the full spectrum of technologies enhanced their attractiveness as additional sources of income for both domestic and commercial properties. This, along with the expansion of Permitted Development Rights across the full range of renewable technologies, has significantly boosted the numbers of technologies installed in Pembrokeshire in recent years.

This is borne out by the findings from an analysis of the Feed-in Tariff Installation Report for Pembrokeshire by postcode and LSOA areas (excluding National Park installations). The analysis focussed on domestic installations, subtracting non-domestic installations to avoid double counting from the list of small to large existing/permitted renewables provided by the Council. The analysis reveals that since the introduction of the Feed-in-Tariff, microgeneration at the domestic level currently stands at just over 10MW of electricity. The majority is generated by PV installations across the county, focussed in the built up areas. Domestic wind energy generation accounts for almost 400KW, reflecting the decline in popularity of micro turbines as effective energy generators.

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Electricity generating renewable systems integrated into Council buildings has also been assessed and total 209KW for PV, and 6KW for wind. This raises the total for existing electricity generating building integrated renewables in the county to just over 10MW (10,215KW).

Information to assess the contribution from micro generating heat technologies is unavailable at a county level from the RHI register. Consequently is not possible to assess what the contribution of biomass microgeneration makes to overall heat generation in the county.

The domestic RHI scheme opened in 2014, initially to retrospective applications from owners of 'legacy' installations commissioned in the period 2011-2014. It then became open to new installations. This boosted sales of small domestic biomass installations, but this has now declined as a result of a reduced tariff for small biomass under 200kW, and the introduction of the mandatory Biomass Suppliers list requiring the use of quality standard wood based fuels.

The potential generation capacity of existing renewables in Pembrokeshire is shown in Table 3.2.3. The largest contributor to electrical energy generation by 2032 is biomass at 39.5% on the proviso that permitted biomass power station at Trecwn is built in 2017. The second largest contributor is solar farms at 36% followed by domestic PV at 18% and wind at almost 16%.

The significant current contribution from domestic PV suggests that if PV in the form of Building Integrated renewables in new developments or more domestic and commercial retrofitting continues, even at existing reasonably low rates, this could make a further significant contribution to renewable electricity generation in the county by 2032.

Table 3.2.3 Potential generating capacity of existing renewables to 2032

Technology	Capacity 2016/17 [MWe]	Capacity 2016/17 [MWt]	Potential generated by 2032 GWh(e)	Potential generated by 2032 GWh(t)
Landfill gas	1.4	n/a	117.2	
Sewage gas	1.2	n/a	70.6	
Anaerobic Digestion	2.2	n/a	277.5	
Biomass	25	n/a	3,153.6	
Hydro	1.08	n/a	56	
Solar farms	205	n/a	2,873	
Wind	33.2	n/a	1,256	
Building Integrated Renewables	10.2	Not avail	1,429	
Biomass (heat)	n/a	6.2 MWt	-	434.5
Totals	**279**	**6.2**	**7,976.9**	**434.5**

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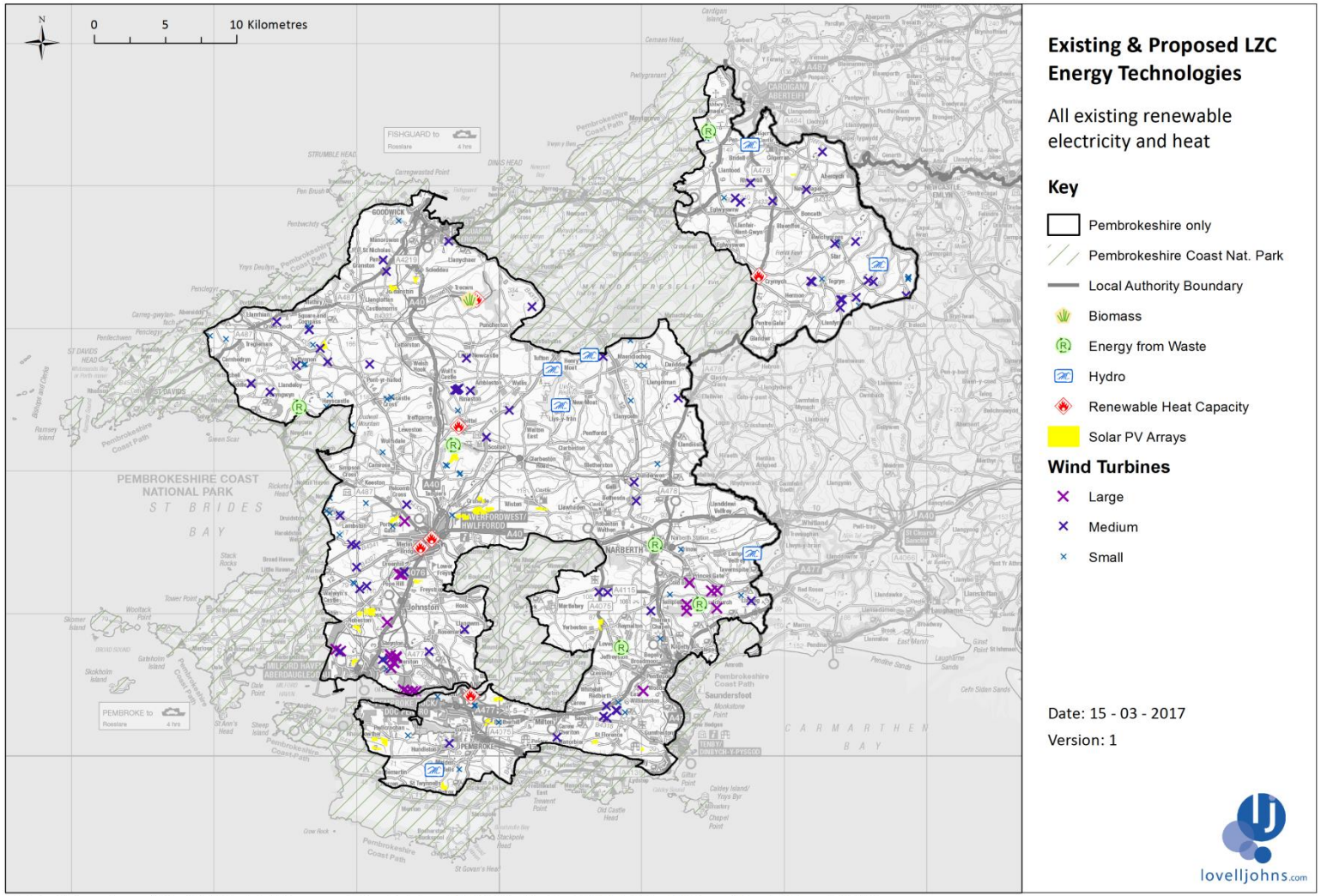
Map 3.2.1: Pembrokeshire - Existing and Proposed Renewable Installations (not including micro-generation)



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3.3 Wind energy resource

The focus of this section of the REA is on establishing the potential wind resource across Pembrokeshire. For the purposes of planning policy in Wales large scale wind power has been defined in TAN 8 as wind farms of > 25MW. TAN8 provides details of 'Strategic Search Areas', [SSA] sites identified as suitable and potential locations for large scale wind. There are no SSA identified in Pembrokeshire. Consequently assessment is concerned with identifying opportunities for wind development of between 5MW and 25MW.

➢ Mapping

Maps have been produced to illustrate at each stage of the process the application of the method to identify spatial constraints and opportunities. All of these are provided in Appendix 2, with selected maps highlighted in this section.

➢ Constraint to wind energy resource

To establish the potential wind energy resource across Pembrokeshire, consideration has been given to the spatial constraints associated with restrictions to wind energy development. This assessment used the following principal constraints to wind energy development outlined in the Toolkit to establish the maximum potential wind resource across Pembrokeshire.

- Special Protection Area (SPA)
- Special Area of Conservations (SAC)
- Candidate Special Area of Conservation (cSAC)
- RAMSAR sites
- National Nature Reserves (NNR)
- Site of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- Scheduled Ancient Monuments (SAM)
- Area of Outstanding Natural Beauty (AONB)
- Infrastructure – Topple distance plus 50m
- Other Infrastructure – Topple distance plus 10%
- Dwellings – Plus 500m (Noise Buffer)
- Watercourses
- Areas of historic and cultural importance

Pembrokeshire currently has

a) designated Special Areas of Conservation,
b) two proposed Harbour Porpoise SACs, which are being treated as implemented but are still awaiting European consent under the Habitats Directive,
c) a Special Protection Area (for seabirds) which is designated – dealing with the land area, and
d) a proposed Special Protection Area for seabirds which is being treated as implemented – dealing with marine areas off Pembrokeshire, which is still awaiting European consent under the Habitats Directive.

There used to be a Marine Nature Reserve, but this is now formally referred to as a Marine Conservation Zone. Finally, there are no AONBs, but there is a Heritage Coast designation.

➢ Additional constraints considered

- Historic Landscapes
- Woodlands
- Ancient Woodlands
- National Parks
- Restricted Airspace

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The purpose of this assessment was to establish the maximum potential wind energy resource across Pembrokeshire. The assessment was based on constraints associated with a typical 2 MW wind turbine. However, this assessment does not necessarily preclude the potential development/deployment of larger or smaller wind turbines across the county. The wind constraints maps illustrate the principal constraints to the development/deployment of wind energy.

Map 3.3.1 illustrates all the constraints to wind development except wind speed. These include environmental, heritage, transportation, air traffic control and radar interference constraints.

- **Sufficient wind speeds**

The performance of wind turbines is a function of wind speed. A 1.5km^2 grid GIS data layer has been established for the Pembrokeshire area and associated average annual wind speed at 45m above ground level (agl) has been attributed to reach respective 1.5km^2 cell. It has then been assumed that there is no wind potential in areas with an average annual wind speed of less than 6.0m/s. Map 3.3.2 has been produced to show areas of sufficient wind speed. One colour denotes areas that have sufficient wind speed but does not apply exclusion buffers around existing development and another with the buffer constraint applied.

- **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: sites unable to support 5MW of generation have been removed from the maps at this stage. Once the total area of unconstrained wind resource is established the total potential installed capacity can be calculated. Similarly, assuming that over the course of a year a 2 MW wind turbine will only generate energy for 27% of the time [2,365 hours], the total potential energy [GWh] can be calculated.

- **Impact on landscape character**

The impact on landscape character, although not considered a 'constraint' that would prevent the practical deployment of wind energy development, was recognised as a significant factor to be mindful of when reviewing opportunities for wind energy development across Pembrokeshire, particularly in relation to the potential for cumulative impact in relation to the high numbers of existing and committed small, medium and large wind turbines that have been permitted within the county in recent years, and the potential impact upon the Pembrokeshire Coast National Park.

- **Cumulative impacts**

It is recognised that only a minor proportion of the 'unconstrained' land identified will be able to be built out. This is because as wind farms are developed they effectively either prevent other sites situated close by from being developed or there is a need to avoid 'cumulative impacts'. A GIS exercise has been undertaken as part of this assessment to demonstrate how the consideration of cumulative impacts reduces the unconstrained or available land.

The Toolkit methodology provides guidance on how to conduct a high level assessment on large scale wind turbines for the purposes of informing an area wide target. The methodology (p136) states that an allowance hasn't been made in the toolkit for landscape sensitivity and that Local Authorities may wish to commission work to support their assessments if landscape is likely to be a key issue. It does however

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provide guidance for assessing cumulative impacts recommending a 7km separation distance (buffer) between potential (and existing) wind farm area. It states goes on to state that *"local authorities may wish to use different figures for this if this is informed by local assessments of landscape sensitivity to wind power".*

Pembrokeshire County Council, Pembrokeshire Coast National Park Authority and Carmarthenshire County Council jointly commissioned White Consultants[4] to provide guidance on the assessment of cumulative impact of wind turbines on landscape and visual amenity. This was published in April 2013 and supports the County Council's more recent SPG on Renewable Energy published in 2016.

The White Consultants report (page 26) outlines in Table 3 recommended areas for cumulative assessment search and study. It also recommends that for turbines larger than 109m height, the detailed study distance should be 10-15km, as opposed to 7km suggested in the toolkit.

In line with the advice of the White Consultant's report, the Council concluded that the nature of the topography of Pembrokeshire forming many of the county's areas of outstanding and high quality landscapes (designated in LANDMAP), coupled with the National Park designation with its long boundaries, suggest that the higher separation distance of 15km would be justified, based on local circumstances. A key consideration is that there are few locations in Pembrokeshire that are further than 15km from the Park boundary.

Furthermore, the Council recognises that there are high quality landscapes, albeit not with National Park designation, but in the neighbouring authorities of Ceredigion and Carmarthenshire, some of which have built turbines / turbine clusters close to the County boundary. The Council also considered that because of the proliferation of turbine installations in Pembrokeshire since the 2010 study the 15km buffer zone should be applied to these existing turbines (small to large) within and around the County area, and not just wind farms and significant wind turbine clusters.

Map 3.3.3 shows the effect of the application of the 15km buffer zone. It results in the exclusion of the whole of the study area for potential largescale wind turbines. It should be noted that applying a smaller 7km buffer, as recommended in the Toolkit also results in the exclusion of the whole of the study area.

As a result of this cumulative impact exercise it was not necessary to apply LANDMAP constraints as part of this assessment as there were no sites identified. **Consequently there is no renewable energy contribution from wind technology.**

It should be noted that this assessment is too high level for detailed conclusions to be drawn for future wind turbine applications in Pembrokeshire. Consequently, detailed assessments would need to be carried out for individual applications in terms of constraints, technical viability and landscape & cumulative impact as required by the Council's Renewable Energy SPG.

[4] Pembrokeshire and Carmarthenshire: Cumulative Impact of Wind Turbines on Landscape and Visual Amenity guidance – White Consultants April 2013

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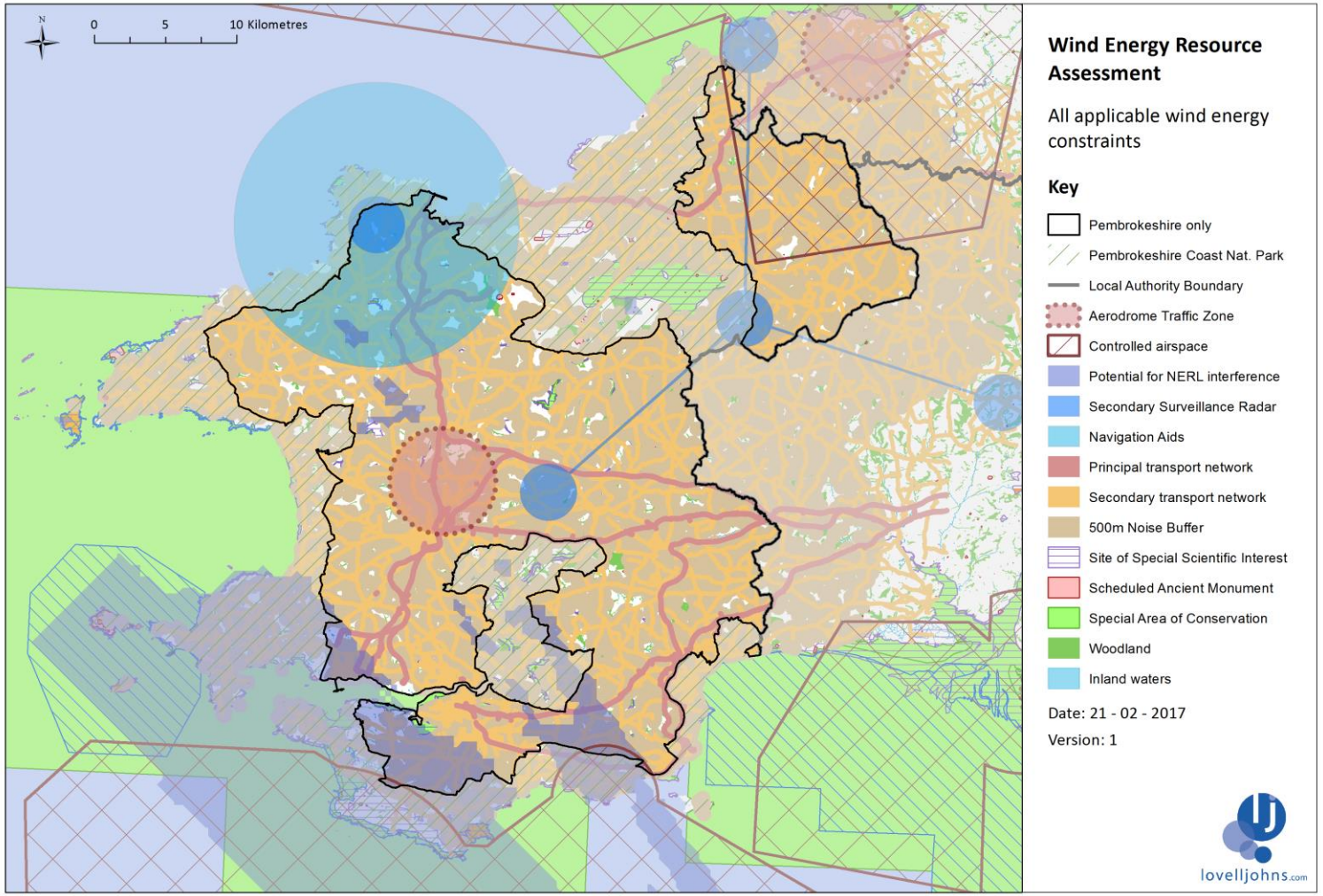
Map 3.3.1: Wind energy constraints



