SD118

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

www.cymru.gov.uk

Practice Guidance

Planning for Renewable and Low Carbon Energy - A Toolkit for Planners

July 2010

Planning Policy Research Development Programme

This practice guidance was prepared for the Welsh Assembly Government by AECOM.

AECOM
Churchill House
Churchill Way
Cardiff
CF10 2HH

Tel 029 2035 3400
Tel + 44 029 2047 2277
www.aecom.com

Planning Division
Welsh Assembly Government
Cardiff
CF10 3NQ

Email : planning.division@wales.gsi.gov.uk
Planning web site - http://wales.gov.uk/topics/planning/?lang=en

75% wedi'i ailgylchu recycled
ISBN 978 0 7504 5616 6

CMK-22-01-205
F0060910

Table of Contents

List of Tables

List of Figures

Executive summary

The One Wales document sets out the Welsh Assembly's commitment to tackling climate change which include achieving annual carbon reduction-equivalent emissions reductions of 3% per year by 2011 in areas of devolved competence. The Assembly Government resolves that all will play the fullest part in reducing CO2 emissions and is committed to developing a comprehensive energy strategy and a renewable energy route map to ensure understanding of what "playing a full part" will mean.

Considerable responsibility for delivery of a low carbon Wales rests with the various departments within local authorities, with key roles in planning, waste management, land-ownership and energy procurement.

The "Planning for Renewable and Low Carbon Energy: A Toolkit for Planners" project was commissioned by the Assembly Government in November 2008. Supported by a steering group comprised of the Assembly Government and the Energy Saving Trust, the toolkit was developed by AECOM with Pembrokeshire County Council selected for a pilot study. Environment Agency Wales and Countryside Council for Wales were key providers of data.

Research associated with the development of the toolkit was divided into three components: the toolkit; a Renewable Energy Assessment for Pembrokeshire County Council (the output of the application of the toolkit to the Pembrokeshire County Council area and circumstances); and a Recommendations Report to the Assembly Government. Although each report can be read as a stand-alone piece of research, users of the toolkit will find it useful to read the reports in conjunction with each other.

The challenge of developing the toolkit was to develop methods for assembling a robust evidence base whilst minimising very technical exercises and ensuring that sources of data were readily available to all local authorities in Wales. In attempting to meet these criteria many of the datasets utilised refer back to UK level.

Also, as a result of attempting to ensure uniformity of approach and comparability of outputs, some local authorities may find they have more detailed data on which they might base their assessments. Refinement of the generic approach outlined in the toolkit is encouraged, though in a controlled way to ensure comparability and continued dissemination of best practice.

As part of a selection of tools upon which local authorities might draw in constructing the evidence base for their Local Development Plans, the "Planning for Renewable and Low Carbon Energy - A Toolkit for Planners" is designed, through the provision of information and method, to facilitate the production of a Renewable Energy Assessment with a view to the inclusion, in Local Development Plans, of renewable energy policies.

Early use of the "toolkit" within the Local Development Plan process is suggested though, as this toolkit has just been completed, this will be dependent upon the stage in the process reached by different local authorities: it is better to employ the toolkit at a later stage in the process than not at all.

As with all issues to be addressed in the Local Development Plan, some will be given a higher priority than others but all should be addressed. The allocation of sites for new development is a key area and it is in relation to this exercise that early use of the toolkit is recommended.

Renewable Energy Assessments will vary between local authorities dependent upon the nature and priorities given by councils and communities to various policy objectives. The toolkit is not a prescriptive document but illustrative, showing examples of some of the exercises that might be undertaken in order to compile a robust evidence base to support a selection of potential policy objectives.

Whilst predominantly a "toolkit for planners", it is strongly recommended that the toolkit is employed by local authorities and other public sector bodies to develop and align corporate estate, property and energy strategies with the findings of the Renewable Energy Assessment. Use of the toolkit is not therefore restricted to the LDP process but can be employed during development of, for instance, Regional Waste Strategies, etc.

The involvement of professionals from a range of disciplines is encouraged in the use of the toolkit. Different sections will require greater or lesser input from planners, energy managers/technicians, waste management officers, etc. In order to avoid unnecessary time and resources, and given the nature of some of the activities included in the toolkit, there is considerable potential for cooperation between local authorities and other public sector bodies in completing various exercises (e.g. wind and biomass resource mapping).

Included within the toolkit are methods to appraise the energy efficiency of current building stock, for both commercial and domestic use, and to predict future energy demand in-line with current UK targets. The public sector, tasked with a leadership role, should be pro-active in discussing cost-effective approaches to meeting such targets and facilitating the success of others. The toolkit provides the methods to contribute to the fulfilment of this role.

List of Abbreviations

AGL	Above Ground Level
ALC	Agricultural Land Classification
ASHP	Air Source Heat Pump
AS	Allowable Solutions
AHL	Anchor Heat Load
AONB	Area of Outstanding Natural Beauty
AAWS	Average Annual Wind Speed
BD	Biodegradable
BAP	Bio-Energy Action Plan
BIR	Building Integrated Renewables
BREEAM	Building Research Establishment Environmental Assessment Method
CO_2	Carbon Dioxide
CERT	Carbon Emissions Reduction Target
CRCEES	Carbon Reduction Commitment Energy Efficiency Scheme
CTW	Carbon Trust Wales
CIBSE	Chartered Institute of Building Services Engineers
CAA	Civil Aviation Authority
The "Code" or CSH	Code for Sustainable Homes
C(C)HP	Combined [Cooling] Heat & Power
CESP	Community Energy Saving Programme
CA	Conservation Area
(D)CLG	Department for Communities & Local Government
DECC	Department for Energy and Climate Change
DCW	Design Commission for Wales
DH(N)	District Heating (Network)
DHW	Domestic Hot Water
DSM	Dynamic Simulation Model
EE	Energy Efficiency
EEAC	Energy Efficiency Advice Centre
EfW	Energy from Waste
EM	Energy Manager
EPC	Energy Performance Certificate
EST	Energy Saving Trust
ESCo	Energy Services Company