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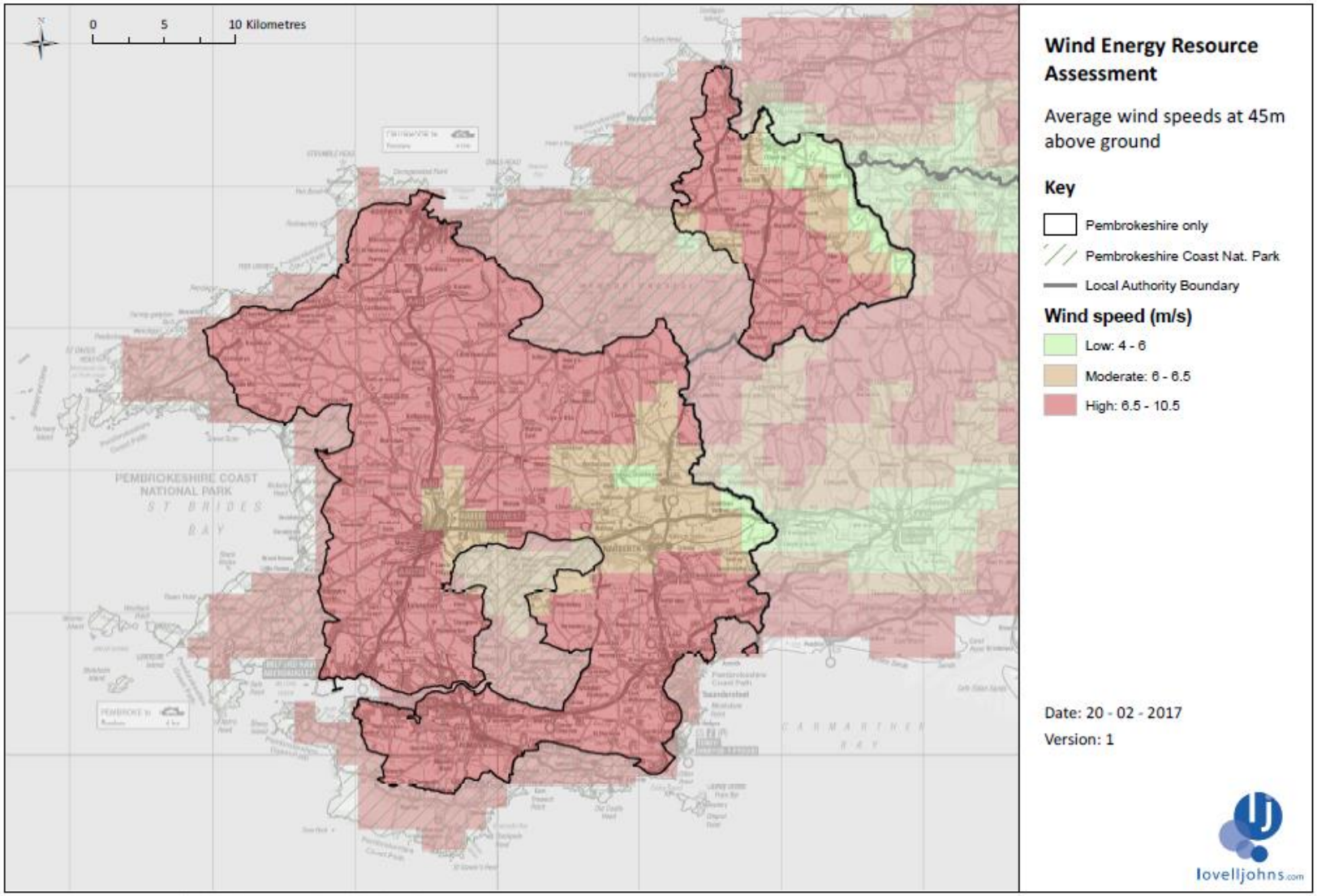
Map 3.3.2: Average wind speeds at 45m above ground



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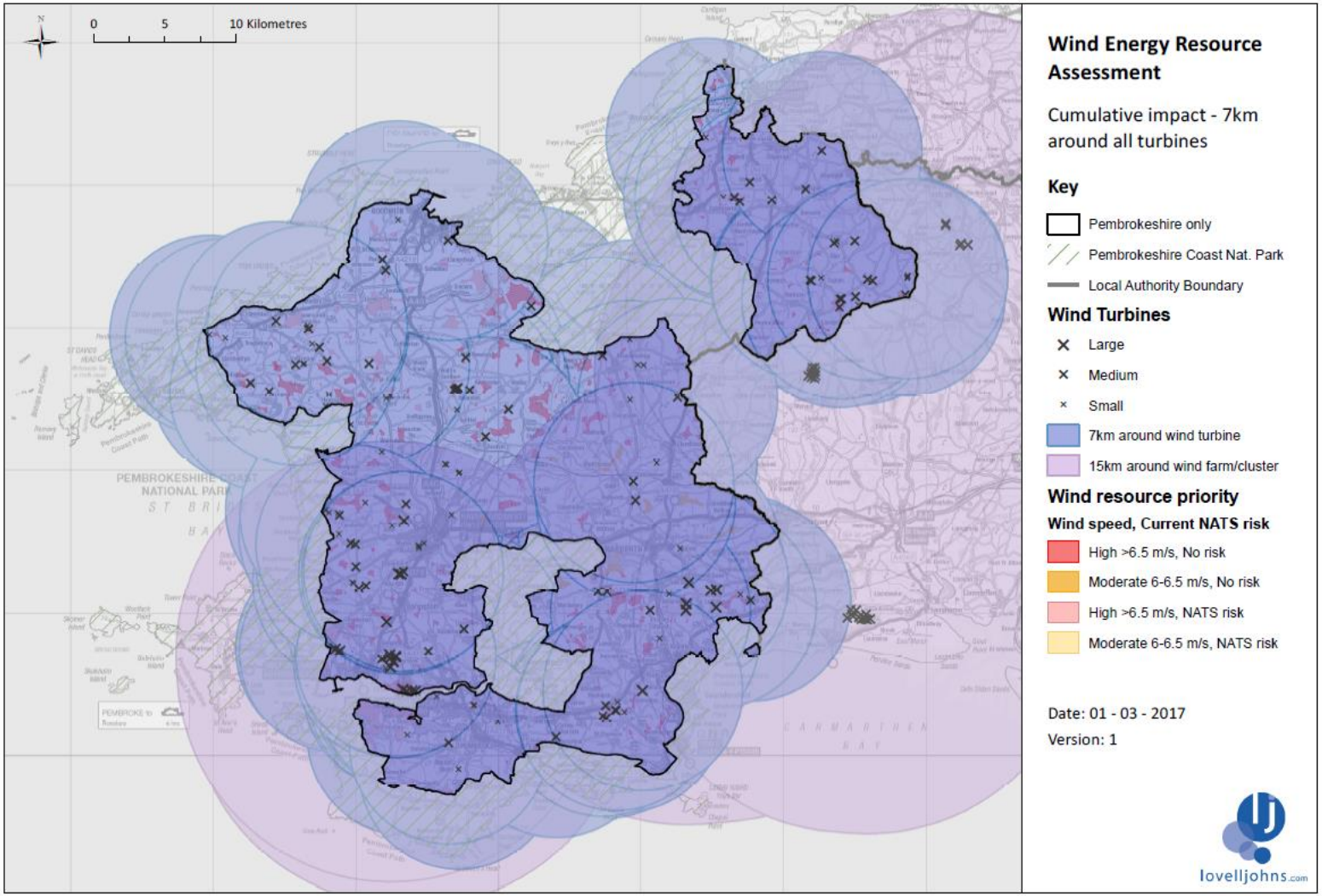
Map 3.3.3 Cumulative Impact of 15km and 7km buffer zones



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3.4 Biomass energy resource

Biomass can be used for the generation of both electricity and heat and domestic hot water. 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 bio-degradable elements from the waste stream
- CO_2 savings if replanting occurs and long distance transportation is avoided

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

The Welsh Government's Energy Policy Statement [2010] confirms a target of 1,000 MWe (1GWe) capacity from biomass by 2020. This is the equivalent of circa 7 TWh.

➢ Existing biomass installations

Section 3.2 described and quantified the existing and permitted biomass installations in Pembrokeshire for both electricity and heat generation. The most significant permitted facility is a biomass energy power station at Trecwn which has yet to be developed. This could generate 25MW of electricity and 5MW of heat. A larger, nationally significant application for a 49.9 MWe waste and biomass gasification plant in Milford Haven is currently being considered by the Welsh Government under the 'Developments of National Significance (DNS) process[5]. Pembrokeshire County Planning Authority is producing a local impact report as part of this process. Smaller building integrated biomass boilers are used in many of the Council's schools and leisure centres. The extent of other small pellet boilers and stoves in the county is unknown as data from OFGEM is not available at the county level.

➢ Energy Crops

The total area of available land for biomass has been calculated using Agricultural Land Classification, grades 2-4 (there is no land grade 1 in Pembrokeshire) and the National Forest Inventory. Conservation and heritage constraints have been applied. The theoretical maximum area of land that could be planted with energy crops (miscanthus and short-rotation coppice) is 81,977 Ha.

In reality only a proportion of the available land could be used for biomass due to competition with other factors, including

- Competition with food, other crops and livestock. Farmers may be able to get a higher return from growing other crop, in particular on land grades 1 to 3 and therefore would not choose to plant energy crops.
- Unsuitable topography, in terms of steep slopes, which would make harvesting of energy crops problematic.

In line with the Toolkit recommendations it is assumed that 10% of the suitable land area could be planted with energy crops.

[5] (Planning (Wales) Act 2015)

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Based on the above constraints the theoretical maximum area of land that could be planted with energy crops across Pembrokeshire is identified as 8,198 Ha.

- **Installed Power and Heat Generation Capacity**

The maximum potential energy crop resource for Pembrokeshire is shown in table 3.4.1.The yield has been calculated using the Toolkit figures.

Table 3.4.1: Total potential energy crop resource for Pembrokeshire

Outputs	Energy crops
Available Area (ha)	81,977
Percentage of area that can be used	10
Usable area (ha)	8,198
Yield (oven dry tonne per ha)	12
Yield (oven dry tonne)	98,372

The amount of energy generated from biomass depends on the facility in which it is used. Table 3.4.2 shows the potential installed capacity for each of the following; electricity, heat from Combined Heat and Power (CHP) and heat from boilers. The figures assume that 100% of the available resource is used in each case so the total capacities cannot be combined.

Table 3.4.2: Potential installed capacity using Pembrokeshire's potential energy crop resource as fuel for electricity, CHP and boilers.

Electricity	
Required oven dry tonne per 1MWe	6000
Installed Capacity (MWe)	16
Heat to power ratio	2:1
Installed capacity (MWt)	33
Heat from CHP	
Required oven dry tonne per 1MWt	3000
Installed capacity (MWt) from CHP	33
Heat from boilers	
Required oven dry tonne per 1MWt	660
Installed capacity (MWt) from boilers	149

The extent to which this theoretical potential could be realised is however less certain. In NEF's recent renewable energy assessment update report for the Pembrokeshire Coast National Park Authority in 2016, we sought the views of the Pembrokeshire Bio Energy cooperative on the future of energy crops and biomass. Comments then revealed that energy crops such as miscanthus and short rotation coppice had diminished significantly in recent years within Pembrokeshire.

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This has been due to a number of factors:

- Lack of start-up funding from the Welsh Government
- Better income from cereal crops
- Lack of a local largescale end user, (although this could potentially change with the development of the Trecwn biomass power station)
- Bulky and costly to transport

The future viability of energy crops depends on cereal and wood prices. As a crop with a long term growth cycle, it is a long term investment which currently is too vulnerable to short and medium price changes. In 2016 Pembrokeshire Bio Energy cooperative forecast that it would be unlikely to return as a potential alternative crop within the next 10 years, but if energy prices increase significantly (eg. with the advent of peak oil) it may become viable in the latter years of the LDP 2 plan period.

➢ **Wood fuel**

The total area of national forest across Pembrokeshire is 9,506Ha. This has been identified using the Woodland layer from a new and open mid-scale OS dataset (OpenMap Local), instead of the National Forest Inventory (NFI) dataset. The OS dataset was adopted as it appears to be more up-to-date, and it also contains small woodland areas, whereas the NFI only includes parcels down to a minimum size of 0.5 Ha.

The Toolkit recommends assuming a figure of 0.6 oven dried tonnes (odt) of available wood fuel per Ha of woodland per annum, based on figures from Bioenergy Action Plan for Wales. Therefore the total wood fuel yield from all woodland across Pembrokeshire is 5,703.6 odt per annum. This is the equivalent of 22 x 300kW wood chip boilers, which is an approximate size for a large new secondary school.

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 thinnings, 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.

Table 3.4.3: Total potential energy resource from wood fuel for Pembrokeshire

Outputs	Woodland
Available Area (ha)	9506
Percentage of area that can be used	n/a
Usable area (ha)	9506
Yield (oven dry tonne per ha)	0.6
Yield (oven dry tonne)	5703.6

This assessment does not consider other factors which would constrain the potential for growing energy crops. Such as; landowner keenness for growing energy crops, access to sites and suitable transport routes to plants.

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➢ **Potential generation from biomass**

Table 3.4.4 below outlines the potential generation form biomass within Pembrokeshire. As stated above in relation to energy crops, the amount of energy generated from biomass depends on the facility in which it is used. The energy crop figures assume that 100% of the available resource is used in each case so the total capacities cannot be combined.

Table 3.4.4 Potential generation from biomass

Fuel	Technology	Installed capacity	Annual GWh output	Potential energy generation by 2032
Energy crops	Electricity	16 MWe	126 GWhe	2,018 GWhe
Energy Crops	CHP (heat)	33 MWt	144 GWt	2,312 GWht
Energy Crops	Boilers (heat)	149 MWt	652 GWt	10,441 GWht
Woodfuel	Boilers	8.6 MWt	37 GWt	602 GWht

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3.5 Energy from Waste

In line with Technical Advice Note (TAN) 21: Waste (2014)[6], there is a requirement for each of the three regions in Wales (North, South East and South West) to prepare an annual waste planning monitoring report. Information on the waste situation in each region is required to monitor a region's waste arisings, recovery and disposal and in order to make forecasts of future arising's.

Information on the region's waste management / resource recovery facilities is required in order to monitor implementation of the National Waste Strategy for Wales – "Towards Zero Waste" (TZW, 2010) – both in terms of the facilities that are being planned for in local authority development plans and in terms of the facilities that are currently operating.

Towards Zero Waste (2010) requires:

"a reduction in waste arising's of around 1.5% (of the 2006-07 baseline) each year across all sectors, including household waste."

Wise About Waste (carried forward from TZW) established the following targets for the stabilisation and reduction of household waste:

- By 2009-10 (and to apply beyond) waste arising's per household should be no greater than those (for Wales) in 1997-98 (21kg)
- By 2020 waste arising's per person should be less than 300kg per annum

[6] Technical Advice Note (TAN) 21: Waste (2014)
http://gov.wales/topics/planning/policy/tans/tan21/?lang=en

➢ **Current Management of Local Authority Collected Waste (LACW)**

Target – Reuse, Recycling and Composting of LACW

- By 2009/10 achieve at least 40% of preparing for reuse and recycling/compositing (or Anaerobic Digestion, AD)
- By 2012/13 achieve at least 52% of preparing for reuse and recycling/compositing (or AD)
- By 2015/16 achieve at least 58% of preparing for reuse and recycling/compositing (or AD)
- By 2019/20 achieve at least 64% of preparing for reuse and recycling/compositing (or AD)
- By 2024/25 achieve at least 70% of preparing for reuse and recycling/compositing (or AD)

Total LACW arising's have, generally, been decreasing consistently over the period 2006 to 2014 in each of the six SW Wales authorities, including Pembrokeshire. For the region as a whole, the TZW target of reducing LACW by 1.5% each year since the 2006/2007 baseline has been met. The exception to this can be seen in a slight rise in risings from the period 2012/13 to 2013/14. This is likely due to the change in definition of Municipal Solid Waste (MSW) from April 2012 to include more types of waste, and consequently has resulted in an increase in waste tonnage figures. Pembrokeshire had the highest rate for reuse, recycling and composting in 2014/15 in SW Wales at 65.4% - well ahead of the TZW target for 2019/20 of 64%.

The potential installed capacity figures for electricity and heat generated from the different waste streams have been derived using the methodology as defined in the document Welsh Government (2015) Practice Guidance, Planning for Renewable and Low Carbon Energy – A

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Toolkit for Planners, Project Sheet D: Energy from Waste (EfW), MSW and Project Sheet E: Anaerobic Digestion (AD).

- **Energy from Waste (EfW), Municipal Solid Waste (MSW), Municipal Solid Waste - Arising's**

Table 3.5.1 shows the actual and predicted municipal solid waste arising's for Pembrokeshire from 2010 to 2020.

Pembrokeshire over the decade from 68,907 tonnes in 2010 to a predicted 74,664 tonnes in 2020.

As outlined in Practice Guidance (2015), based on the proposed targets set out in Wales Waste Strategy, *"Towards Zero Waste, One Wales: One Planet, A Waste Strategy for Wales",* June 2010, it has been assumed that 30% of the total MSW in Wales would be available for energy recovery. Applying this 30% recovery figure for Pembrokeshire would result in potential installed energy capacity for electricity or heat of just over 0.7MW. If this was to be 100% energy recovery this would still only generate a little over 2MW which is too small to be financially viable to set up a specialised EfW plant in the county for this purpose.

The need for economies of scale for waste disposal and the requirement for re-direction of waste from landfill resulted in Pembrokeshire County Council (PCC) and Ceredigion County Council (CCC) entering into a residual waste treatment contract in 2013. This provides an export-based solution which will run for 10 years (and could be extended thereafter). Material is shipped to Sweden via Pembroke Dockyard. It is used in an EfW facility.

Table 3.5.1: Pembrokeshire – Actual and predicted waste arising's

Year	Actual / Prediction	Tonne(s) / year	Waste Wales Strategy - Assumption 30%, Tonne(s) / year	Potential Installed capacity - electricity (MWe)	Potential Installed capacity – heat (MWt)
2010	Actual	68,907	20,672	0.70	0.70
2011	Actual	65,308	19,592	0.66	0.66
2012	Actual	64,516	19,355	0.66	0.66
2013	Actual	67,729	20,319	0.69	0.69
2014	Actual	68,074	20,422	0.69	0.69
2015	Actual	69,804	20,941	0.71	0.71
2016	Prediction	71,040	21,312	0.72	0.72
2017	Prediction	71,750	21,525	0.73	0.73
2018	Prediction	72,468	21,740	0.74	0.74
2019	Prediction	73,193	21,957	0.75	0.75
2020	Prediction	74,664	22,399	0.76	0.76

Data source: PCC

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The figures show a gradual increase in the level of MSW arising's in Pembrokeshire still has an operational landfill site at Withyhedge near Haverfordwest, however it is now used for the disposal of materials that cannot be recycled, composted or reused. In the past it was used for the disposal of household and municipal waste, consequently the site produces methane gas from the decomposition of the waste. This gas is extracted and burnt currently generating 1.4MW of electricity to the grid. The site is included within the list of existing energy from waste sites in the county and shown on Map 3.2.1.

The long-term residual waste contract for the export of MSW from Pembrokeshire ensures that all of the county's MSW is used for energy recovery in an EfW facility. However, the energy generated is not local but in Sweden, so it cannot, therefore, contribute to the County's EfW energy generation capacity for this study.

➢ Energy from Waste (EfW), Natural Resources Wales (NRW) Commercial & Industrial (C&I) Waste

Whilst there is no continued annual survey of Commercial & Industrial (C&I) waste, Welsh Government (WG) requires surveys to be done on a five yearly basis. NRW C&I data is collected on a five year basis, with the last dataset available being for 2012.

Data was collected from 1,540 business sites of differing sectors and sizes throughout Wales between July 2013 and December 2013. The data was grossed up using population data to regional and national level in Wales, Office for National Statistics (ONS) data showed that there were 85,695 industrial and commercial business units in Wales in 2012 with 7% in industrial sectors and 93% in commerce. The methodology used in the survey was comparable with the previous Industrial and Commercial surveys completed in Wales, of which the most recent provided data for the 2007 calendar year.

Analysis of 2012 data showed:

- Welsh industrial and commercial sectors generated an estimated 3.7 million tonnes of waste split 55%:45% between industrial and commercial businesses. The precision for the total waste generated was ±7.9% at 90% confidence.
- An estimated 278 thousand tonnes of industrial waste and 474 thousand tonnes of commercial waste were generated in South West Wales.

When compared to the results of the 2007 waste generation survey:

- There was no statistically significant difference in the quantity of industrial waste generated in Wales.
- There was no statistically significant difference in the quantity of commercial waste generated in Wales.
- There was no statistically significant difference in the preparation for re-use, recycling and composting rate for industrial waste; the rate was 59% in 2007 and 50% in 2012.
- There was a statically significant difference in the preparation for re-use, recycling and composting rate for commercial waste; the rate was 37% in 2007 and 68% in 2012.

➢ Hazardous Waste

Hazardous wastes are those types of waste that are especially harmful to human health or the environment either immediately or over an extended period of time. Hazardous waste is stringently controlled, and the consignee (the producer), the carrier and the consignor (the recipient) all have responsibilities in respect of reporting the production, movement and treatment/disposal of hazardous wastes.

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An estimated 239 thousand tonnes of hazardous waste was generated by industry and commerce in 2012; this equates to 7% of the total waste generation of 3.6 million tonnes. The estimated split was 159 thousand tonnes industrial waste (67%) and 80 thousand tonnes commercial waste (33%).

The data above is sourced from the following documents:

Welsh Government (2012) Natural Resources Wales - Survey of C&I Waste Generated in Wales 2012 (Page 8, including Incineration with energy recovery and Composting with AD)

SW Wales Region (2016, Page 21, Figure 13) Waste Planning Monitoring Report, Hazardous waste Arising's by European Waste Catalogue (EWC) chapter for SW Wales (2007-2013), in tonnes.

Table 3.5.2 below shows the actual and predicted waste arising's for Pembrokeshire from 2010 to 2020. It shows over the period that there are slight increases and decreases in arising's, but no overall increase in levels by 2020.

Again, as outlined in Practice Guidance (2015), based on the proposed targets set out in Wales Waste Strategy, *"Towards Zero Waste, One Wales: One Planet, A Waste Strategy for Wales",* June 2010, it has been assumed that 30% of the total hazardous waste in Wales would be available for energy recovery.

Table 3.5.2 shows what 30% energy recovery from Pembrokeshire hazardous could mean in terms of potential capacity for either electricity or heat energy recovery. However, the current direction of Pembrokeshire's hazardous waste is, along with SW Wales hazardous waste, mainly recovered, with none incinerated with energy recovery.

Table 3.5.2: Pembrokeshire Actual and predicted hazardous waste

Year	Actual / Prediction	Tonne(s) / year	Waste Wales Strategy - Assumption 30%	Potential capacity electricity (MWe)	Potential capacity heat (MWt)
2010	Actual	35,517	10,655	0.36	0.36
2011	Actual	35,152	10,545	0.36	0.36
2012	Actual	28,166	8,449	0.29	0.29
2013	Actual	38,919	11,675	0.40	0.40
2014	Prediction	33,543	10,063	0.34	0.34
2015	Prediction	36,231	10,869	0.37	0.37
2016	Prediction	34,887	10,466	0.35	0.35
2017	Prediction	35,559	10,668	0.36	0.36
2018	Prediction	35,223	10,567	0.36	0.36
2019	Prediction	35,391	10,617	0.36	0.36
2020	Prediction	35,307	10,592	0.36	0.36

Data source: Actual data from Environment Agency (EA) Hazardous Waste Interrogators & NRW. Predicted data based on rolling average of preceding two years (to 2020)

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➢ **NRW Permitted Site Waste**

Table 3.5.3: SW Wales Actual and predicted inert waste

Year	Actual / Prediction	Total Tonne(s) / year	Potential Installed capacity - electricity (MWe)	Potential Installed capacity – heat (MWt)
Amalgam of 2012 / 2013 / 2014	Actual[7]	57,000	0.58	0.58
2015	Prediction	57,000	0.58	0.58
2016	Prediction	57,000	0.58	0.58
2017	Prediction	57,000	0.58	0.58
2018	Prediction	57,000	0.58	0.58
2019	Prediction	57,000	0.58	0.58
2020	Prediction	57,000	0.58	0.58

Source: SW Wales (actual 2013(14)) LACW & 2012 C&I & C&D); Inert Wastes C&D – EfW based on Inert Waste (EfW, LACW + C&I + C&D)

[7] Actual data: 57,000 Tonnes comprising LACW 44,000 Tonnes + Commercial 5,000 Tonnes + Industrial 7,000 Tonnes + C&D 1,000 Tonnes, South West Wales Region (2016, Page 21, Figure 13) Interim Monitoring Report, Amounts of HIC and inert wastes C&D, Energy Recovery

Table 3.5.3 above shows the actual and predicted levels of inert waste generated for the SW Wales region. Data could not be disaggregated for Pembrokeshire. The figures show a constant level of 57,000 tonnes of inert waste generated each year up to 2020. The potential installed capacity for energy generation, either electricity or heat is very small at 0.58MW, and is for the SW Wales region as a whole. It can therefore be assumed that Pembrokeshire's inert waste component would be too small to be viable for separate energy recovery within the county.

➢ **Anaerobic Digestion**

- Animal Manure (cattle and pigs)
- Poultry Litter
- Food waste
- Sewage sludge

➢ **Animal Manure**

Nationally, the past five years have seen a growth in the AD sector, primarily due to changing economics, and the introduction of government incentives in the form of the Feed in Tariff (FiT) and the Renewable Heat Incentive (RHI). These incentives have provided a guaranteed price for for small scale AD facilities with less than 5MW capacity for a fixed period of twenty years.

The growth in this sector has been reflected within Pembrokeshire as an area renowned for livestock and dairy farming. There are currently four AD facilities within Pembrokeshire that have received planning permission totalling 2.2MW of electricity generated. One at Langdon Mill near Begelly is currently under construction, with a generating capacity of 1MWe. Three more farm AD schemes have been permitted but not yet constructed totalling 1.2MWe.

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There is also an AD and composting facility operated at Crugmore Farm, Nant-y-Caws, run by Penparc[8] near Cardigan Ceredigion. This processes up to 20,000 tonnes of agricultural slurry and category 3 food waste, sourced within the local area including Pembrokeshire. The AD facility was commissioned in spring 2016 and can produce up to 1MW of power and will be capable of producing high grade organic fertiliser.

Cattle @ 6 tonnes sewage sludge / head: **PEMBROKESHIRE**

Cattle farming in Pembrokeshire is predominantly based around milk production and meat production; "dairy" and "beef". Farms with cattle tend to specialise in either meat or milk production. Dairy production is closely linked with the availability of good grazing land; which is reflective of the number of cattle in the Pembrokeshire area.

Welsh Government (2015, Page 25) Welsh Agricultural Statistics, Statistics for Wales, http://gov.wales/statistics-and-research/welsh-agricultural-statistics/?lang=en and Welsh Government (2014, Page 25) Welsh Agricultural Statistics, Statistics for Wales, http://gov.wales/statistics-and-research/welsh-agricultural-statistics/?tab=previous&lang=en

Table 3.5.4: Cattle: Pembrokeshire

Year	Actual / Prediction	Cattle (thousands)	Slurry @ 6 tonnes /head (000s)	Wet tonnes (000s)	Potential Installed capacity - electricity (MWe)	Potential Installed capacity – heat (MWt)	*HEAT ONLY Installed capacity – heat (MWt)*
2014	Actual	184.4	1106.4	276.6	1.23	1.84	*5.89*
2015	Actual	187.2	1123.2	280.6	1.25	1.87	*5.97*

[8] MD Recycling http://www.mdrecycling.co.uk/digestable-bio-waste

It is interesting to note that the potential installed capacity for electricity generation from cattle slurry through the process of AD for 2014 and 2015 is calculated to be around 1.25MW per annum. This is much less than the potential installed capacity of 2.2MWe for the four AD schemes in the county recently permitted. It is therefore not possible to forecast whether further capacity exists in the future to 2032.

Pigs @ 0.6 tonnes / head: **ALL WALES**

The number of pigs in Wales has declined greatly in recent years. As recently as the late 1990s, there were over 100,000 pigs in Wales, over the past decade the number of pigs has fluctuated at a level between 20,000 and 30,000. It has been assumed that the level of pigs will remain at this level. Data at regional and local level is unknown. The table below shows the total number of pigs throughout Wales. The final column (HO) is for Heat Only.

Table 3.5.5: Wales – Number of pigs

Year	Actual / Prediction	Pigs	Slurry @ 0.6 tonnes / head	Wet tonnes / year	Potential Installed capacity - electricity (MWe)	Potential Installed capacity – heat (MWt)	*HO Potential Installed capacity (MWt)*
2010	Actual	26,974	16,184	4046	0.02	0.03	*0.09*
2011	Actual	25,809	15,485	3871	0.02	0.03	*0.08*
2012	Actual	28,665	17,199	4300	0.02	0.03	*0.09*
2013	Actual	24,890	14,934	3734	0.02	0.03	*0.08*
2014	Actual	28,370	17,022	4256	0.02	0.03	*0.09*
2015	Actual	25,295	15,177	3794	0.02	0.03	*0.08*

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Source: WG (2015, Page 35) Welsh Agricultural Statistics, Statistics for Wales, http://gov.wales/statistics-and-research/welsh-agricultural-statistics/?lang=en

It is anticipated that there will be no energy generation capacity from the use of pig manure in Pembrokeshire .

- **Poultry Litter**

Poultry: **ALL WALES**

The largest number of poultry in Wales is chickens raised for meat production. There are also significant numbers of chickens of egg production. The poultry sector is a sector that is skewed with less than 100 producers accounting for over 90 per cent of poultry in Wales. The number of birds is dominated by a small number of producers with over 10,000 birds. However, there are many farms that have very small numbers of poultry for non-commercial purposes.

WG (2015, Page 37) Welsh Agricultural Statistics, Statistics for Wales, http://gov.wales/statistics-and-research/welsh-agricultural-statistics/?lang=en

Table 3.5.6: Poultry – All Wales

Year	Actual / Prediction	Poultry (numbers)	Slurry (available)	Tonnes / year	Potential installed capacity - electricity (MWe)
2014	Actual	8,997,200	8997	283,412	25.76
2015	Actual	7,844,922	7845	247,115	22.47

Table 3.5.7 below shows that there were 144,000 poultry farmed in Pembrokeshire in 2015. This is approximately 2% of the total farmed in Wales. The potential installed capacity for energy from the estimated level of waste produced is very small at 410KW. The waste is likely to be used for a more viable use such as fertilizer production.

Table 3.5.7: Poultry: PEMBROKESHIRE

Year	Actual / Prediction	Poultry (numbers)	Slurry (available)	Tonnes / year	Potential installed capacity - electricity (MWe)
2015	Actual	144,000	144	4536	0.41

- **Food Waste - Anaerobic Digestion**

Pembrokeshire County Council is part of a regional hub comprising three local authorities, including Ceredigion and Powys. The hub dispose of food waste via an AD contract with Agrivert Limited, who process the material at their Parc Stormy facility in Bridgend, which became operational in October 2016.

The Parc Stormy AD plant was designed and built by Agrivert, operating on long and medium term municipal contracts. It also processes spot market commercial food wastes (solid and liquid), which include packaged goods. The facility processes over 50,000 tonnes of solid and liquid wastes a year, generating 3MW of electricity and producing bio-fertiliser.

Both facilities are approved to process category 3 animal by-products and a wide-variety of food wastes including:

- Production wastes from the manufacture of food and beverages; both solids and liquids
- Packaged food waste such as surplus, spoiled or off-specification, out of date products, stock clearances, factory breakdowns or quality control failed products
- Food collected on trade waste collection rounds
- Restaurant and catering wastes
- Bakery and bread products
- Domestic, kerbside collected food waste
- Liquids and very wet wastes such as compost leachate, alcohols, fats and oils.

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Table 3.5.8: Pembrokeshire – Actual and projected food waste

Year	Actual / Prediction	Tonne(s) Produced/year	Tonne(s) Collected/year	Projected Installed capacity - electricity (MWe)	Projected Installed capacity – heat (MWt)
2015	Actual	9346	4882	0.24	0.37
2016	Prediction	9365	4901	0.25	0.37
2017	Prediction	9365	4901	0.25	0.37
2018	Prediction	9365	6017	0.30	0.45
2019	Prediction	9365	6352	0.32	0.48
2020	Prediction	9365	7105	0.36	0.53

Data source: PCC

In view of the Council's on-going contract, the study will not include the projected installed capacity from using food waste towards the County's future renewable energy generating capacity.

- **Sewage sludge**

In 2013 the SW Wales region had a resident population of 904,616 which represented 29.3% of the population of Wales (2013 Mid-year estimate, StatsWales). The population has been gradually rising since 2001 when the census showed it to be 848,328 (2001 Census, ONS).

Table 3.5.9 shows the population of Pembrokeshire in 2015 to be 123,500, with an annual growth of between 300 and 600 per annum (i.e., 500 used for prediction). The projected installed capacity from sewage sludge is estimated to be 0.32 per annum. Currently the Narberth sewage treatment works uses sewage gas to run a 1.1MWe combined heat and power plant. Other smaller treatment works within the county also operate microscale energy generating plants. As the existing energy generation capacity already exceeds the projected capacity, the study will not include these figures to avoid double counting.

Table 3.5.9: Pembrokeshire – Actual and projected sewage sludge

Year	Actual / Prediction	Population	Sewage Sludge Tonne(s)/year	Projected Installed capacity - electricity (MWe)	Projected Installed capacity – heat (MWt)
2010	Actual	122,000	4,076	0.31	0.47
2011	Actual	122,600	4,096	0.32	0.47
2012	Actual	123,000	4,109	0.32	0.47
2013	Actual	123,300	4,119	0.32	0.48
2014	Actual	123,700	4,132	0.32	0.48
2015	Actual	123,500	4,126	0.32	0.48
2016	Prediction	124,000	4143	0.32	0.48
2017	Prediction	124,500	4159	0.32	0.48
2018	Prediction	125,000	4176	0.32	0.48
2019	Prediction	125,500	4193	0.32	0.48
2020	Prediction	126,000	4210	0.32	0.49

PCC (2016), Data and Statistics about Pembrokeshire, http://www.pembrokeshire.gov.uk/content.asp?nav=101,649

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3.6 Hydropower energy resource

Existing hydro power installations across Pembrokeshire currently have a combined total installed electrical capacity of 1.08 MWe.

The 2010 Pembrokeshire Renewable Energy Study identified one existing hydropower installation in the county at Y Gaer. Since then, a further six micro hydro schemes have been developed within the county (Table 3.6.1 below) and Map 3.2.1 (Existing renewables). These are either operational or approved for future development with installed capacity unknown.

Table 3.6.1: Existing hydro schemes

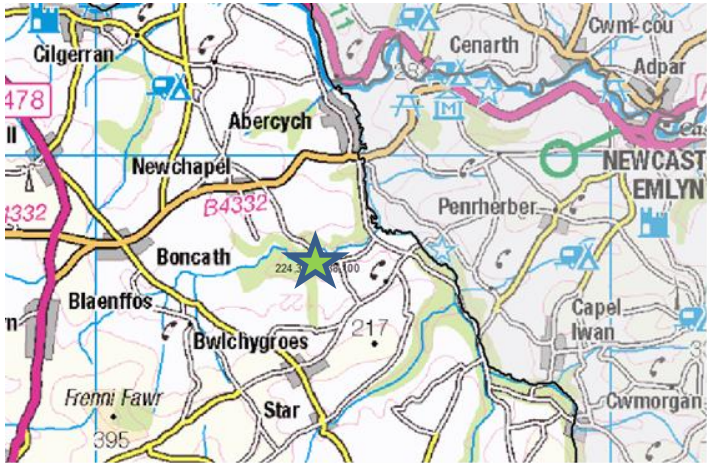
Hydro	Current installed capacity	Status	Source
Preseli Hydro	0.7	Operational	Ofgem
Y Gaer	0.1	Operational	British Hydropower
Rhyddgoed	0.02	Approved	PCC
Orielton Mill	Not avail	Approved	PCC
Llys Y Fran reservoir	0.25	Approved	PCC
Tirbach	0.01	Approved	PCC
Drysgolgoch	Not avail	Approved	PCC
Total	**1.08**		

➢ Additional resource assessment studies

The toolkit seeks to facilitate an assessment of the accessible resource of large (circa10MW) and small scale (circa hundreds of kilowatts) hydro sites and potential micro-hydro schemes, through the identification of existing feasibility studies.

It recommends use of the British Hydropower Association 'England and Wales Hydropower Resource Assessment in 2010' to quantify potential hydropower opportunities, and to consult with Natural Resource Wales to find out if any site or area-specific feasibility studies have been carried out.

Analysis of the British Hydropower study has found that it identifies one potential micro hydro site within Pembrokeshire. This is located on the River Dulas near the settlement of Penrhiw within one kilometre of the county boundary with Carmarthenshire.



It is identified as having a potential installed capacity of 28kw and an annual energy yield of 108 MW. The study considered that such a scheme

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would be undertaken by a private developer. As yet this scheme has not yet been developed.

In addition, consultation with Natural Resources Wales confirmed that there are no known sites or area-specific feasibility studies being carried out within the county.

- **Potential generation from existing hydro schemes by 2032**

The contribution from hydropower in the county is outlined in Table 3.6.2 below.

Table 3.6.2: Potential generation from hydro schemes

	Installed capacity (MW)	Annual GWh output per unit	Potential annual electricity generation by 2032
Existing	1.08	3500	56,000 GWh
Potential	0.028	90.7	1451 GWh
Total	**1.1**	**3590.7**	**57,451 GWh**

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3.7 Solar PV resource

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

➢ Background: Solar Photovoltaic Arrays

Photovoltaic (PV) solar cells / panels generate renewable electricity from the direct conversion of solar irradiation. It 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 2015 there were 48,850 solar PV sites in Wales with a combined capacity of 626.4MW[9i]. This represents 98% of all renewable installations and 27% of all installed renewable energy capacity across Wales.

For the purposes of the Feed in Tariff Ofgem PV installations fall into one of two categories, "stand-alone" or "standard". A solar PV installation with a total installed capacity of greater than 250kW will be classed as stand-alone if it is not wired to provide electricity to a building or is wired to provide electricity to one or more buildings and:

A. the maximum amount of electricity that the site can consume is less than 10% of the Declared Net Capacity (DNC) of the installation or
B. the maximum amount of electricity that can be imported from the network via the import connection(s) of the site is less than 10% of the DNC of the installation.

A solar PV installation with a total installed capacity of less than 250kW will also be defined as stand-alone if it is not wired to provide electricity to a building.[10]

➢ Mapping

The Practice Guidance – Planning for Renewable and Low Carbon Energy – A Tool Kit for Planners[11] sets out guidance to local authorities on Assessing Solar Photovoltaic (PV) Farm Resource on Project Sheet K. .In this renewable energy assessment we have used GIS constraints mapping to facilitate a visual representation of 'usable' land resource for large-scale 'stand-alone' PV developments within Pembrokeshire County Council, excluding the Pembrokeshire Coast National Park.

The methodology adopted is in accordance with the six step approach set out in Sheet K:

- Step 1: Map locations of built-up areas and infrastructure
- Step 2: Map further environmental and heritage constraints
- Step 3: Map areas of suitable slope and topology
- Step 4: Addressing cumulative impact
- Step 5: Assess potential installed capacity and energy output

[9] Source: Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2015 at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/556271/Renewable_electricity.pdf

[10] Source: Feed-in Tariff: Guidance for Renewable Installations (Version 10.2) Published 20 June 2016 at https://www.ofgem.gov.uk/system/files/docs/2016/06/feed-in_tariff_guidance_for_renewable_installations_v10.2.pdf

[11] Planning for Renewable and Low Carbon Energy - A Toolkit for Planners Published September 2015 at http://gov.wales/topics/planning/policy/guidanceandleaflets/toolkit-for-planners/?lang=en

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- Step 6: Map locations of suitable Agricultural Land Classification and apply further constraints as necessary

Reduced sized copies of all GIS maps are reproduced here for reference purpose only. Full scale versions of all maps can be found at Appendix 2

➢ *Step 1 Map locations of built-up areas and infrastructure*

Existing settlements and infrastructure (such as roads and railways) are a constraint on the development of stand-alone solar PV farms. These features have therefore been mapped and excluded as being unsuitable for this type of development.