ESW	Energy Strategy for Wales
ECA	Enhanced Capital Allowance
EAW	Environment Agency Wales
FIT	Feed in Tariff
FEC	Final Energy Consumption
FRZ	Flood Risk Zone
FCW	Forestry Commission Wales
GIS	Geographical Information Systems
GW	Giga Watt (1,000,000kW)
GWh	Giga Watt hours
GIFA	Gross Internal Floor Area
GSHP	Ground Source Heat Pump
kW	kilowatt (a unit of power equivalent to 1000watts or 1000 Joules/second
kWh	kilowatt hour (a unit of energy equivalent to the work done by one kilowatt constantly for one hour)
JHLAS	Joint Housing & Land Availability Studies
LPG	Liquefied Petroleum Gas
LDP	Local Development Plan
WLGA	Welsh Local Government Association
LLPG	Local Land Use & Property Gazetteer
LWPA	Local Waste Planning Authority
LZC	Low and Zero Carbon
LCBP	Low Carbon Buildings Programme
LCD	Low Carbon Development
LSOA	Lower Super Output Area
MJ	Mega Joule
MW	Mega Watt (1,000kW)
MW_e	Mega Watt electrical
MW[h]	Mega Watt hour
MW_t	Mega Watt thermal
MCS	Microgeneration Certification Scheme
MTOE	Million Tonnes of Oil Equivalent
MIPPS	Ministerial Interim Planning Policy Statement
MoD	Ministry of Defence
MUSCo	Multi Utility Services Company
MSW	Municipal Solid Waste

NATS	National Air Traffic Service
NFU	National Farmers Union
NNR	National Nature Reserve
NWSW	National Waste Strategy Wales
OGA	Off-gas area
ONS	Office of National Statistics
OS	Ordnance Survey
ODT	Oven Dry Tonne
PV	Photovoltaic
PPW	Planning Policy Wales
PL	Point Load
PCR	Post Construction Review
Part L	Part L of the Building Regulations relating to the Conservation of Fuel and Power
REA	Renewable Energy Assessment
RER	Renewable Energy Resource
RERM	Renewable Energy Route Map for Wales
RHI	Renewable Heat Incentive
ROC	Renewable Obligation Certificate
SRC	Short Rotation Coppice
SBEM	Simplified Building Energy Model
SSSI	Site of Special Scientific Interest
SAA	Small Area Agricultural [dataset]
SPA	Special Protection Area
SAP	Standard Assessment Procedure
SEA	Strategic Environmental Assessment
SSA	Strategic Search Area
SPG	Supplementary Planning Guidance
SDF	Sustainable Development Fund
TER	Target Emission Rate
TAN	Technical Advice Note
TM	Technical Memorandum
UPRN	Unique Property Reference Number
UDP	Unitary Development Plan
VOA	Valuation Office Agency
WHE	Welsh Health Estates

1 Introduction

1.1 Background and purpose of this toolkit

Climate change and energy security are key priorities of both the UK and Welsh Assembly Governments. The use of fossil fuels is seen as a major contributor to greenhouse gas emissions, a major cause of global climate change and moving towards a low carbon energy based economy to tackle the causes of climate change and improve energy security are a Government priority. The generation and use of renewable and low carbon energy sources has a key role to play in this and the UK Government is committed to meeting the EU target of 15 percent of energy from renewable sources by 2020. The Climate Change Act 2008 introduces a legally binding target of at least a 34 percent cut in greenhouse gas emissions by 2020, and at least an 80 percent cut by 2050, against a 1990 baseline.

The Welsh Assembly Government has made a commitment to tackling climate change, resolving that the Government and the people of Wales will play the fullest possible part in reducing its carbon footprint and meeting statutory UK and EU targets on greenhouse gas emission reduction[1].

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

1. Preparing planning policies and allocating land in their Local Development Plans
2. Development management - taking decisions on planning applications submitted to the local planning authority for development; as well as preparing Local Impact Assessments for schemes which are determined by the Infrastructure Planning Commission
3. Corporate - taking action at a council wide level to achieve a low carbon economy.
4. Leadership - taking forward wider community action and communicating the need to increase the uptake of renewable energy.

This toolkit has been prepared by AECOM for the Welsh Assembly Government to, primarily, support local authority planning officers with the first of the roles identified above these. It sets out how a Local Authority can prepare a robust evidence base to underpin a number of local development plan policies that can support and facilitate the deployment of renewable and low carbon energy systems. The evidence base, which is the outcome of this toolkit, consists of an assessment of the potential for renewable and low carbon energy generation, at different scales, and at different levels of detail.

In terms of development management, completing the assessment can be useful in several ways. Firstly, when assessing applications for new development sites, it can aid officers in discussions with developers around opportunities for district heating and making use of waste heat. Secondly, when assessing applications for larger scale new generation schemes, it can enable officers to identify whether there is the potential for those schemes to supply heat to new or existing development. Thirdly, in the case of wind developments, in can assist officers in understanding why a developer has chosen a particular location to develop a scheme.

However, as well as supporting planning officers with their LDP's, the intention is that the renewable energy opportunities that can be identified by applying the toolkit will also be useful in assisting local authorities to fulfil the third and fourth roles identified above.