Not mapped, although still a consideration, is the proximity of any proposed stand-alone site to the nearest suitable grid connection. The proximity of a suitable connection could have a significant impact on cost and financial viability of any proposed project. Negotiations between the proposed developer and the District Network Operator on this subject will be needed on a site by site basis.

Map 3.7.1 shows the built up areas and other infrastructure within Pembrokeshire County Council. It also maps existing functional sites where stand-alone PV already exists.

➢ *Step 2 Map Environmental, heritage and other physical constraints*

Map 3.7.2 shows the further environmental and heritage constraints for Pembrokeshire with Map 3.7.3 highlighting other physical constraints of woodlands and flood risk areas. These include the same constraints as listed in Section 3.3 on Wind.

➢ *Step 3: Map areas of suitable slope and topology*

The performance of a solar PV farm is directly related to the orientation, angle and shading of the panels. On flat sites, it will be possible to place the panels so that they are orientated in the most advantageous way. On more sloping sites, the orientation will be fixed by the typography of the site and will be shaded by surrounding slopes.

The information contained within the Terrain 50 dataset, available from Ordnance Survey has been used to establish slope orientation in this assessment. In accordance with the guidance set out in Project Sheet K all orientations of inclinations of 0-3 degrees from horizontal have been considered suitable, whilst for inclinations between 3-15 degrees only 3-15 degrees have been included. All slope inclinations above 15 degrees have been considered a constraint.

Map 3.7.4 shows suitable slope orientations for PV in Pembrokeshire.

➢ *Step 4: Addressing the cumulative impact*

The main cumulative impact affecting the deployment of stand-alone solar PV within Pembrokeshire is the proximity of the Pembrokeshire Coast National Park where the County Council requested a 1km exclusion zone be applied along the boundary with the National Park. The presence of existing solar PV farms within this exclusion zone can be noted.

Map 3.7.5 shows the borders shared with the Pembrokeshire Coast National Park with a 1km exclusion zone along the adjoining boundaries. The map does not show the cumulative impact of stand-alone Solar PV as no fixed distance between stand-sites is proposed: rather each application should be considered on its merits.

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Step 5: Assess potential installed capacity and energy output

According to the DECC UK Solar PV Strategy Part 1: Roadmap to a Brighter Future: www.gov.uk/government/uploads/system/uploads/attachment_data/file/249277/UK_Solar_PV_Strategy_Part_1_Roadmap_to_a_Brighter_Future_08.10.pdf

"the land area required for a 1MW fixed-tilt PV array is approximately 6 acres (or 2.4Ha or 0.024km2)". This figure has therefore been used to determine the potential installed capacity within Pembrokeshire.

The recommendation that a cut off equivalent to 0.5MW (i.e. 3 acres, 1.2Ha or 0.012km2) be applied, as any sites smaller than this are less likely to be viable (commercially speaking) for development has also been followed.

Map 3.7.6 shows all unconstrained land parcels over 1.2 Ha.

Step 6 Map Locations of suitable Agricultural Land Classification and apply further constraints as necessary

Large-scale solar PV farms must be appropriately sited; this means utilising lower grade agricultural land (preferably of Agricultural Land Classification 3b, 4 or 5), or promoting the effective use of contaminated land, brownfield land, and previously developed/industrial land under national planning policy recommendations.

The aim of this guidance is to ensure protection of the best and most versatile agricultural land; however it is understood diversification helps to support agriculturally based businesses, promoting multi-functional use of land in some cases. Map 3.7.7 shows the suitable land parcels for solar farms on agricultural land quality of grade 5 or lower.

Step 7: Map landscape constraints as necessary

The Council's Supplementary Planning Guidance for renewable energy states in chapter three, ' Planning Application Considerations' that the county's LANDMAP dataset should be used in appraising landscape impact for all renewable technologies. Giving all five layers consideration ensures no aspect of the landscape is overlooked. Further on in Appendix 1 – 'Solar Energy' the guidance states in paragraph iv. "Large scale solar farms require extensive areas of land and can have major landscape impacts".

As a consequence officers have recommended the study to apply the Pembrokeshire LANDMAP Outstanding and High quality areas for each Aspect area, excepting geology, as a further layer of constraint. This leaves 22 unconstrained land parcels (clustered in to 7 areas) totalling 187 hectares shown on Map 3.7.8.

Using the Toolkit guidance (Step 5) to determine the potential installed capacity, each land parcel over 1.2ha is divided by 2.4ha (the land required for a 1MW fixed-tilt PV array) generating a potential installed capacity for solar PV farms on the land areas identified. We have used the seven cluster areas to calculate the potential installed capacity from solar farms as shown in Table 3.7.1 below.

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Table 3.7.1: Potential generation from solar farms

Potential solar PV Farm Cluster	Installed capacity (MWe)	Annual GWhe output per unit	Potential annual electricity generation by 2032 (GWhe)
1) 89.9	37.4	32.7	524.1
2) 29.68	12.3	10.7	172.3
3) 15.89	6.6	5.7	92.4
4) 15.89	6.6	5.7	92.4
5) 21.97	9.1	7.9	127.5
6) 6.77	2.8	2.4	39.2
7) 7.21	3.0	2.6	42
Total	**77.8**	**67.7**	**1,089.9**

The figure of a potential generation of 1,089.9 Gwh of electricity from solar farms in the county is, as described in Section 3.3 in regard to Wind, a theoretical and high level assessment figure. Consequently, detailed conclusions cannot be drawn from this study for future solar farm locations and applications in Pembrokeshire. Detailed assessments would need to be carried out for individual applications in terms of constraints, technical viability and landscape & cumulative impact as required by the Council's Renewable Energy SPG.

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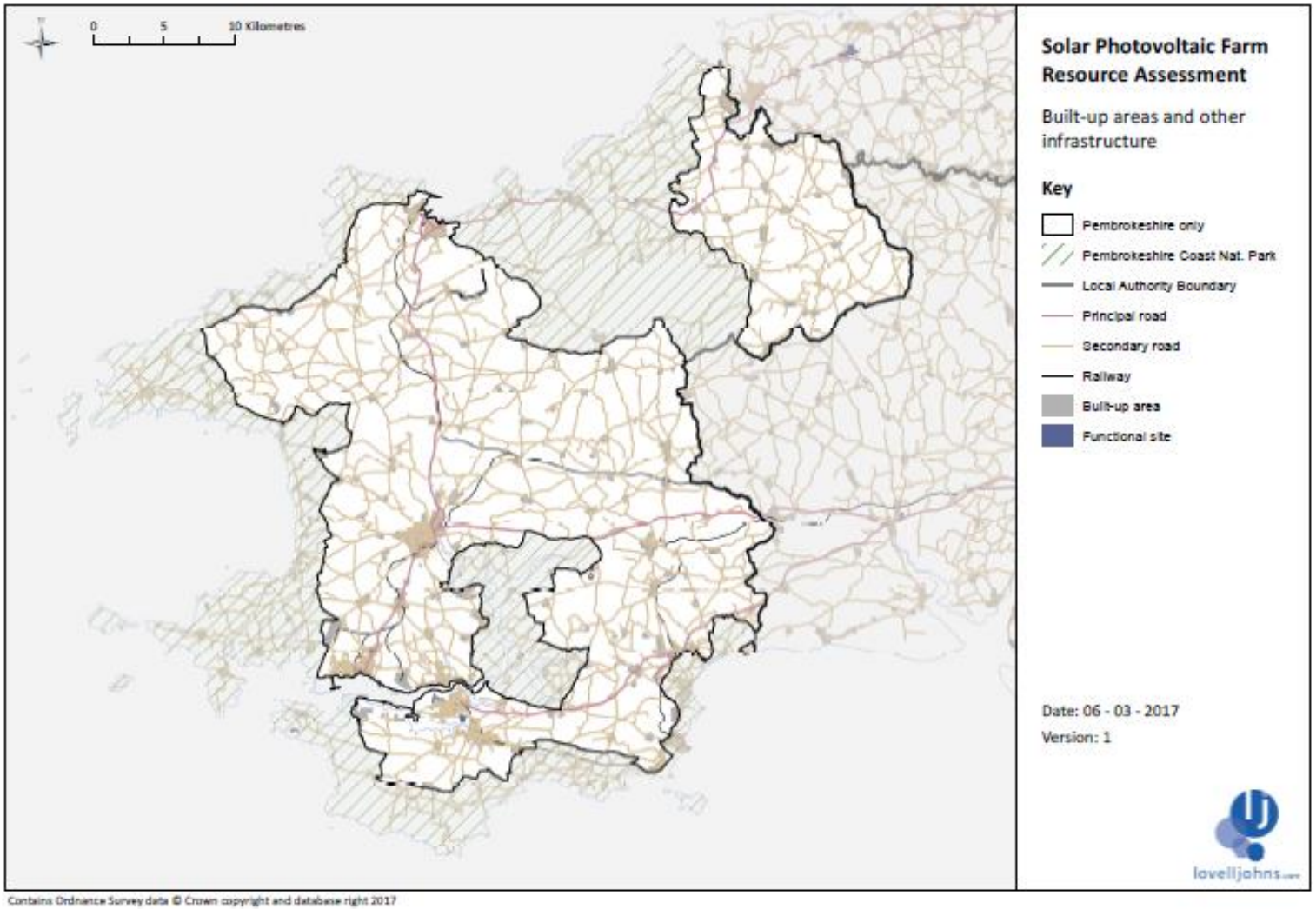
Map 3.7.1 Solar PV – Built up areas and other infrastructure



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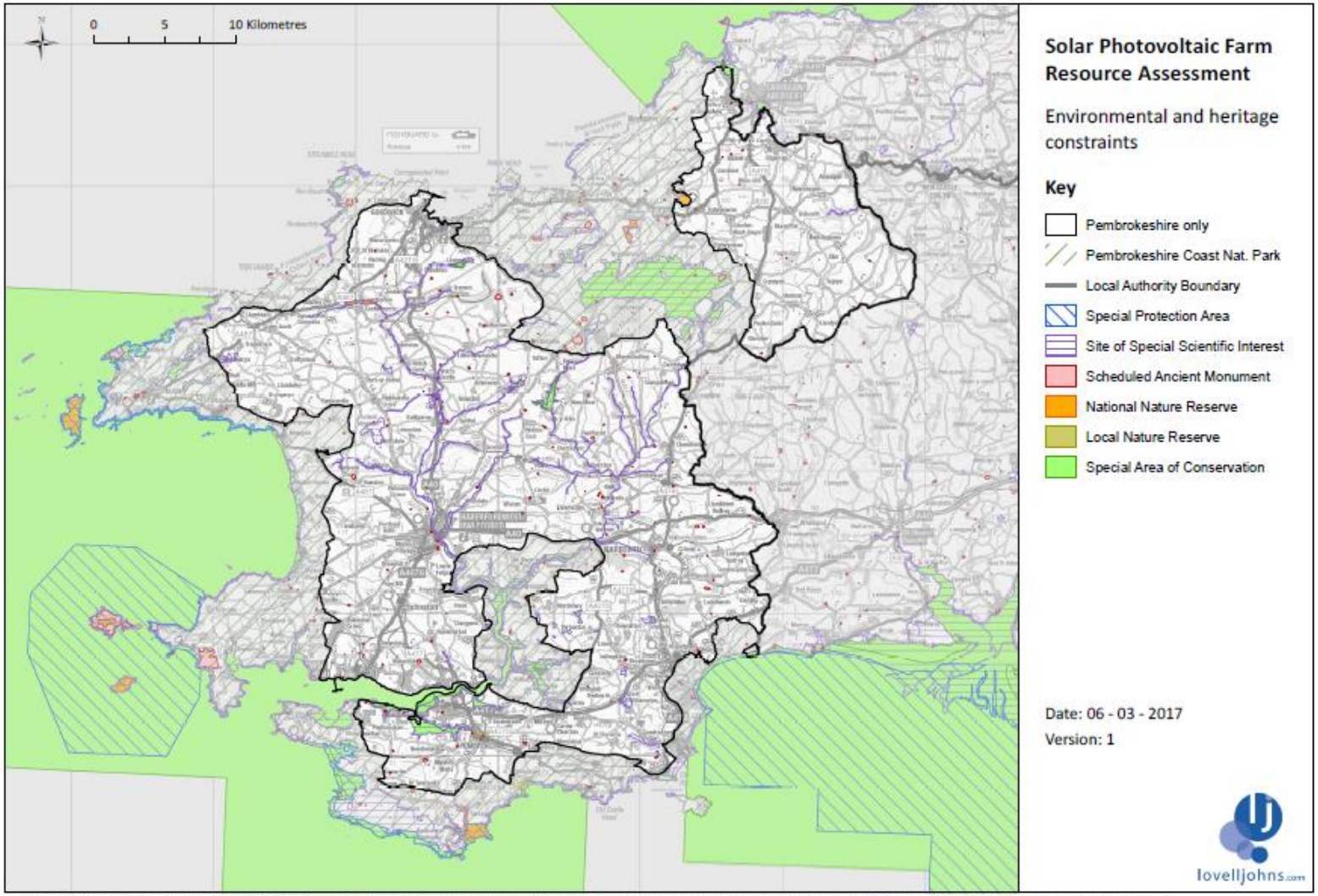
Map 3.7.2: Solar PV further environmental and heritage constraints (excluding woodland and flood risk areas)



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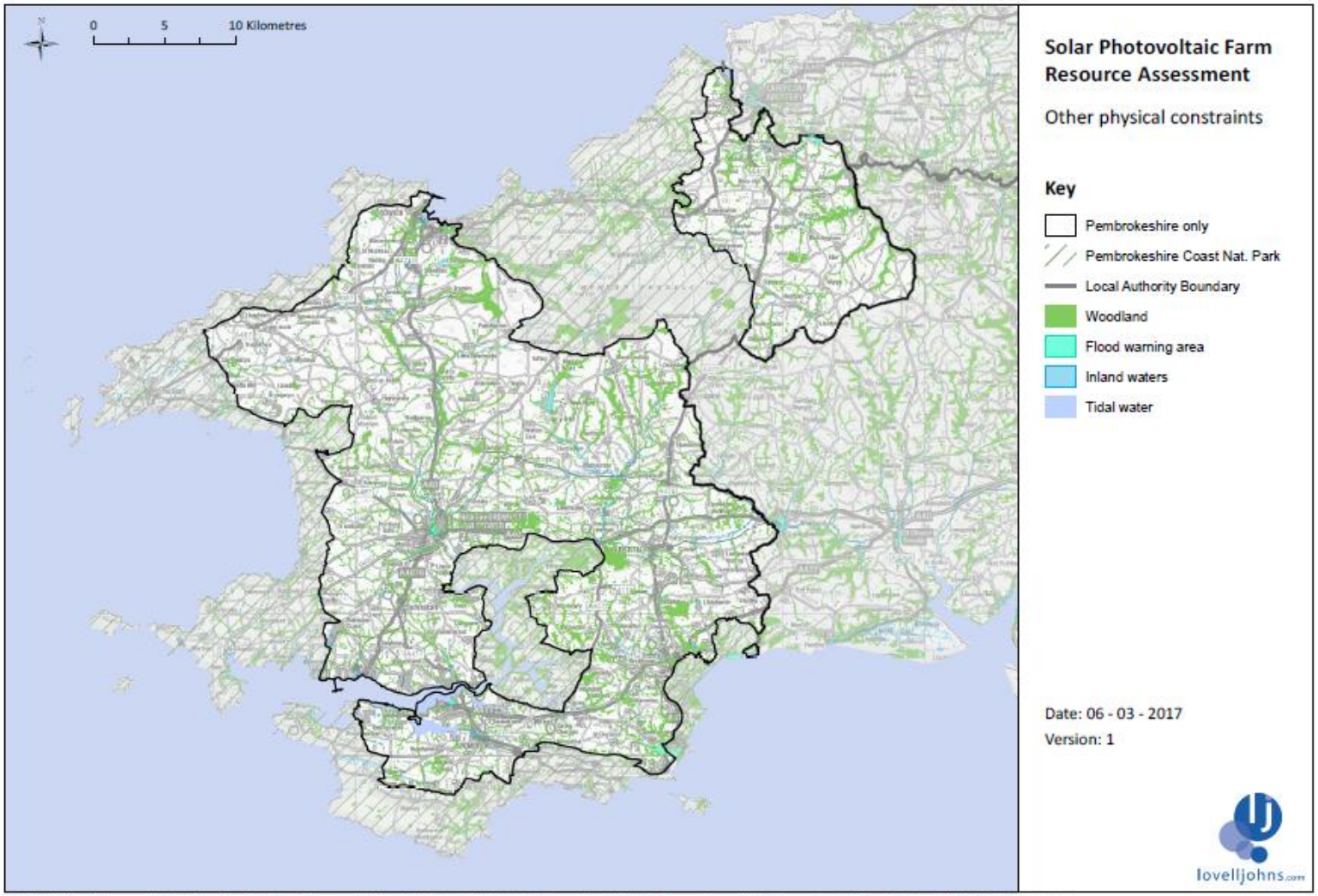
Map 3.7.3: Other physical constraints