1.2 Why should local authorities use the toolkit?

Planning policy

Use of the toolkit will assist local planning policy officers deliver two national planning policy expectations as set out in Planning Policy Wales, namely:

1. **Planning for Renewable Energy**[2] This indicates that local planning authorities (LPA's) should undertake an assessment of the potential for all renewable energy resources, renewable energy technologies, energy efficiency, and conservation measures and include appropriate policies in LDP's.

   To date only a few LPAs have produced an assessment of renewable energy to accompany their LDP and this toolkit is designed to facilitate the wider take up of this assessment.
2. **Planning for Sustainable Buildings**[3] This states that, as part of preparing their LDP's, "Local planning authorities should assess strategic sites to identify opportunities for higher sustainable building standards (including zero carbon) to be required. In bringing forward standards higher than the national minimum … LPAs should ensure that what is proposed is evidence-based and viable".

In order to achieve higher standards, it is highly likely that some form of renewable or low carbon energy generation will be required, and this toolkit sets out a method for how the potential for this can be identified and assessed.

Wider corporate role

In terms of their wider role, local authorities may have objectives or requirements in relation to tackling climate change that they need to meet, stemming from either Sustainable Community Strategies, national strategies (such as those listed in chapter 2) or their own corporate strategies. Applying the toolkit will enable local authorities to identify specific opportunities for taking forward renewable and low carbon energy generation in their area. This can then form a basis for more detailed implementation plans, feasibility studies and practical action.

As well as climate change mitigation, using the toolkit to identify renewable and low carbon energy opportunities can also assist in developing measures to tackle fuel poverty, through the promotion of district heating networks which serve existing as well as new developments. These opportunities can also help in delivering local economic benefits either in terms of locally grown fuel supplies, or by enabling a proportion of expenditure on energy to be retained within the local economy, from local generation, rather than going out to external energy companies[4].

1.3 Scope of this toolkit

What this toolkit does, and does not cover is set out below.

Planning

- The toolkit focuses on planning policy, rather than development management. As explained above, this toolkit is primarily aimed at policy planners, to guide them on how to prepare an evidence base to support renewable and low carbon energy policies and site allocations in their LDP's. It also aims to give some guidance on how planners can translate the evidence base into policies and targets.
- It is not intended to be a toolkit for use by development management officers to assess planning applications for either strategic new development sites that are incorporating renewable energy, or for stand-alone renewable energy generating systems. Having said this, the information that applying the toolkit can produce (such as the Energy Opportunities Plan, described in Chapter P, Policy Options) can potentially be very useful to inform pre-application discussions between development management officers and developers.

The toolkit provides guidance on how to identify opportunities for using low carbon as well as renewable energy sources, because sources of energy that emit less carbon dioxide can contribute to overall carbon targets. This is because, in the context of strategic new development sites, either can contribute to meeting any enhanced carbon reduction or Sustainable Buildings Standards targets that a local authority may wish to set.

Technology

- This toolkit is not meant to be an exhaustive guide to the different renewable and low carbon energy technologies that are available. Technical Advice Note 8[5] provides an introduction to a range of renewable and low carbon technologies and should be first point of reference. Others include The Department for Energy and Climate Change[6] and the Energy Saving Trust[7].
- Energy Hierarchy - The toolkit focuses on renewable and low carbon energy generation, and the opportunities for promoting this through LDP's, rather than on improving energy efficiency in new or existing buildings. This is not to imply that the latter is less important in terms of mitigating climate change: it is at least as, if not more, important. However, it is not covered in this toolkit, partly to keep the toolkit to a manageable size, but also because there is only a limited amount, if anything, that planning policy for new developments can contribute in this area,

over and above the existing Sustainable Buildings standards in Wales, and future changes to part L of the Building Regulations[8]. Again, we refer the reader to other excellent sources of information on energy efficiency in buildings, existing and new, that already exist[9].

- Transport - The toolkit covers how to assess the potential for generating renewable electricity, or heat (for use in buildings or processes) but does not include guidance on how to assess the potential for renewable or low carbon fuels for transport.
- On-shore - In terms of renewable energy options and resources, the toolkit only provides guidance on how to assess the potential for on-shore renewable energy. It does not cover the potential for offshore renewable energy, such as wave, offshore wind and tidal[10].
- Large scale on-shore wind - The toolkit is not intended to duplicate the analysis carried out in TAN 8, which identified Strategic Search Areas (SSAs) for large scale on-shore wind power. Rather, in the case of wind power, it is intended to help identify smaller scale opportunities outside of SSAs.
- Policy wording - The toolkit focuses on how to prepare an evidence base to support relevant policies in LDP's, rather than giving detailed guidance on how policies should be worded. The latter is the role of the existing MIPPS[11], and their supporting guidance in TAN 8, and TAN 22, and more up-to-date guidance will be given in the forthcoming revision to TAN 8.
- Test of Soundness - Whilst this toolkit provides a framework for how an assessment can be carried out, and policies proposed, it does not provide a definitive template for sound evidence. The responsibility of preparing evidence for LDP policies and decisions taken in the LDP is the sole responsibility of the LPA. In the majority of cases assumptions and data used in carrying out the assessment have been sought from established sources, and these are listed in the text. Where there is no established source AECOM has derived assumptions based on the best evidence available. In future, guidance, assumptions and data sources may change, particularly as technology and the policy and regulatory framework evolves.

14 Defining renewable energy and low carbon energy

Renewable energy

There are many definitions of renewable energy[12]. A useful one is:

> **"Renewable energy is that which makes use of "energy flows which are replenished at the same rate as they are used[13]"**

The definition employed in Planning Policy Wales (Para 12.8.7) is as follows:

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

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

Most forms of renewable energy stem directly or indirectly from the sun. The direct ones include, obviously, solar water heating, and photovoltaics. This also includes ground source and air source heat pumps[14], which make use of solar energy stored in the ground. The indirect forms are: wind power, as wind is caused by differential warming of the earth's surface by the sun; hydropower, as rainfall is driven by the sun causing evaporation of the oceans; and biomass energy (from burning organic matter), as all plants photosynthesise sunlight in order to fix carbon and grow.

The combustion of biomass fuel is carbon neutral, because although the combustion releases CO2, the same amount of CO2 was taken out of the atmosphere when the biomass was growing. Research informing Planning Policy Wales confirms "Biomass is generally regarded as fuel (other than fossil fuel), at least 98 per cent of the energy content of which is derived organically from plant or animal matter. This includes agricultural, forestry or wood waste or residues, sewage and energy crops".

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

Of all these, perhaps the most complex and multi-faceted are biomass energy, as it can take so many forms. It can include: burning of forestry residues; anaerobic digestion of animal manures and food wastes; combustion of straw and other agricultural residues and products. It also includes the methane produced from the anaerobic digestion of biodegradable matter in landfill sites (i.e. landfill gas), as well as any energy generated from the biodegradable fraction of waste going into an energy from waste plant.

This toolkit does not cover the assessment of the resource for all renewable energy options. It is focused on onshore renewable energy options only. It also does not cover renewable energy options that are unlikely to be generally accessible at a local authority level, for sites in Wales, such as geothermal energy, or tidal barrages. It does cover the following renewable energy technologies (considering both electricity and heat):

Table 1 - Renewable Energy Technologies covered by the Toolkit.

- Wind energy (on-shore wind and community scale development)
- Biomass energy: including forestry residues, miscanthus, short rotation coppice and straw
- Energy from Waste (EfW) including:
  - Waste wood
  - Municipal waste
  - Industrial and commercial waste
- Centralised Anaerobic Digestion, covering:
  - Food waste
  - Agricultural wastes
  - Sewage sludge
- Hydropower energy
- Building Integrated Renewables (BIR), covering: biomass boilers; air and ground source heat pumps, photovoltaics; small and micro wind power.

Low carbon energy options

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

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

As explained above, this toolkit covers both renewable as well as low carbon forms of energy, but the extent to which both can be considered depends on which policy objective you wish to pursue (see sections P1-5 for a description of some of these). If you are looking at developing an evidence base for area wide renewable energy targets (in support of meeting the UK 15% renewable energy target) then you should only include renewable energy options.

On the other hand, if you are considering the opportunities for carbon reduction on strategic new development sites, then you should consider both renewable and low carbon energy options. This is because either can contribute to carbon reductions, as measured by Part L of the Building Regulations.

1.5 Explanation of energy terms: the difference between power and energy and electricity and heat

Power vs. Energy output

In the context of this report, power is measured in either kiloWatts (kW), or MegaWatts (MW), which is a thousand kW, or gigaWatts (GW), which is a thousand MW. It is a measure of the electricity or heat output being generated (or used) at any given moment in time. The maximum output of a generator, when it is running at full power, is referred to as its installed capacity or rated power output.

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

This distinction is important, because in carrying out the renewable energy resource assessment set out in E1, you will need to calculate both the potential installed capacity (or maximum power output) of different technologies, as well as the potential annual energy output.

Electricity vs. Heat output

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

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

References

1 Climate Change Strategy - High Level Policy Statement, Welsh Assembly Government, 2009

2 Planning Policy Wales Chapter 12 Infrastructure and Services

3 Planning Policy Wales Chapter 4 Planning for Sustainability

4 Low Carbon Wales, Sustainable Development Commission, 2009

5 Technical Advice Note 8, Renewable Energy, http://wales.gov.uk/desh/publications/planning/technicaladvicenotes/tan8/

6 DECC http://www.planningrenewables.org.uk/page/index.cfm

7 Energy Saving Trust at http://www.energysavingtrust.org.uk/Energy-Saving-Trust-advice-centre-Wales

8 Obviously, there is a lot that can be done to reduce energy use in existing buildings, but these do not generally fall with the remit of the planning system

9 e.g. from the Energy Saving Trust in Wales, as per the weblink given above

10 This is because, apart from the cable footfall onshore, offshore renewables are not within the planning jurisdiction of local planning authorities

11 On Renewable Energy (01/2005) and Planning for Sustainable Buildings, as mentioned above

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

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

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

2 Policy context and drivers for renewable energy

2.1 Introduction

In One Wales- the programme for government, the Welsh Assembly Government set out a commitment to reduce greenhouse gas emissions in Wales, with an aim to achieve annual carbon reduction-equivalent emission reductions of 3% per year by 2011 in areas of devolved competence, including actions on diversified renewable energy generation. The Assembly Government has reiterated the recognition that climate change is the greatest threat facing humanity and is committed to ensuring that Wales plays a full part in meeting the challenges which this presents.

The Assembly Government has a legal obligation to promote Sustainable Development and has embarked on an ambitious and long-term programme of cross cutting policy initiatives to address these issues. This is contained in One Wales: One Planet (2009) which sets out a vision where within the lifetime of a generation we want to see Wales using only its fair share of the earth's resources. Renewable energy plays an integral part in achieving this vision. The draft Climate Change Strategy[15] set out a vision for Wales in 2050. Within this vision it states.

"The energy intensity of society has decreased significantly. There has been a major consistent drop in energy and water demand. There has been a major increase in renewable energy generation, offshore and onshore".