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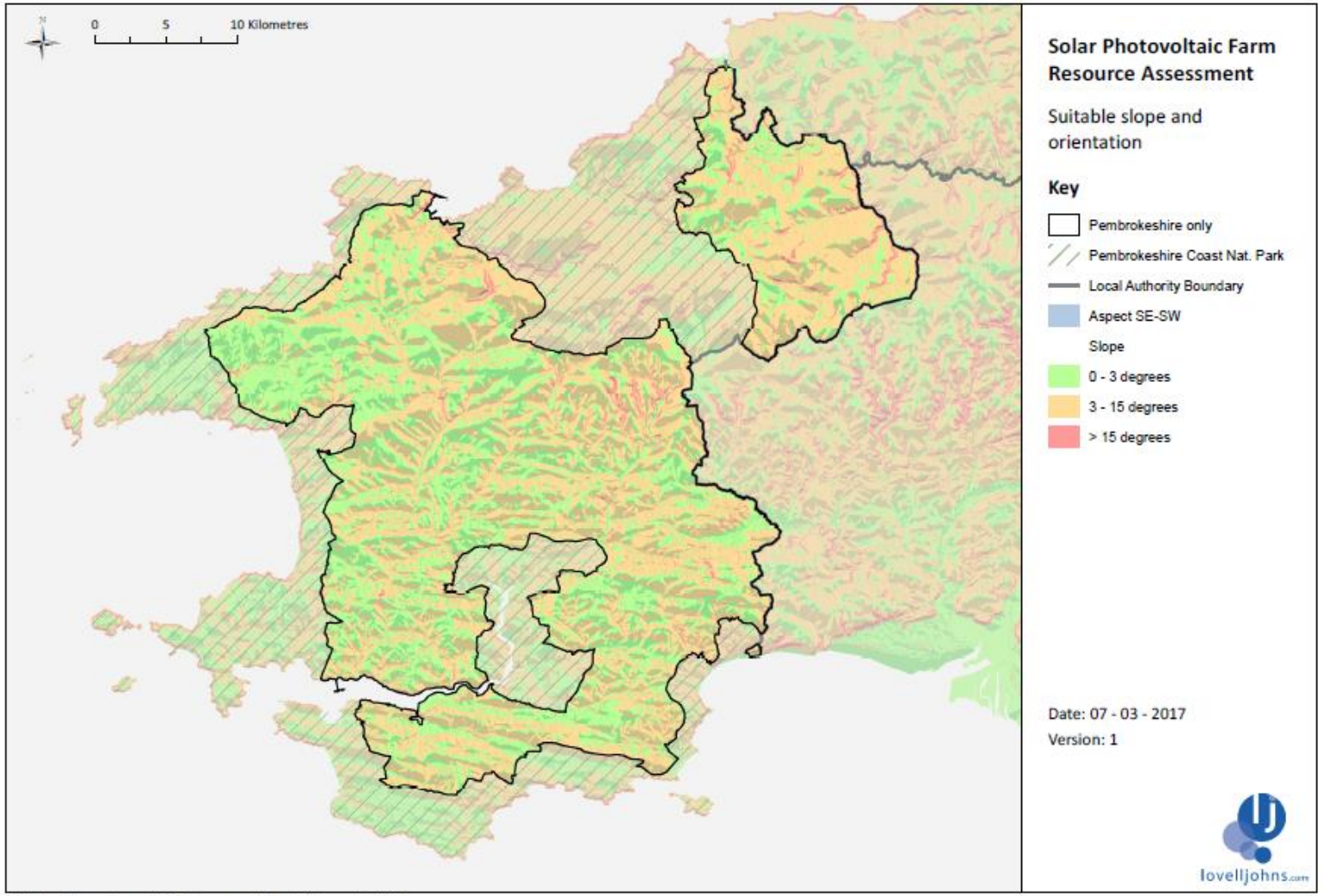
Map 3.7.4: Solar PV - Slope Orientation showing suitable slope orientations for PV



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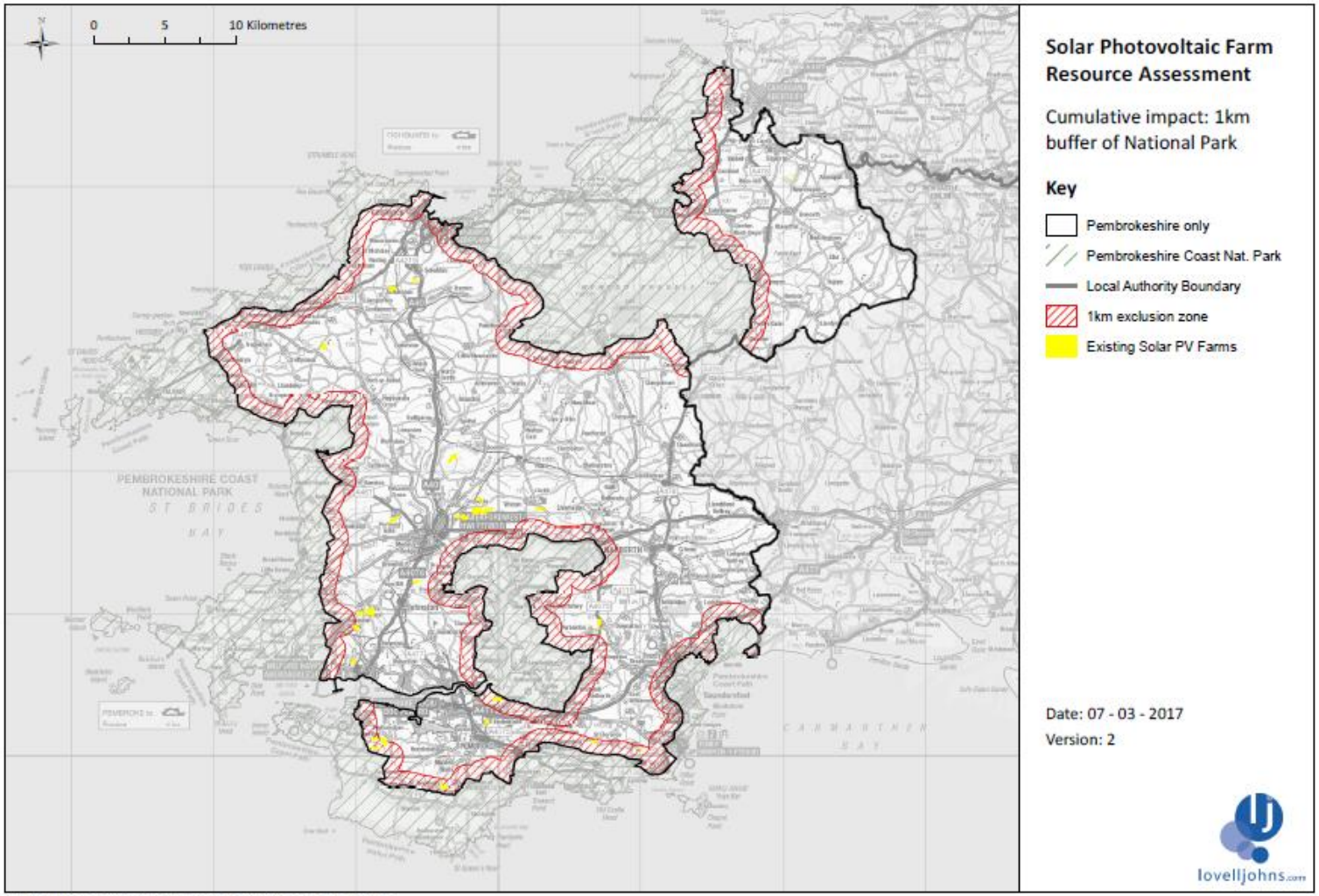
Map 3.7.5 Cumulative Impact – 1km buffer from National Park Boundary



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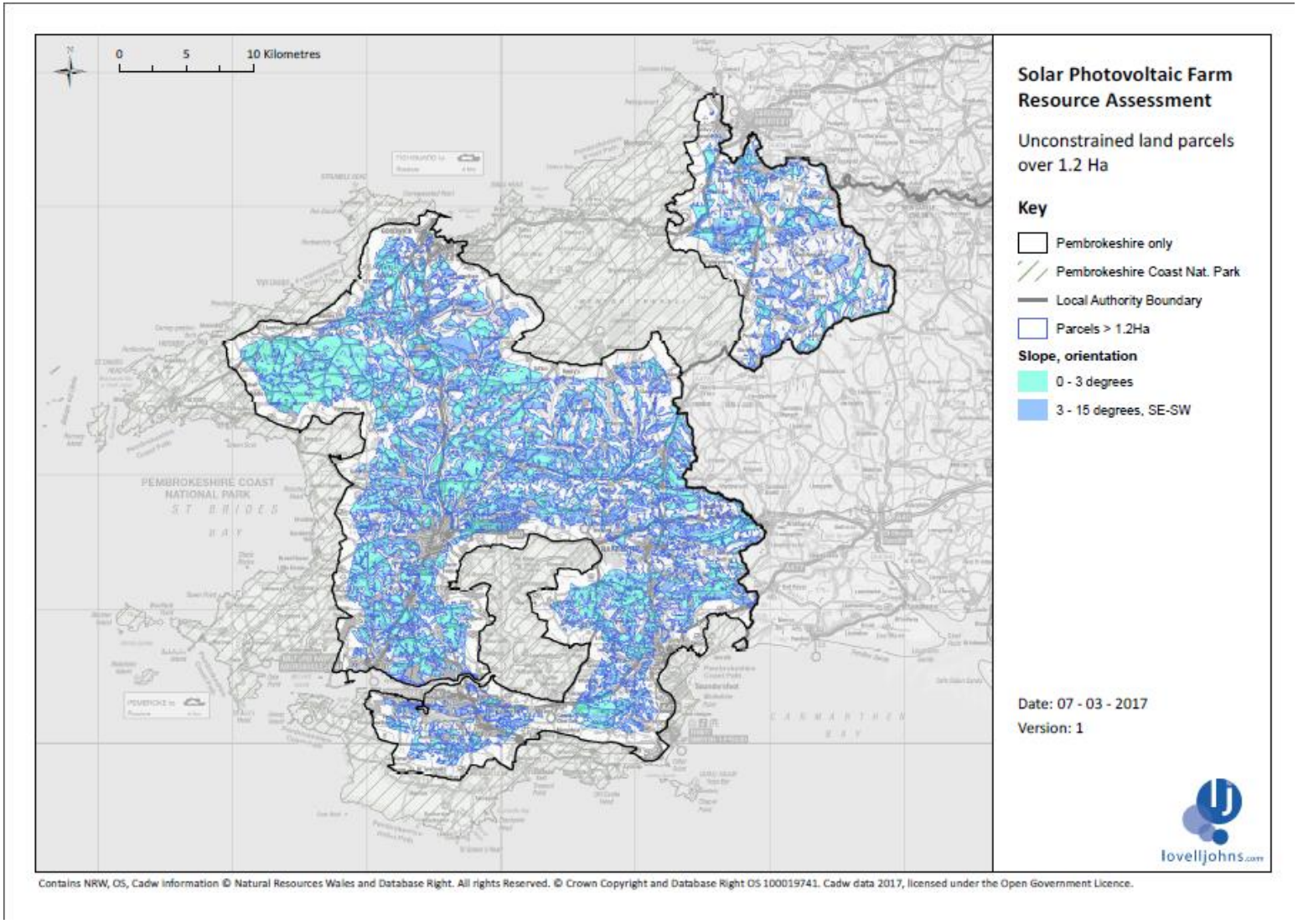
Map 3.7.6 Unconstrained land parcels > 1.2ha



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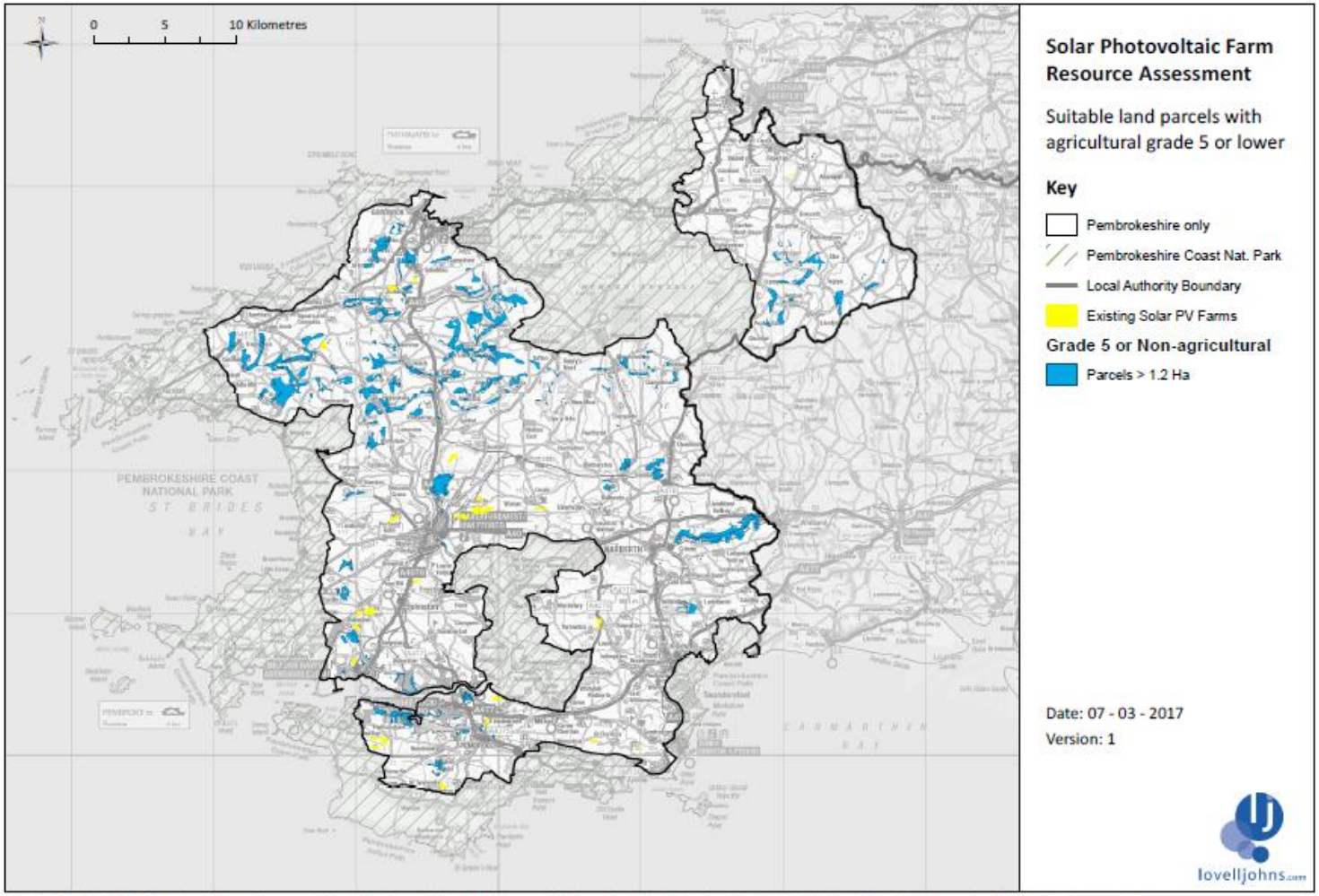
Map 3.7.7 Suitable land parcels with lower grade agricultural land



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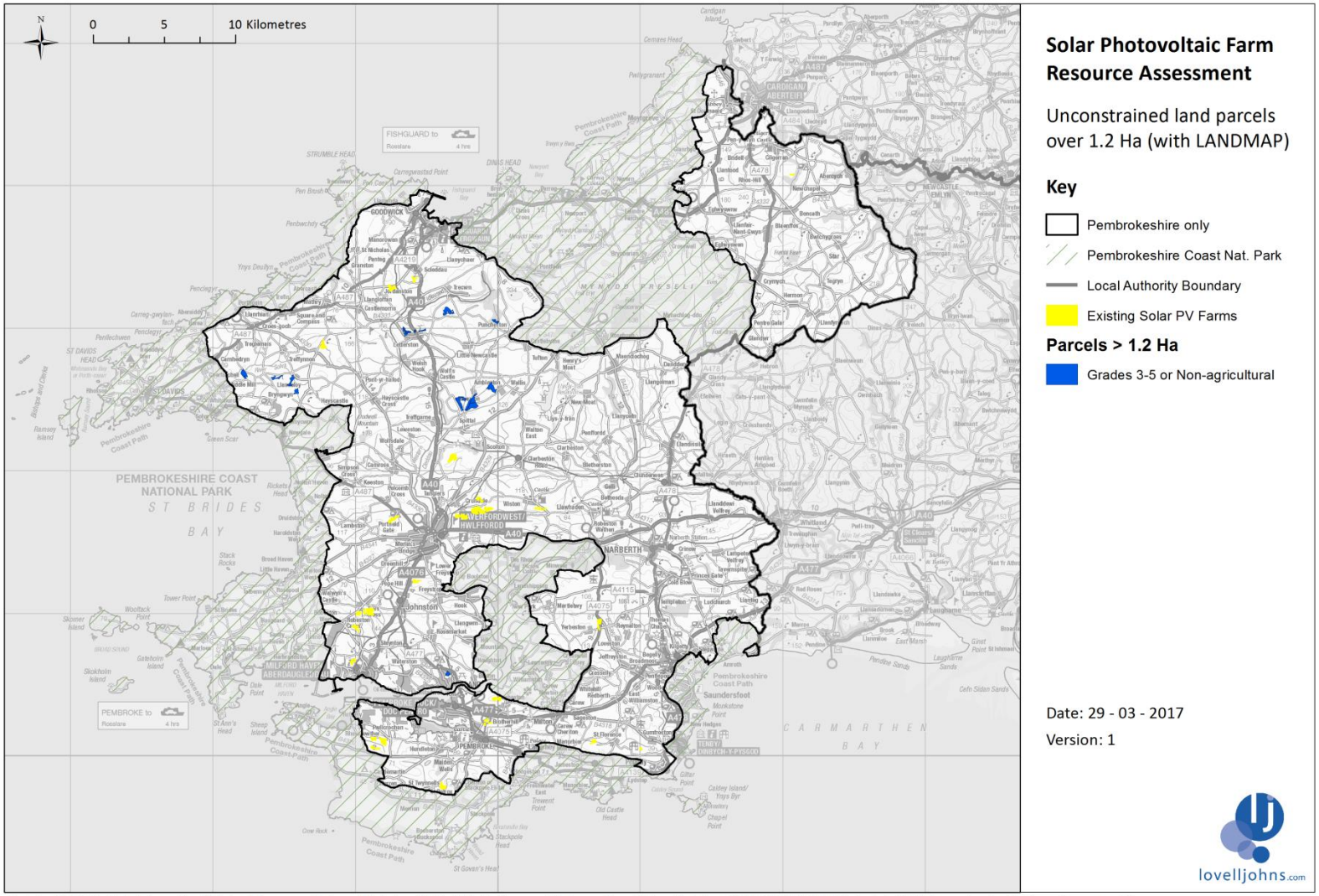
Map 3.7.8: Suitable land parcels on agricultural land grade 3 to 5 - applying LANDMAP Outstanding and High landscape designations as a constraint



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4. Toolkit Task E2. Building Integrated Renewables (BIR) Uptake Assessment

The Toolkit provides a methodology for calculating the energy contribution from existing building integrated renewables in the county. This requires information on the forecast levels of new residential and non-residential development over the Plan period.

The Pembrokeshire Local Development Plan Review has not yet reached the stage of identifying the numbers or locations of any future housing and non-residential development. Consequently, it has not been possible to use the majority of the Toolkit BIR Active Template to extend the LPD forecast horizon to 2032. Where the data is known, such as revised numbers of existing dwellings, average net completions and existing BIR, these have been substituted within the template, but only for the time period to 2020. The figures for non-residential buildings remain the same as those forecast in the 2010 renewable energy assessment.

Table 4.1 opposite shows the total predicted new and existing BIR renewable electricity capacity for Pembrokeshire by 2020.

The Active Template can also be used to calculate the predicted new and existing BIR for renewable heat capacity. The same data issues apply as outlined above but are also compounded in that an estimate of existing renewable heat is not available from the Renewable Heat Incentive subsidy scheme in the same way as it is available through the Feed In tariff quarterly reports. Consequently, the only existing BIR renewable heat data we have included in the template are biomass boilers installed in County buildings such as schools and leisure centres.