Moving towards a low carbon energy based economy is a national priority. The UK Government is committed to meeting the EU target of 15 percent of energy from renewable sources by 2020, and the Welsh Assembly Government will deliver its fair share towards these targets as set out in the draft Climate Change Strategy (2009).

2.2 UK and European policy context

EU Renewable Energy Directive: The UK has signed up to the Directive, agreeing to legally binding targets of 15% of energy from renewable sources by 2020. Modelling undertaken on behalf of the Department for Energy and Climate Change (DECC) suggests that by 2020, this could mean:

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

The UK Renewable Energy Strategy (RES) (2009) sets out how the UK will increase the use of renewable electricity, heat and transport to meet this target and address the urgent challenges of climate change and national security of energy supply.

2.3 Wales policy context for planning and renewable energy

Planning's wider role in shaping places with lower carbon emissions and resilience to climate change is set out in Planning Policy Wales (PPW) (2010). The Assembly Government has shown leadership by producing policy guidance in PPW and the associated Technical Advice Note (TAN) 8 on renewable energy.

In September 2009 changes were made to 'permitted development' rights to make provision for the installation of certain types of micro-generation by householders without the need for planning permission, namely solar photovoltaic and solar thermal panels, ground and water source heat pumps and flues for biomass heating.

The Assembly Government will be consulting on further proposals on the appropriate extension of the permitted development rights in relation to micro-generation, which should encourage greater domestic and non-domestic take-up of these technologies.

The Planning and Energy Act, 2008, enables local planning authorities in Wales to set reasonable requirements in the LDP for the generation of energy from local renewable sources and low carbon energy and for energy efficiency. The Act is complemented by the policies contained in PPW that cover such issues and provides a legal basis for the implementation of LDP policies against the national framework. The Act requires that LDP policies must not be inconsistent with relevant national policies, and the new powers of local planning authorities under the 2008 Act are also subject to the requirements of section 62 of the Planning and Compulsory Purchase Act 2004.

As mentioned in chapter 1, now PPW and supporting TAN 22, states that, as part of preparing their LDP's, "Local planning authorities (LPAs) should assess strategic sites to identify opportunities for higher sustainable building standards (including zero carbon) to be required. In bringing forward standards higher than the national minimum … LPAs should ensure that what is proposed is evidence-based and viable".

2.4 Wales wider policy context

The Renewable Energy Route Map for Wales (Consultation) (2008) set out proposals for moving Wales towards self-sufficiency in renewable electricity in a generation whilst at the same time driving towards increased energy efficiency and a greater level of heating requirements being supplied from renewable sources. The route map envisages that microgeneration and other small scale technologies can play a significant role in delivering these proposals, as supported by the Microgeneration Action Plan for Wales (2007). This is supported by the actions in One Wales: One Planet (2009) and the draft Climate Change Strategy (2009) to remove barriers to the installation of microgeneration.

Wales low carbon Energy Statement. In 2010 the Assembly Government published a low carbon energy policy statement that provides the sustainable development framework for the acceleration, in Wales, of the transition to an efficient low carbon energy based economy. The successful delivery of this will depend on the facilitation of all forms of renewable energy across Wales.

National Energy Efficiency Savings Plan (Consultation) (2009). This proposes practical short term actions that aim to reduce greenhouse gas emissions, tackle fuel poverty in Wales with a particular emphasis on improving the energy efficiency of the most inefficient homes in Wales, and support 'green' jobs and development of the supply chain for energy efficiency and microgeneration technologies. The Plan will sit below the Energy Statement which will provide the overall framework for energy policy in Wales.

The Bioenergy Action Plan (BAP) (Consultation) (2009). This proposes targets of 5TWh of electricity and 2.5TWh of usable heat energy from renewable biomass by 2020.

Climate Change Strategy (Consultation) (2009) Wales has set a target to reduce its emissions of greenhouses gases by 3% per year from 2011 from areas of devolved competence. In June 2009, the Welsh Assembly Government published its Climate Change Strategy - Programme of Action consultation. The consultation sets out in more detail the actions the Assembly Government are proposing to deliver their climate change objectives.

2.5 Other UK Drivers for Renewable Energy

Building Regulations and Zero Carbon: Changes to the Building Regulations in 2010, 2013 and 2016 are expected to bring in challenging dwelling (CO_2) emissions rate targets for residential development and for commercial development by 2019. By 2016, new homes will need to achieve a 70% reduction in CO_2 emissions on or near site from energy efficiency and the use of Low and Zero Carbon (LZC) energy options[17]. For large sites, district heating (DH) from a low carbon source is likely to be one of the most cost-effective ways of achieving this.

Developers will then have to deal with their residual carbon emissions through the use of Allowable Solutions (AS). One AS proposed would allow credit for carbon emissions where heat is exported from the site to nearby existing buildings via a DHN. The power to make Building Regulations for buildings in Wales was transferred to the Welsh Ministers on 31st December, 2009.

Feed in Tariffs (FITs). The 2008 Energy Act contains powers for the introduction of FITs in Great Britain to incentivise renewable electricity installations up to a maximum capacity of 5 MW. The Government intends that FITs should be implemented by April, 2010. At the time of writing, the final details of the scheme are yet to be announced. The impact of FITs will be significantly increased revenue for small-scale generators of renewable electricity, such as photovoltaic systems or small wind turbines. The FITs may also make it easier to obtain finance for such projects as it provides a guaranteed price for the electricity generated.