Table 4.1		***Units***
Existing dwellings and non-residential buildings		
No. of existing dwellings in Pembrokeshire	60,688	
EDR	*1.09*	
Predicted RE electricity capacity for Pembrokeshire by 2020	4.6	MWe
Future dwellings		
No. of average net annual completions assumed for Pembrokeshire	572	
NDR	*0.98*	
Predicted RE electricity capacity for Pembrokeshire by 2020	4.3	MWe
Future non-residential buildings		
Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000	m^2 GIFA
FNR	*1.3*	
Predicted RE electricity capacity for Pembrokeshire by 2020	10.6	MWe
TOTALS		
Total predicted new BIR RE electricity capacity for Pembrokeshire by 2020	***19.5***	**MWe**
Existing BIR RE electricity capacity in Pembrokeshire	10.2	MWe
Total predicted new and existing BIR RE electricity capacity in Pembrokeshire by 2020	***29.7***	**MWe**

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Table 4.2		*Units*
Existing dwellings and non-residential buildings		
No. of existing dwellings in Pembrokeshire	60,688	
Calculate EDR	*1.09*	
Predicted RE heat capacity for Pembrokeshire by 2020	*10.8*	MWt
Future dwellings		
No. of average net annual completions assumed for Pembrokeshire	572	
Calculate NDR	*1.0*	
Predicted RE heat capacity for Pembrokeshire by 2020	*4.3*	MWt
Future non-residential buildings		
Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000	m^2 GIFA
Predicted RE heat capacity for Pembrokeshire by 2020	1.23	MWt
TOTALS		
Total predicted new BIR RE heat capacity for Pembrokeshire	***16.33***	**MWt**
Existing BIR RE heat capacity in Pembrokeshire	1.4	MWt
Total predicted new and existing BIR RE heat capacity for your LA by 2020	***17.73***	**MWt**

Table 4.2 shows the total predicted new and existing BIR renewable heat capacity for Pembrokeshire by 2020.

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5. Toolkit Task E3: Heat Opportunities Mapping

Background

Pembrokeshire County Council's adopted local plan (2013) states in Paragraph 6.34:

"For major development sites, proposals will be expected to consider the potential for re-use of waste heat and power in, for example, District Heating Networks in line with the conclusion of Background Paper E8 'Renewable Energy Study'.

The 2010 Study identified four development sites where District Heating Networks were considered to have potential to connect to key anchor heat loads. The Council did not consider that all of these development sites would be required or be suitable for LDP allocations, and one (Slade Lane) had already been granted planning permission without any provision for district heating. Nevertheless, the Council welcomed proposals to incorporate District Heating Networks into new developments identified in the study.

On sites with prior consents, the Council suggested that its SPG would include references to the potential for incorporating DHNs. Consequently, if consents lapsed without implementation and then came forward for renewal, or were re-negotiated, the Council suggested that consideration would be given to the installation of DHNs, in line with the identified opportunities in the study. This has not happened yet, but may in the future, so cannot be ruled out.

At this early stage in the review of the Local Plan, the Council has not yet called for Candidate Sites (potential new development sites) through consultation with the public. It is expected that this will take place in early 2018. The evaluation of what comes back will then need to assessed, and potential new sites for development put forward through consultation on the Deposit Plan. This will indicate whether individual Candidate Site requests have been initially accepted by the Council or otherwise. The Council may also prepare a background paper summarising the results of their evaluation of Candidate Sites.

In the absence of new strategic sites to consider, this study presents the GIS heat map data in the form of an 'opportunities map' for five key settlements in the county, namely, Haverfordwest, Milford Haven, Pembroke and Pembroke Dock and Fishguard (see Maps 5.1 to 5.5 below).

In the absence of Heat Map data for Wales from the UK Heat Map, the study overlaid the following GIS layers to help assess the potential opportunity areas for district heat networks.

- residential heat density (≥ 3MW per m^2)[12] (Map 5.1)
- fuel poverty (Map 5.2)
- social housing (Map 5.3)
- potential anchor heat loads (Map 5.4)

The maps identify areas of high residential heat density, which as may be expected broadly coincide with areas of social housing and fuel poverty. However Map 5.1 is to some extent misleading, as the main influence on density is the form of the particular output area. Many output areas include some residential area and some neighbouring non-residential land but to have a density above 3 MW/km^2, needs to consist entirely of dense residential land.

[12] 'The potential & costs of District Heating Networks'. A report to the Department of Energy and Climate Change – April 2009.

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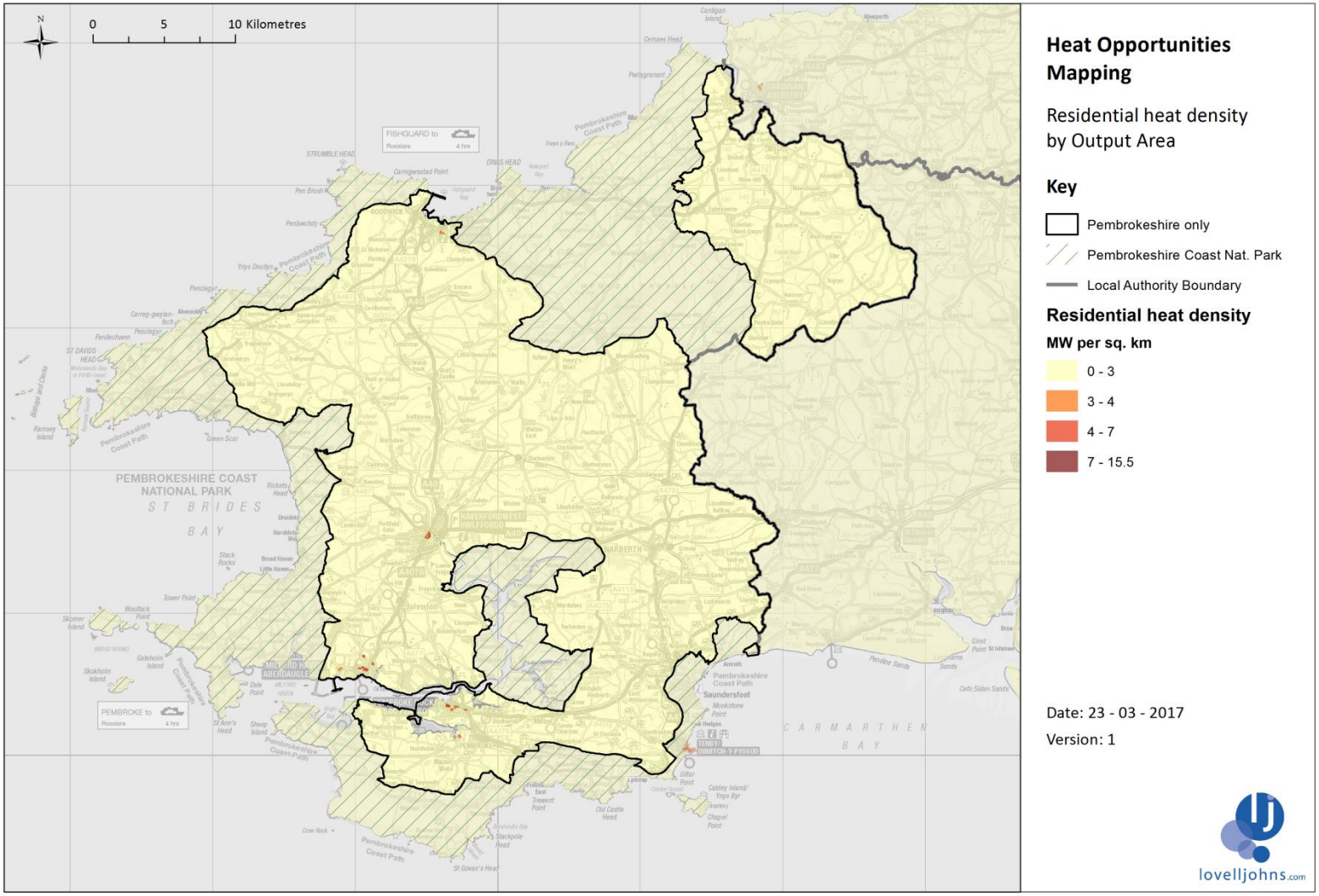
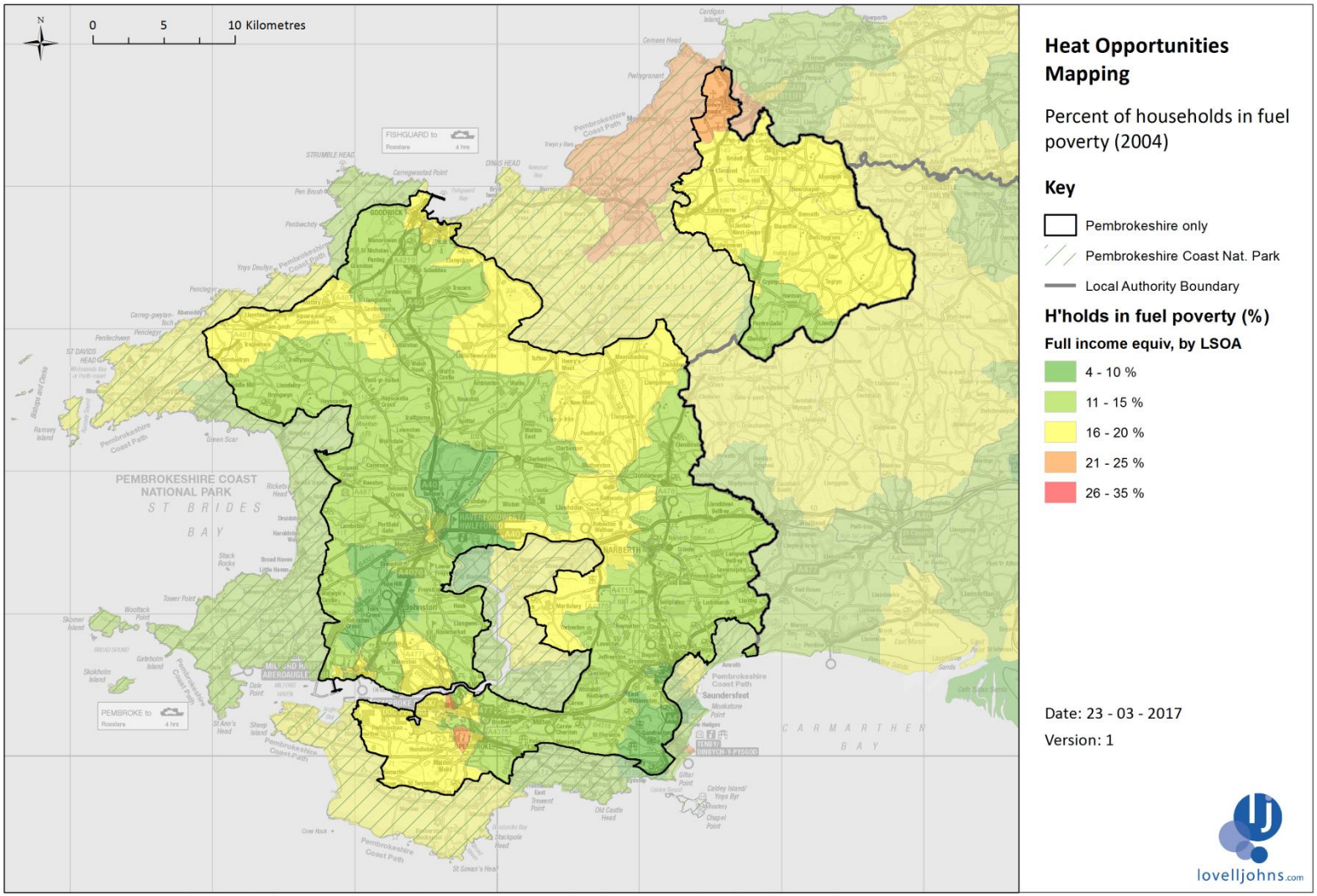
Map 5.1 Heat Opportunities: Residential heat density by Output Area



Map 5.2 Heat Opportunities: Percentage of households in fuel poverty (based on 2004 data)



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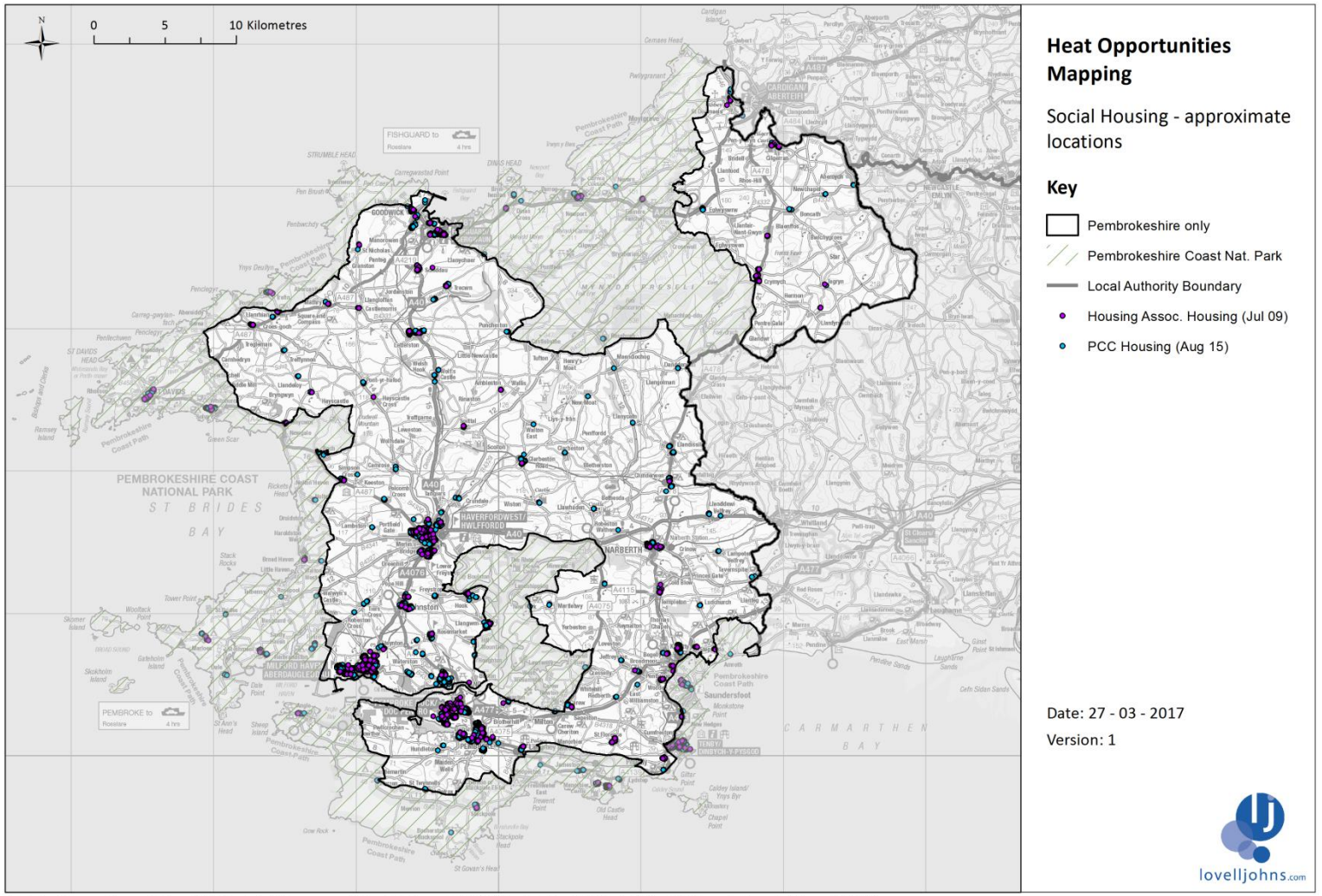
Map 5.3 Heat Opportunities: Social Housing (approximate locations)



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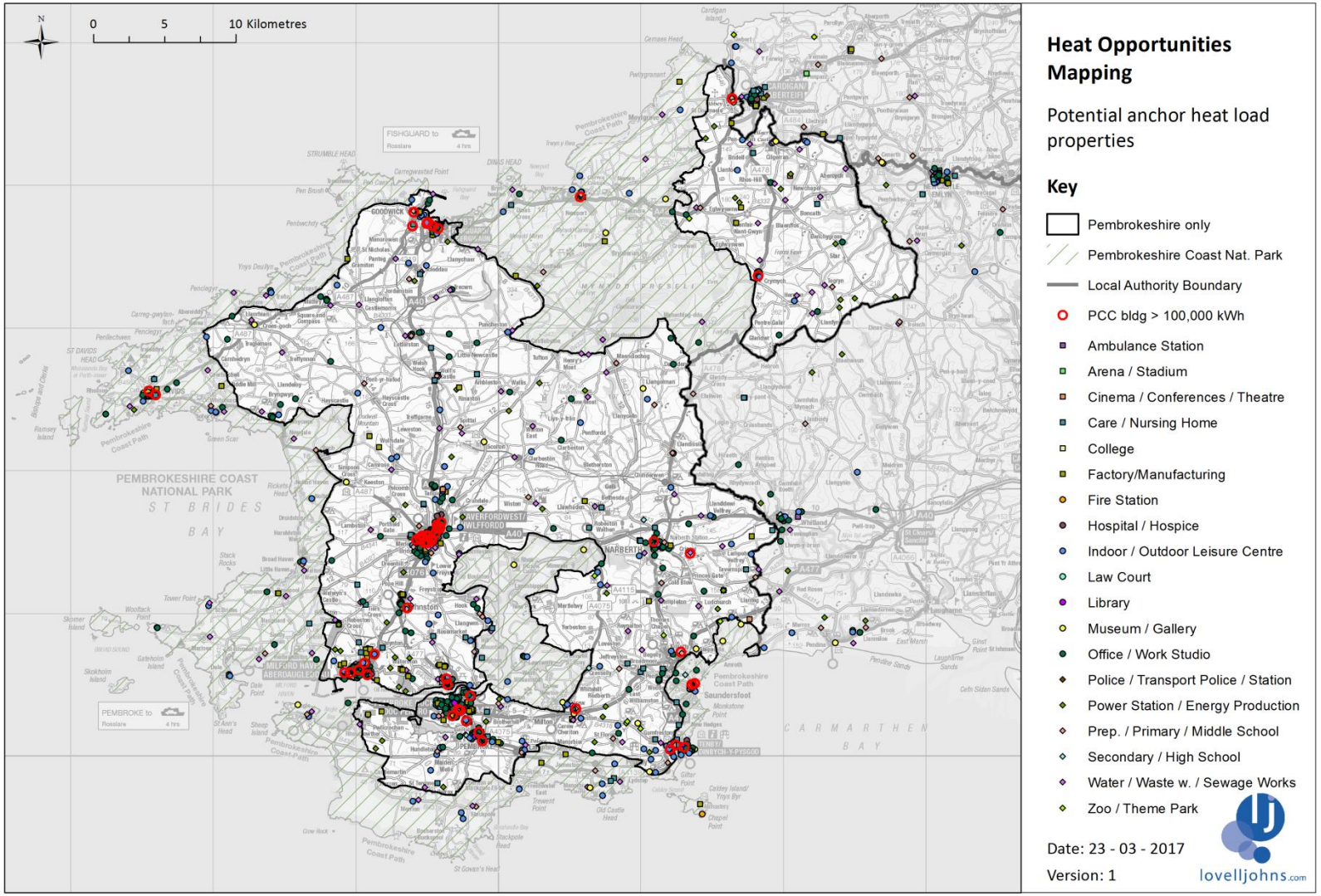
Map 5.4 Heat Opportunities: Potential anchor heat load properties



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The densest types of housing, which are therefore best for district heating, are usually flats or apartments, and especially high rise flats, whether private or socially owned. However within Pembrokeshire the largest blocks are typically only four storeys high which significantly reduces the potential to make district heating schemes viable in the towns.

The anchor heat loads, which provide stable sources of heat demand such as power plants, industry, and large institutional buildings such as hospitals and other public buildings, are present within the county and shown on the maps. It is unlikely however, that these could be linked via a heat network to existing residential areas of high heat density as there would be too many barriers in terms of cost of retrofitting pipe through existing urban areas, and viability due to uncertainty of heat supply and demand.

In terms of new development, district heating is only viable where development is a mixture of high density housing and mixed development, again providing a viable source of heat and demand. Unless the current pattern of development within the county changes to higher density it is unlikely that heat networks will be a viable source of heat for future developments. Future opportunities should however be examined through the planning application process, in which case the Local Plan policy GN 4 and its supplementary text provide an adequate policy framework.

Nevertheless, heat opportunities maps are shown below for the five centres with some areas of relatively high residential density. Although a sixth area (St Dogmaels) has historically been identified as containing relatively high levels of fuel poverty, this area lacks social housing or sufficient density and also lacks existing anchor heat loads.

Of the five areas, Fishguard has a single area identified as potentially high density and social housing, but the area is characterised by mixed housing types and is relatively new, so would not be suitable for retrofitting district heating; it is also away from likely sources of heat. Haverfordwest is similarly unpromising, with most social housing on lower density estates around the periphery.

The Monkton area on the West side of Pembroke may be more promising, with older social housing at a moderately high density, including many bungalows which may have high heat losses per capita. However this is remote from existing anchor heat loads, and would only be worth considering if the LDP were to link this into Pembroke Town.

There are likely to be more opportunities in Pembroke Dock and Milford Haven, but the issue here would be about matching sufficient housing to new industrial or commercial development. Again, as the LPA have yet to identify potential sites, it is too early to offer firm suggestions, but there may be ones adjacent to the Cleddau Bridge Strategic Employment Site, or – if redevelopment to include mixed uses is envisaged – replacing some of the warehousing in Pembroke Port. As a potential source of waste heat the Valero Pembroke refinery is too far from habitation for district heating. North of the river may also offer limited redevelopment opportunities in Milford Haven.

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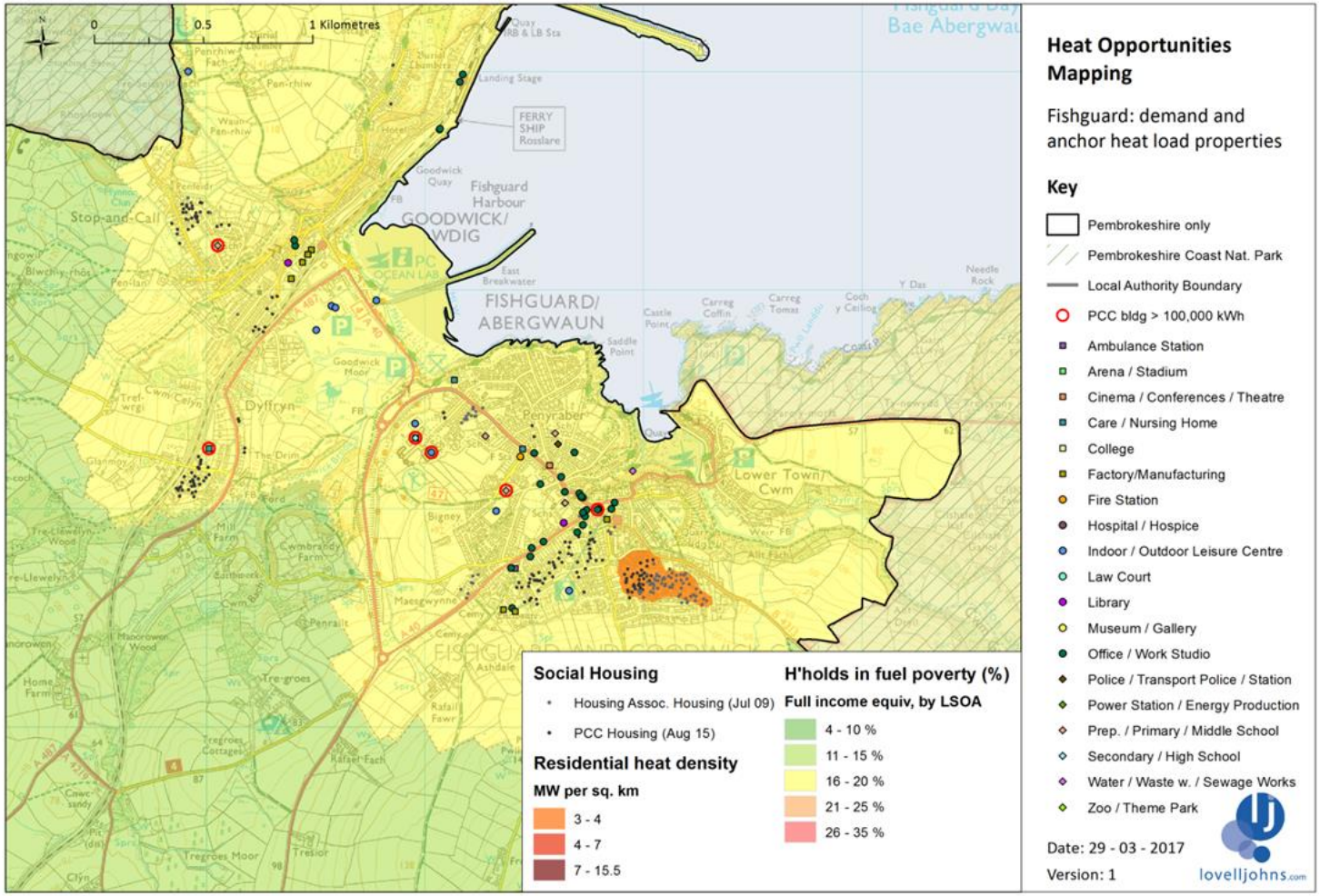
Map 5.5.1 Heat Opportunities: Fishguard demand and anchor heat load properties



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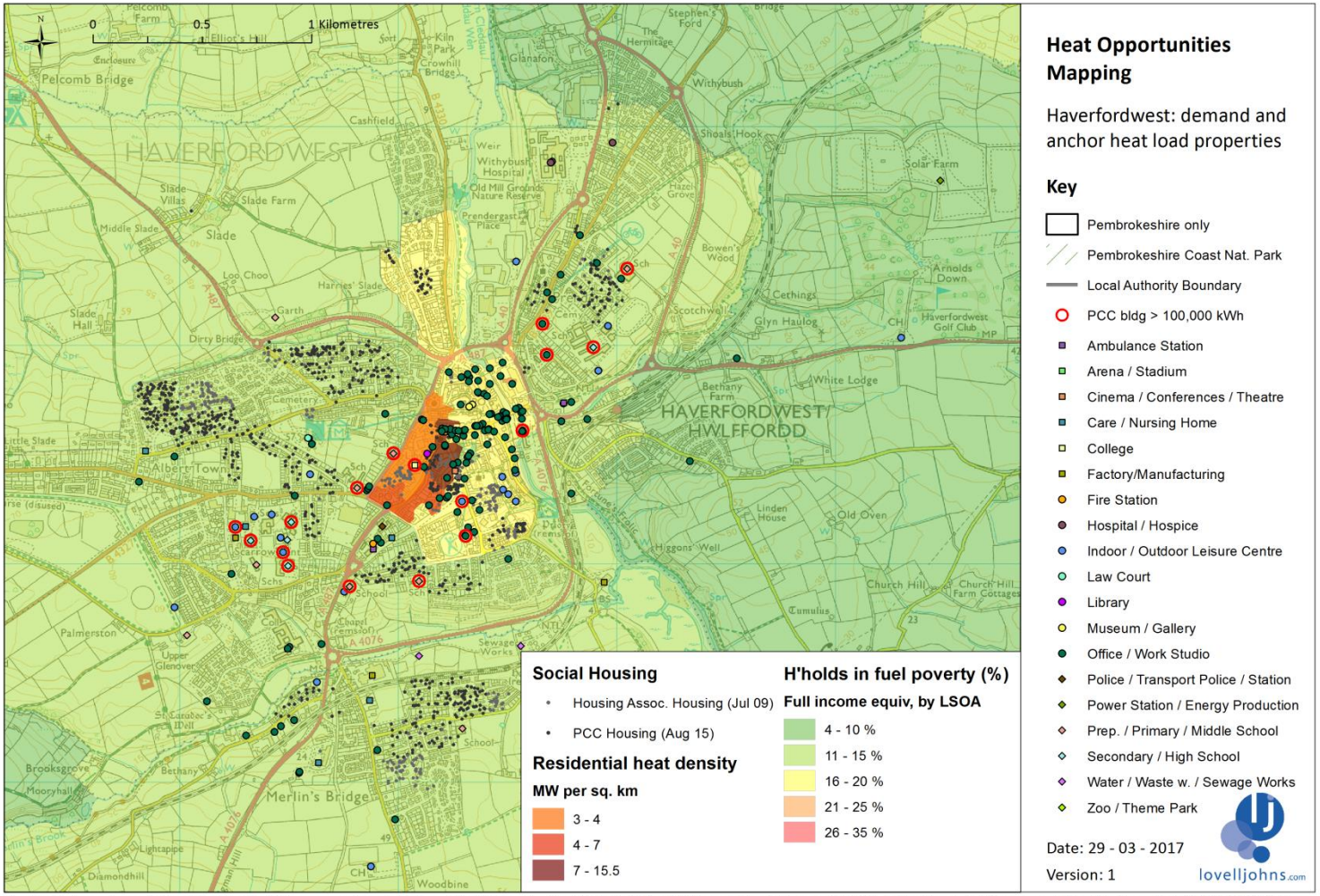
Map 5.5.2 Heat Opportunities: Haverfordwest demand and anchor heat load properties



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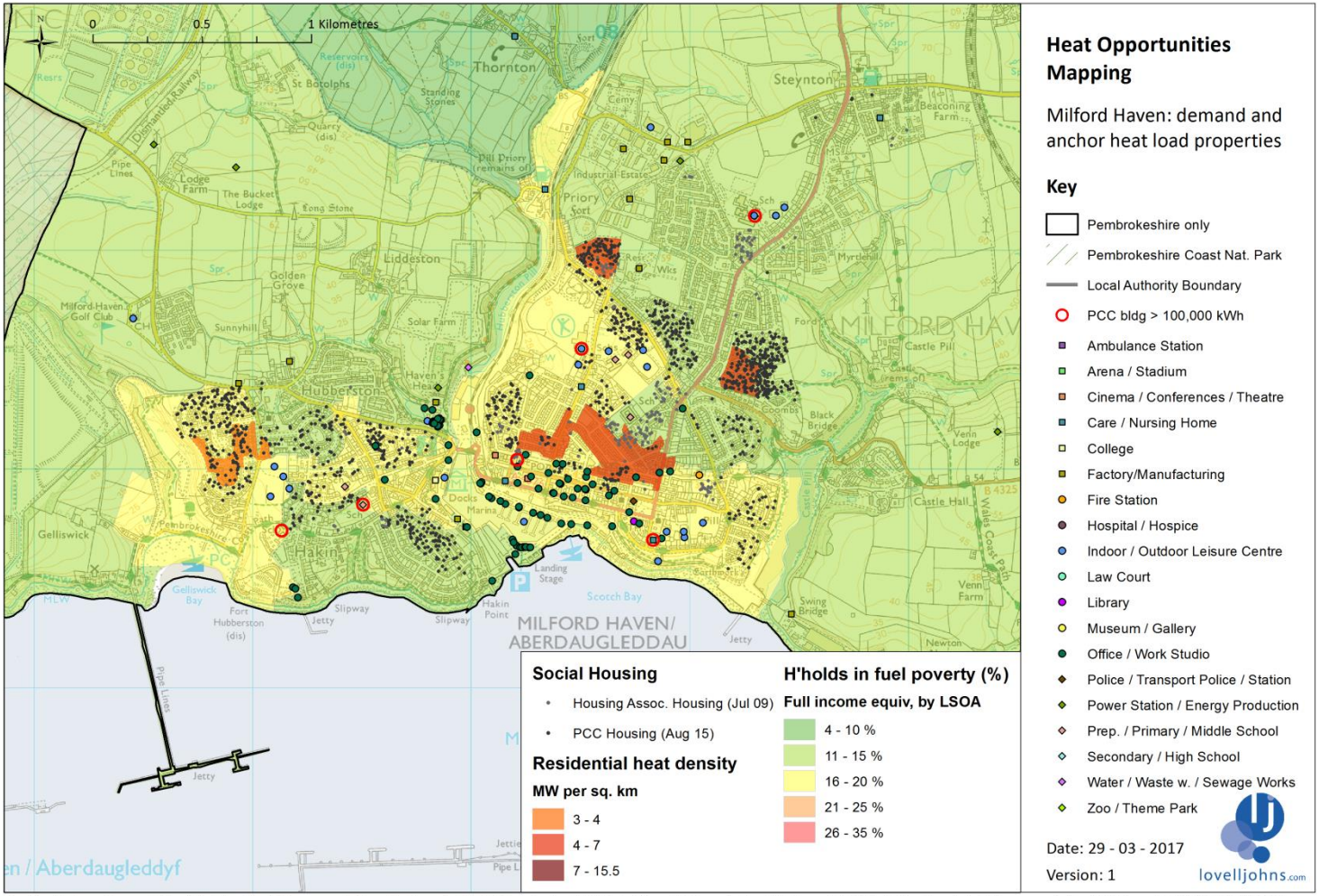
Map 5.5.3 Heat Opportunities: Milford Haven demand and anchor heat load properties



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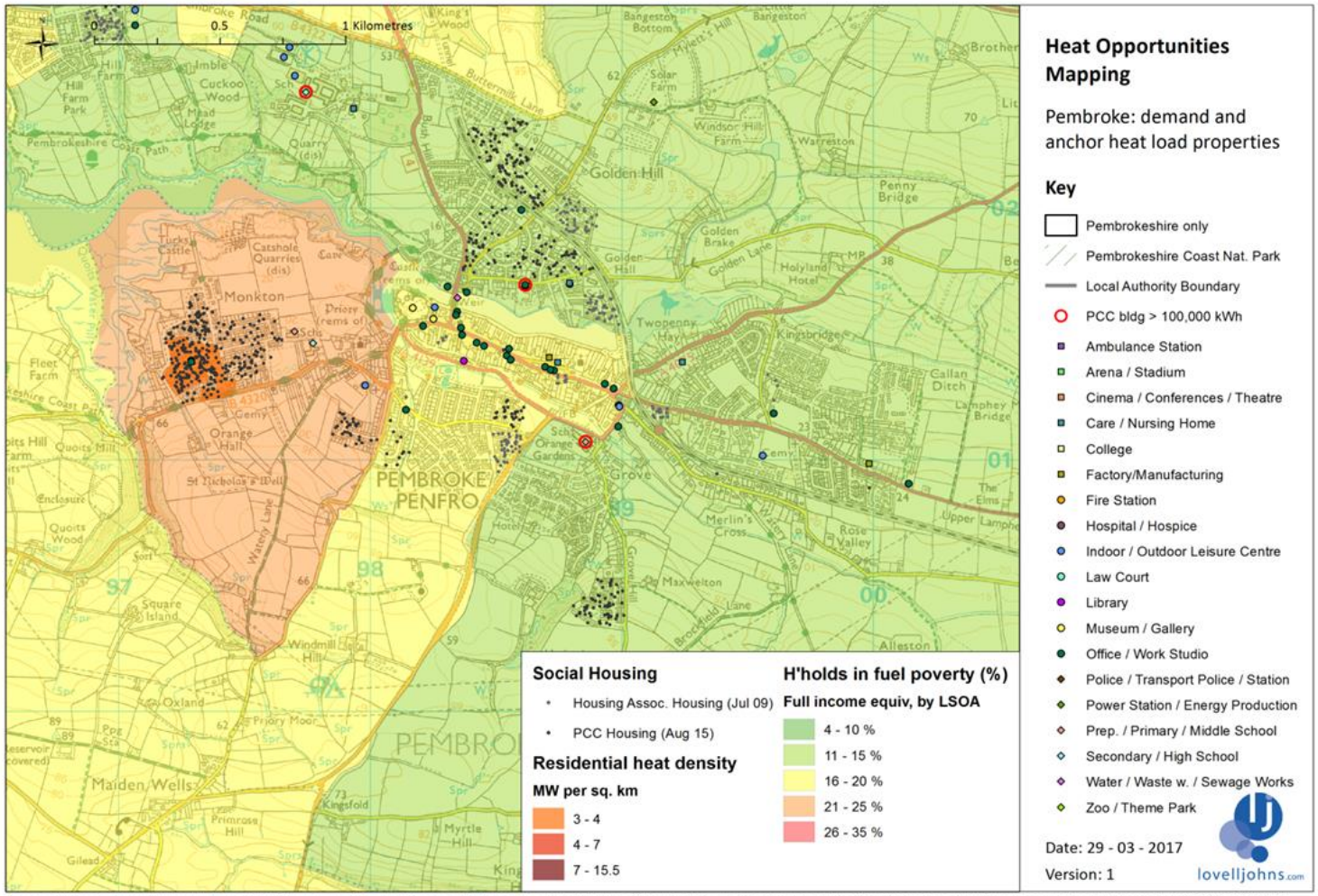
Map 5.5.4 Heat Opportunities: Pembroke demand and anchor heat load properties



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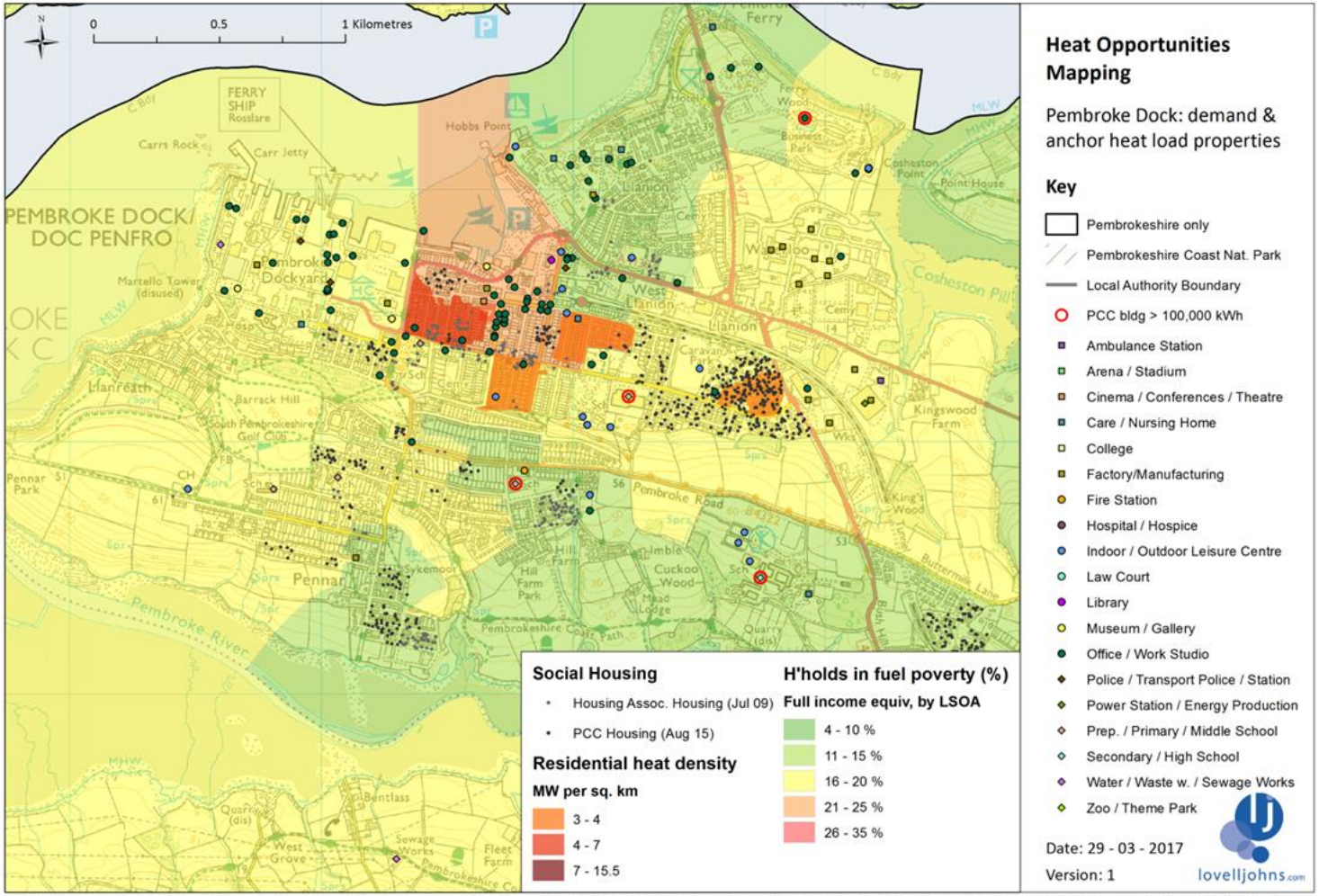
Map 5.5.5 Heat Opportunities: Pembroke Dock demand and anchor heat load properties



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6. Other considerations for future renewables

➢ Grid Connection

Western Power Distribution is the electricity grid provider for Pembrokeshire and the Pembrokeshire Coast National Park. Over recent years the company has experienced unprecedented demand for the connection of renewable and conventional generation technologies within the Pembrokeshire area which has restricted capacity and created the need for upstream reinforcement works. This reflects the considerable rise in renewable technology installations in Pembrokeshire described earlier in Section 3.2 regarding existing and proposed renewable energy technologies.