Renewable Heat Incentive (RHI). The Energy Act 2008 also allows for the setting up of a Renewable Heat Incentive (RHI), which would provide financial assistance to generators of renewable heat and to some producers of renewable heat, such as producers of biomethane. The Government aims to have this in place by April 2011. The incentive payments will be funded by a levy on suppliers of fossil fuels for heat. The proposal is that the RHI will cover a wide range of technologies including biomass, solar hot water, air and ground source heat pumps, biomass CHP, biogas produced from anaerobic digestion and injection of biomethane into the gas grid. The UK Government plans to issue a consultation on the details of the RHI in 2010.

The impact of the RHI is that it will make generation of renewable heat more financially viable than it is currently.

The Renewables Obligation (RO). The RO is the main current financial support scheme for renewable electricity in the UK, and is administered by Ofgem. It obliges electricity suppliers in the UK to source a proportion of their electricity from renewable supplies. They demonstrate this has been achieved by showing they have the required quantity of Renewable Obligation Certificates (ROCs), which renewable electricity generators are awarded for their output.

If suppliers fail to meet their target, they have to pay a fine and also the value of the fine "pot" is, on an annual basis, split among those suppliers who do meet their targets. This creates a market for the ROCs and means that generators of renewable electricity can sell the ROCs that they receive for significantly more than they receive for their electricity output. The intention is that RO will continue to incentivise electricity generation from larger scale renewable energy installations, whilst the FIT will be aimed at smaller generators.

The Renewable Heat Incentive (RHI) (Feed-In Tariff) (2011). The UK Government has announced it will introduce the RHI for generators of renewable heat. This is likely to provide producers of renewable heat with guaranteed premium revenue for all the heat they sell. Although the full details of the scheme are yet to be consulted on, this is likely to provide a significant source of revenue for DHNs fed by renewable fuels, such as biomass.

Grant funding. The Low Carbon Buildings Programme (LCBP), Phase 1 provides grant funding of up to £2,500 per property to householders wishing to generate their own heat or electricity. The grants are administered by the Energy Saving Trust (EST) on behalf of DECC. Phase 2 of the programme relates to grants for microgeneration technologies for a public sector building (hospitals; schools; local authorities; housing associations), community or charitable bodies.

The Microgeneration Certification Scheme (MCS). The LCBP is open to all products and installer companies registered on the Microgeneration Certification Scheme (MCS). The MCS is an independent scheme that certifies microgeneration products and installers in accordance with consistent standards. It is designed to evaluate microgeneration products and installers against robust criteria providing greater protection for consumers. The web addresses below can be used for further information:

- http://www.microgenerationcertification.org/
- www.eca.gov.uk/etl/find
- www.estif.org/solarkeymark/productsandcertificates.php

References

[15] Climate Change Strategy - High Level Policy Statement Consultation, 2009

[16] Which is now to be the Wales low carbon Energy Statement

[17] The power to make Building Regulations for buildings in Wales will be transferred to the Welsh Ministers on 31st December, 2009. Therefore, the timescales for zero carbon in Wales may, in future, differ from those currently proposed in England

3 How to use this toolkit

3.1 Structure of the toolkit

We have laid out this toolkit in such a way that, depending on which policy objectives or options your local authority wishes to pursue in relation to renewable energy, you can quickly choose which of the evidence base options could support this policy option. You can then navigate to the relevant chapter for that evidence base option to find detailed guidance on how to prepare the evidence base. This is designed to avoid you having to read chapters that are not relevant to you or, more to the point, to avoid preparing elements of the evidence base when they are not relevant for the policy objectives or options you are aiming towards.

There are five potential policy options, and four evidence base options, and these are shown in the navigation table on the next page. Each of the evidence base options has its own chapter, (E1 to E4), whilst the policy options are all covered in chapters P through to P5. For each of the five policy options, one or more of the evidence base options would support it. The aim of the table is to show you, for any given policy options, which combination of the evidence base options may be suitable. In support of the evidence base there are 10 different projects set out in individual Project Sheets at the back of this document.

The areas of dark shading in the navigation table indicate those elements of the evidence base that will be relevant in supporting a particular policy option shown in the left hand column. The lighter coloured squares indicate those aspects of the evidence base that are less relevant to supporting a particular policy option, but will be useful in informing it. The white squares indicate that an evidence base option is not needed for that policy option. If you are not clear at this stage on which policy options you are interested in, you can go straight to chapter P to review these in more detail. A brief summary of the policy options is given below.

Local Development Plan - Planning for Renewable Energy Policy Scenarios

P1. Develop area wide RE targets. This involves setting authority wide targets for installed capacity and energy generation from both renewable electricity and renewable heat.

P2. Inform site allocations. This involves making use of the area wide renewable energy assessment, and the heat opportunities map as a factor in assessing the suitability of candidate sites. These can identify whether the sites may be in conflict with potential sites for renewable energy deployment, or whether there may be an opportunity to consolidate sites together in terms of new development providing potential heat loads for renewable energy generation.

P3. Identify sites for stand-alone renewable energy development. This covers the identification for renewable and low carbon development of two kinds of strategic sites. The first kind is strategic sites for stand-alone, larger scale renewable energy schemes, not necessarily linked to any new developments.

The second is strategic sites in the more traditional site allocation sense, i.e. sites for major new development. The latter may involve developing carbon reduction targets or sustainable buildings standards for major new development sites in excess of those set out in the Planning for Sustainable Buildings MIPPS, where the assessment shows that there is significant potential for renewable or low carbon energy generation or use.

P4. Develop policy mechanisms to support District Heating Networks (DHNs) for strategic sites. For new development sites where there is the potential for district heating networks (DHNs) to be fuelled by renewable or low carbon energy sources, local authorities can consider setting requirements to connect to DHNs, or perhaps to pay into a fund to support DHN infrastructure in the locality. For both P3 and P4, a key output from the evidence base assessment is an Energy Opportunities Plan, which is a visual, spatial depiction of the opportunities. This is discussed in detail in chapter P.