Western Power is aware that this demand for generation connections has created constraints, with the key constraints to connection to the grid being cost and time taken to provide a connection, particularly where a project is small in scale and some distance from the existing grid network i.e. rural in location, or the connection requires upstream reinforcement.

In the short term (3-5 years) substantial reinforcement work is planned on the 33 kilovolt (kV) and 132 kV distribution networks which will create sufficient capacity to allow all accepted generation offers to connect. In addition National Grid has identified the need for reinforcement works on the transmission network serving the Pembrokeshire area, the planning and design of required transmission works is at an early stage. It is difficult to quantify the capacity these works will release back into the network as Western Power Distribution does not undertake speculative reinforcement but rather the general methodology is to address upstream reinforcement on a case by case basis as connection applications are received. However, as a general rule Western Power Distribution does not foresee grid constraint issues precluding the development of medium to small-scale renewable electricity generating technologies subject to reinforcement having been carried out.

In areas where there are multiple complex constraints affecting a number of customers over a long time period, full active network management systems will be implemented. Due to the level of generation projects within Pembrokeshire, Western Power Distribution has declared the network as an Active Network Management area.

Distributed control systems continually monitor all the limits on the network and then allocate the maximum amount of capacity to customers in that area based on the date their connection was accepted. This Last In, First Out hierarchy prioritises the oldest connections when issuing capacity, but is scalable so that new entrants will get access to the capacity when it becomes available. If generators wish to connect to the grid without reinforcement they will need to apply for an Active Network Management connection offer.

➢ Marine Renewable Developments

Marine technologies have not been considered in this update as the marine environment lies beyond the jurisdiction of the County (other than at the point where the energy comes ashore). However, Pembrokeshire has continued to develop as an important location for marine technology research and development.

As referred to earlier in Section 2, an injection of funding from the Welsh Government created the Haven Waterway Enterprise Zone in March 2014 which provides support for businesses within the marine energy sector. The enterprise zone is in turn supported by Marine Energy Pembrokeshire (MEP), a not-for-profit partnership between technology developers, the supply chain, academia and the public sector working together to establish Pembrokeshire as a 'centre of excellence' for sustainable marine energy generation.

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7. Summary of Potential Contributions

Potential generating capacity of existing renewables to 2032

Table 7 Potential for renewable energy in Pembrokeshire to 2032

Technology	Capacity 2016/17 [MWe]	Capacity 2016/17 [MWt]	Potential generated by 2032 GWh(e)	Potential generated by 2032 GWh(t)
Landfill gas	1.4	n/a	117	-
Sewage gas	1.2	n/a	71	-
Anaerobic Digestion	2.2	n/a	278	-
Biomass	25	n/a	3,154	-
Hydro	1.08	n/a	56	-
Solar farms	205	n/a	2,873	-
Wind	33.2	n/a	1,256	-
Building Integrated Renewables	10.2	n/a	1,429	-
Biomass (heat)	n/a	6.2 MWt	-	435
Totals	**279**	**6.2**	**9,234**	**435**

Potential generating capacity from wind

None.

Potential generation from biomass

Fuel	Technology	Installed capacity	Annual GWh output	Potential energy generation by 2032
Energy crops	Electricity	16 MWe	126 GWhe	2,018 GWhe
Energy Crops	CHP (heat)	33 MWt	144 GWt	2,312 GWht
Energy Crops	Boilers (heat)	149 MWt	652 GWt	10,441 GWht
Wood fuel	Boilers	8.6 MWt	37 GWt	602 GWht

Energy from Waste

None

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Hydro

Table 3.6.2: Potential generation from hydro schemes

	Installed capacity (MW)	Annual GWh output per unit	Potential annual electricity generation by 2032
Existing	1.08	3500	56,000 GWh
Potential	0.028	90.7	1,451 GWh
Total	**1.1**	**3591**	**57,451 GWh**

Building Integrated renewables

Only assessed to 2020

Heat Networks

Not possible to identify suitable locations (and so impossible to estimate - see text in Heat Mapping section).

Table 3.7.1: Potential generation from solar farms

Potential solar PV Farm Cluster	Installed capacity (MWe)	Annual GWhe output per unit	Potential annual electricity generation by 2032 (GWhe)
8) 89.9	37.4	32.7	524
9) 29.68	12.3	10.7	172
10) 15.89	6.6	5.7	92
11) 15.89	6.6	5.7	92
12) 21.97	9.1	7.9	128
13) 6.77	2.8	2.4	39
14) 7.21	3.0	2.6	42
Total	**77.8**	**67.7**	**1,089**

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8. Role of Pembrokeshire County Council in supporting community renewables

Background

Community Renewable Energy can take many forms. From its simplest being local projects supporting individuals to own renewable energy systems, through medium scale renewable energy measures sited on community buildings through to ownership, or part-ownership of large scale renewable energy developments.

Throughout the UK there are many community groups which effectively move from one project to the next as the make-up and interests of the group change over time. This means that a group that may have formed as a resident's association can easily morph into a community energy group. However it also means that should circumstances change its focus may change again to a non-energy related issue.

The kind of projects that community groups characteristically undertake are likely to revolve around disseminating information on energy saving, providing energy assessments or thermal images of domestic properties and potentially helping to source renewable energy installers. Some groups have gone as far as tendering for a local renewable energy installer who will offer a better price on installations, where they know they are likely to undertake many in the same area. This kind of project was prevalent in 2010-2013 when Feed in Tariff levels were high; the investment was a 'easy sell' and installers would often pay a 'kick back' to the community groups for the introductions made and this income could be used to support additional activity.

When Feed in Tariffs were high another phenomenon was the advent of medium sized PV arrays on local community owned buildings, schools etc.

More latterly, especially following the Community Energy Strategy (2014) there has been more community action in larger scale projects, especially following the development of Split-FiT availability.

Recent History

In the 21st century there had been much more emphasis on working within and for communities. A number of NGOs and Charities were already working to support community activity and had formed a number of organisations to offer support and advice; The Community and Climate Action Alliance, Local United and The Community Energy Practitioners Forum, to name but a few. Collectively these organisations, and others, lobbied government for more support for community energy. Whilst their messages were not ignored, Government was also consulting widely and including community activists in many policy development areas. However, there wasn't quite the necessary impetus for the Government to fully commit to the suggestions, collectively they instead set up

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Community Energy England and Community Energy Wales in 2012. This crystallised the growing interest in larger scale community energy. A statement from Community Energy Wales is outlined below.

"Community Energy Wales was constituted in 2012. We have a management board drawn from professionals working in the community energy sector, but the organisation belongs to its members, who can vote on the composition of that board on an annual basis. Community Energy Wales is funded initially by the Welsh Government, but has to raise an increasing percentage of its operating costs from Sponsorship and other income generating activities. We work in partnership with other organisations to deliver assistance and networking opportunities to community energy groups in Wales."

At a similar time, Government began to investigate the potential for a Community Energy Strategy. Working with these same individuals, charities and community groups they under took some analysis into the prevalence of Community Groups in the UK. They commissioned investigations with Local Authorities into how they interacted with the Community Groups and then sought advice on what both central and local Government could do to support this burgeoning activity. Finally in 2014 the Government produced the Strategy, with the devolved administrations encouraged to adopt this strategy or develop their own.

The strategy was the first time that Community Energy was prioritised, with specific policies, such as split-fit, designed to encourage more large scale Community Energy Development and a new team was set up within the Government's Department for Energy and Climate Change (DECC) to provide ongoing support. Rt Hon Edward Davey MP, then Secretary of State for Energy and Climate Change explained

"[T]his Strategy aims to help these existing groups grow and to inspire more to set up and expand. We want to tap into the enthusiasm and commitment that's so evident in community groups across the country – whether it's for helping people struggling with energy bills or for playing a part in the global race to decarbonise our society"

However, the discussion about Community Energy was short lived. Whilst the split-Fit initiatives continue to exist, there has been very little action, or even talk of action, since then. Fiona Booth, who headed up the unit, is now at the Cabinet Office and since the metamorphosis from DECC to BEIS nothing has been mentioned of Community Energy.

What has happened however, is that local Councils are now being encouraged to take on the mantle of Community Energy Advocate. This is the case in Wales.

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➢ **Community Renewable Energy in Pembrokeshire**

i) Wind

Transition Bro Gwaun is a community in Fishguard whose stated purpose is 'imagining and creating a future that addresses the challenges of climate change, resource depletion, including expensive oil and gas supplies, and an unsustainable economy reliant on growth'. Back in 2008 they began examining the potential for tidal power in the local area. When this appeared unlikely they moved to wind power and in 2011 they initiated a joint-venture wind turbine. The group has a full half share in a 250KW turbine which cost approximately £285,000. Profits from the generation are ploughed back into the community with approximately £50,000 per year being gained for local low carbon projects.

A planned community owned 500KW wind turbine at Llanfyrnach in NE Pembrokeshire was refused planning permission in 2014, although plans for a smaller turbine are now in progress. There were also plans for a 500kW turbine at Prouts Park Farm, East Williamston which has recently been won on appeal. However, the turbine is no longer profitable under the current Feed in tariff levels and whilst the team now has a connection offer from Western Power Distribution for a development up to 900kW it is not clear what will happen with this project.

ii) Solar

We have not been able to locate any community owned solar farms Pembrokeshire. The most recent largescale farm has been built on a 64 acre site (10.8MW), in Rudbaxton, between Haverfordwest Aerodrome and a landfill site. It is not a community owned solar farm, but it easily could have been. Many examples across the UK are springing up of commercial farms, with a community owned element. Gawcott Fields in Buckingham is a good example, a 9MW farm owned by the local landowner, with a 4.17MW community owned extension.

iii) Hydro

No community owned hydro projects were found in Pembrokeshire, although there are a number of micro hydro commercial schemes. However there is community owned hydro in other parts of Wales. Taff Bargoed Hydro is a useful example. The scheme is designed to deliver 480MWh/per year which is all being exported to the grid. Income, from government subsidies as well as the power purchase is likely to be as much as £105,000 per year and profits will be used to ensure sustainability of the site and to support Friends of Taff Bargoed Park.

Taff Bargoed is a useful example as they have blended funding from many different sources. Funding has been received from the Heads of Valleys programme for Heritage, Big Lottery and Finance Wales. Finance was also secured for NEF's own Community Generation Fund, but this was not required in the end.

Hydro power has also not seen the reduction in cost of materials that has been witnessed with other technologies, such as Solar. This means that it is still an expensive technology and should only be considered where the circumstances are right.

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iv) Anaerobic Digestion

There is no evidence of Community Owned renewable energy from AD, although there is currently a plan for a 10MW plant which is a good feasibility study and is now at the stage of lease negotiations.

➢ Funding

The funding landscape for Community Energy in Wales is complex.

GRANTS - Ynni'r Fro (2010-2015) was a European funded Welsh Government programme to encourage the development of community renewable energy initiatives through the provision of advice, support and financial assistance. Although successful in encouraging community groups and feasibility studies, it was not able to meet its ambitious targets due to planning, technical and other issues associated with Renewable Energy. Ynni'r Fro has not been replaced.

Awards for All grants are still available, but their low levels mean that they are likely to support early work on large schemes or smaller projects altogether. They can be particularly useful for supporting community action on behaviour change and inspiring carbon reductions.

The Welsh Government Rural Communities – Rural Development Programme 2014-2020 is a 7 year investment programme supporting a wide range of activities including 'contributing to ensuring the sustainable management of natural resources and climate action'. This is done via six priorities which include:

- enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests
- restoring, preserving and enhancing ecosystems related to agriculture and forestry
- promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors
- promoting social inclusion, poverty reduction and economic development in rural areas.

The programme also funds Glastir Woodland Grants and Glastir Woodland Restoration funding.

Other European funding is available through streams such as Horizon2020, but these require European Partnerships and are unlikely to be suitable for inexperienced Community Groups.

Small grants can often be found on internet searches, or via grant portals, such as Grantsnet.

SUBSIDIES AND TARIFFS are another common way to support Community Renewable Energy Projects. However, these have been being reduced slowly over time. Government has made some concessions to

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Community Energy, not least the pre-accreditation period given to FiT eligible projects, but the rates are now so low as to make many proposed projects unfeasible. Indeed, it is often the case that the length of time taken to reach planning approval exceeds the pre-accreditation time and projects are no longer able to proceed; witness the East Williamston turbine. It is also worth noting that the Turbine from Awel Amen Tawe took 12 years of development, including many of those in the planning system.

On a positive note here, the development of Split-FiTs could be relevant as much of the planning work is often done by the original developer and therefore the community element may require much less development time and cost to go ahead.

SHARE ISSUES are not a new invention, but whilst they used to be few and far between they are now viewed by many as an obvious route to fund (or part-fund) local generation. Shares or bonds can be purchased by the local community, or can be sold further afield, and whilst in many cases they are non-transferable they do provide a regular interest payment to the investor and usually a substantial sum for Community Benefit.

LOANS are probably one of the most common forms of finance for Community Energy. The Local Energy Service, funded by the Welsh Government, provides advice and funding to social enterprises and SMEs to develop renewable energy projects that deliver benefits to people and communities in Wales.

Banks loans, whether principal or mezzanine finances can often be obtained when projects are further into the planning process. For instance a project which has planning approval, is a known technology (such as solar), has an installer ready and full feasibility study has been completed which shows energy output and financial benefits, should find it reasonably easy to find finance. Triodos and Ecology banks have a big presence in this area.

As we have noted many projects used blended funding to further their projects.

- **Other Community Energy**

What is apparent in Pembrokeshire is that there is no deficit of Community Groups interested in energy. From those involved in renovating community buildings; witness Narberth Energy Ltd, to those running electric car clubs and community Orchards, such as St David's Eco City Group.

Support is also available through the likes of Community Energy in Pembrokeshire (CEP) and PLANED (Pembrokeshire Local Action Network for Enterprise and Development) which helped to set up CEP. PLANED was originally funded by the LEADER programme, so there is lots going on in Pembrokeshire and lots of support available. Renew Wales was also

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set up, by a group of practitioners, to support others entering the field. But how can Pembrokeshire County Council help to support this activity?

From NEF's work with Community Groups across the UK we have found a number of issues. These are likely to be similar in Pembrokeshire and much of this has been borne out through our conversations with local people.

➢ **Issues and suggested ways forward**

1) **Lack of local enthusiasm**. This is not usually a problem when groups are first formed. However it can become problem when projects don't get to fruition. This has been witnessed many times in Wind projects where planning rejections and appeals can take their toll. It can also be that the planning application takes up all the time of the committee members and no other projects can progressed during this time.

Supporting small nascent groups can be as important as supporting larger ones or those who have been established for longer. Given that the majority of groups do not go on to large generation projects, it is imperative that as many of these smaller groups can be encouraged and nourished as possible to provide a pool of groups to grow larger and potentially branch into energy generation in the future.

2) **Planning**. As above, interacting with the planning system can be slow and difficult. Many laypeople find that they are not familiar enough with the system that this becomes a steep learning curve and one where there is little support.

Planning issues can be difficult to resolve, not least because it is not possible to please everyone. These issues can take many forms. The first is that community groups often have a lack of understanding of the planning process. It is recommended that the Council could alleviate this issue somewhat by considering offering the expertise of the Council's Energy Officer to community groups to provide advice on potential projects. The Council's Energy Officer has facilitated the development of a wide range of renewable technologies for Council properties over a number of years, so this expertise could be shared in the form of broad advice to community groups looking to set up new projects. There are also many web-based community energy resources available, so it is also recommended that the Council consider sign-posting community groups to these resources, either via the Council's own website, or via an alternative appropriate format.

3) **Legal**. Many projects have similar legal issues, constituting a legal entity (which one to choose) rights of access, share offers etc.

To some extent this issue may be somewhat resolved in Pembrokeshire by the existence of organisations such as Planed and CEiP, but it is worth noting that production of template documents which can be amended to make relevant for each project can be very beneficial to community groups. Not only does it provide a cheaper start to their legal proceedings, but it can also be very informative if seen at an early stage as it provides guidance on what may need to be covered. PCC could

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certainly facilitate this. They may also want to tender for suitably qualified legal assistance which they could signpost interested community groups to.

4) **Financial**. As we have noted above blended funding is often the best way to fund Community Renewable Energy projects, but many projects will require financial help before that stage is reached. Small amounts of funding are difficult to come by, just a £100 or so to enable hire of a venue for meetings or perhaps a few hundred pounds to produce a website.

It is recommended that the Council could consider whether a small grants pot could be provided for small amounts of funding towards energy groups. This could be administered in a similar way to the current Community Chest grants.

The Council could also consider investing in Community Renewable Energy itself. Where share issues allow local organisations as well as individuals to invest, the Council could, following obvious due diligence considerations, submit its own application for shares. This would support local Community Energy Activity, keep funding local and provide and income stream for future years. It is also likely to repay the capital at some future date. However, it is acknowledged that spending cuts have brought Council budgets under severe pressure and that this will limit the scope of what may be achieved.

Appendices

These are produced as separate documents due to size.

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