P5. Identify further actions for LA, public sector and wider stakeholders. This follows on from P3 and P4, and involves the identification of actions wider than just planning policy to assist in the delivery of strategic opportunities for renewable or low carbon energy generation.

Figure 1: Navigating your way through the toolkit

Evidence base options

Policy options		E1. Area wide RE assessment	E2. BIR uptake assessment	E3. Heat opportunities mapping	E4. Detailed viability appraisal for strategic sites
	Chapter	E1 Project Sheets A-F and I-J	E2 Project Sheets H, J	E3 Project Sheet G	E4
P1. Develop area wide RE targets	P1				
P2. Inform site allocations	P2				
P3. Identify opportunities and set targets for RE on strategic sites	P3			Energy Opportunities Plan	
P4. Develop policy mechanisms to support District Heating Networks (DHNs) for strategic sites	P4				
P5. Identify further actions for LA, public sector and wider stakeholders	P5				

RE = Renewable Energy; BIR = Building Integrated Renewables

Table 2: Example policy scenario

Example Policy Scenario

A local planning authority wants to identify an authority wide renewable energy target to support their approach to facilitating renewable energy in their LDP.
To do this they would need to

1. Carry out an area wide renewable energy assessment (E1)

   To prepare this evidence they would need to read chapter E1, and then complete

   Project Sheet A: identify existing and proposed LZC energy technologies

   Project Sheet B: assess wind energy resource

   Project Sheet C: assess wood fuel and energy crops resource

   Project Sheet D: assess the energy from waste resource

   Project Sheet E: assess the energy resource from anaerobic digestion

   Project Sheet F: assess the hydropower resource

   Project Sheet I: calculate the current and future energy baseline

2. Carry out a 'Building Integrated Renewables' uptake assessment (E2).

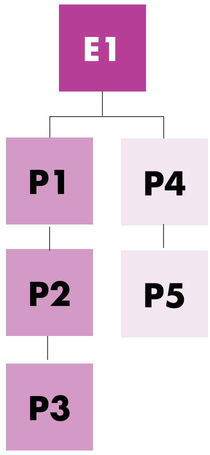
   To prepare this evidence they would need to read chapter E2 and complete the simplified method given in that section. If they wanted to do a more bespoke uptake assessment for their authority, they would also need to complete:

   Project Sheet H: assess the building integrated renewables resource

   Therefore you would refer to chapters E1 and E2 and the relevant appendices/ project sheets for information on how to prepare these aspects of the evidence base and to section P1 in chapter P to give a general overview of how to draw on the evidence to formulate the targets.

In order that you do not have to constantly revisit the main toolkit structure diagram, at the beginning of each section a summary diagram is provided showing the policy objectives (in dark purple) for which completing the section is recommended and (light purple) where it is optional but would be useful to inform such policy objectives. An example of the section header diagram is shown below.

Figure 2: Example of the evidence base sections header diagram



For the example above, the evidence base chapter is E1: Area Wide Resource Assessment, which is shown as the top box. The darker shaded boxes to the left are those policy objectives for which completion of the component is strongly recommended. The boxes to the right show policy objectives for which completion of the evidence base would be useful to inform them.

3.2 Tasks and steps

Within each evidence base, there may be a series of tasks that need to be completed. A table at the start of each section lists the tasks involved, and also indicates the questions that completing that task will enable you to answer about the renewable or low carbon energy potential in your area.

Within each task, we provide a series of steps that must be followed in order to complete the task. Where appropriate, we provide examples of the outputs of key steps or tasks, to give you a better understanding of what is required.

3.3 Who should carry out the work outlined in this toolkit?

The toolkit is designed for use by LA's although there is a requirement for officers with certain skill sets. The toolkit uses a Geographical Information Systems (GIS) approach and therefore requires significant input from a GIS officer. It is our understanding that all or most local authorities in Wales have access to such skills.

In addition to the use of GIS, the involvement of an energy officer, preferably with knowledge of renewable energy generation, is desirable. Although we have set out a detailed method for assessing the renewable and low carbon energy resource, it will inevitably be more straightforward for an officer with energy expertise to apply this than, say, a planning policy officer.

The identification of opportunities and the translation of potential resource into potential targets will require input from a wider stakeholder group (e.g. waste manager, estates manager, education officer, etc). This is to ensure that all relevant information is captured and that decision making is integrated across the LA. Further, the setting of area wide targets and enhanced targets for development sites will require engagement with the wider public sector and community, and potentially developers and the private sector.

Lastly, for detailed analysis, particularly in relation to the economic and technical feasibility of DHNs and other technologies, it is likely that consultants will be required to undertake such work. Where this is the case, this toolkit provides information on the issues that LA's should incorporate within a work brief and that should be addressed in detail by the consultant.

3.4 At what stage in the LDP development process should this toolkit be used?

The toolkit can be used at various stages, depending on the policy objective.

If the aim is to develop area wide renewable energy targets then, as long as the local authority has a rough idea about potential future dwelling numbers and non-residential development (to inform the BIR uptake assessment) then this element of the evidence base can be completed.

In terms of informing site allocations, it is for the local authority to decide where in the process of sieving candidate sites the potential for renewable energy should be considered. The Area Wide Renewable Energy Assessment (E1) and the Heat Opportunities Mapping (E3), can be carried out in advance of the LDP process, if required, so that the results are available to inform the early assessment of candidate sites.

For strategic sites (E4), the local authority will need to know what its strategic new development sites are, so this may need to come later in the LDP process.

3.5 The use of GIS

To benefit from identifying opportunities for renewable energy as part of an LDP mapping these opportunities and renewable energy potential is best done using Geographical Information System (GIS) database.

Using GIS to map these opportunities and resources allows the imposition of constraint layers and to identify specific locations for where certain renewable energy technologies may be viable and where strategic renewable energy opportunities can be identified and further work carried out.

In the vast majority of cases LPA's will be using a GIS database to inform the LDP process anyway. This toolkit adds additional layers of information with which to inform decisions of the LDP growth strategy, identification of sites and preparation of planning policies.

Mapping opportunities and constraints through GIS also provides a useful visual tool with which to engage with the community, developers and potential energy suppliers in the delivery of renewable and low carbon energy developments. Local authorities can update this tool over time to continue to inform the delivery of specific opportunities as they develop.

3.6 The case study approach

In preparing this toolkit Pembrokeshire County Council was chosen as a case study authority to demonstrate worked examples of the evidence, tasks and projects carried out in implementing the toolkit. The case study has been produced as a separate report, but throughout this toolkit the outputs from each of the case study projects and tasks have been presented to provide an illustration of the level of detail needed.

E1 Area wide renewable energy assessment

This section provides an introduction to renewable energy resource assessments and provides an example taken from the renewable energy resource assessment completed for Pembrokeshire County Council using the method detailed in this toolkit. This section will lead you to explore 'accessible' renewable energy resources, the variation in technologies employed to utilise such resources and the different outputs [electricity/ heat] of each technology. The following table indicates the tasks that are associated with this component and the questions that this toolkit helps you answer.

Reference is made to various appended Project Sheets. Each Project Sheet contains a method for completing a task. Completion of these tasks will provide a supporting evidence base relevant to the section heading [e.g. "Area wide renewable energy assessment"].

Table 3: Tasks associated with the 'area wide renewable energy assessment' section

Area Wide Renewable Energy Assessment		
Task	**Questions that this toolkit helps you answer**	**Local Authority Action Required**
1. Calculate existing and future energy baseline	What is the current energy demand in your local authority area? What will be the energy demand in your local authority area in 2020?	**Complete Project Sheet I**
2. Existing and proposed LZC energy technologies	What is the existing capacity of low and zero carbon energy technologies in your local authority area? Are any low and zero carbon energy technology installations being proposed in your local authority area?	**Complete Project Sheet A**
3. Wind Energy Resource	What is the potential for medium and large scale wind in your local authority area? What are the potential sites for stand-alone renewable energy development in your local authority area?	**Complete Project Sheet B**

Area Wide Renewable Energy Assessment (Cont'd)		
Task	**Questions that this toolkit helps you answer**	**Local Authority Action Required**
4. Biomass Energy Resource	What is the potential energy from biomass in your local authority area?	**Complete Project Sheet C**
5. Energy from Waste	What is the potential energy from municipal solid waste in your local authority area?	**Complete Project Sheet D**
	What is the potential energy from commercial and industrial waste in your local authority area?	**D**
	What is the potential energy from energy from food waste in your local authority area?	**E**
	What is the potential energy from energy from animal manure and poultry litter in your local authority area?	**E**
	What is the potential energy from energy from sewage sludge in your local authority area?	**E**
6. Hydropower Energy Resource	What is the potential energy [MW] from hydropower in your local authority area?	**Complete Project Sheet F**

E1.1 Task 1: Calculate existing and future energy baseline

This section addresses the method employed for base-lining area wide energy consumption. The detailed method can be found in Project Sheet I. The method relies upon:

- WAG derived data and statistics currently published by DECC.

A comprehensive methodology for calculating your local authority energy baseline is given in Project Sheet I.

The following table indicates the reported total energy annual demand [GigaWatt hour [GWh]] for the UK, Wales and the Case Study Authority for 2006 by energy sector.

Table 4: Annual energy demand [2006] for the UK, Wales and Pembrokeshire

	Total Energy 2006 [GWh]		
Sector	**UK**	**Wales**	**Case Study Authority**
Electricity	328,393	17,394	**1,042**
Heat	898,287	55,489	**9,735**
Transport	504,871	25,319	**919**

Future energy demand

Future energy demand should be established in order to:

- Provide indicative figures to inform area wide renewable energy installed capacity targets.

The basis of the analysis undertaken for the RES analysis is the projected Final Energy Consumption [FEC] for 2020, to which the UK share of the EU target applies. This is based on forecast demand across the different energy use sectors - electricity, heat and transport, from the lead DECC energy model.

The following table indicates an example of predicted future energy demand by key energy sector for Pembrokeshire in 2020. A comprehensive methodology for calculating your local authority future energy demand is given in Project Sheet I.

Table 5: An example of future energy demand for Case Study 1

	Case Study		
Sector	**Total Energy 2006 [GWh]**	**Predicted % change to 2020**	**Total Energy 2020 [GWh]**
Electricity	1,042	-0.3	1,039
Heat	9,735	-18.7	7,915
Transport	919	1.2	930

E1.2 Task 2: Existing and proposed LZC energy technologies

Establishing the capacity of any Low and Zero Carbon [LZC] technologies already installed for an area can demonstrate the progress being made and establish a baseline of installed capacity to inform future potential and target setting. Where LZC energy technologies already exist, the installed capacities [measured in MW] can be recorded and incorporated as a contribution to overall final targets. Project Sheet A sets out a method for establishing how much generation you already have in your area.

Example output

Based on the method as described in Project Sheet A, an example of the total existing and proposed LZC energy technology installations for Pembrokeshire County Council is given in the tables below.

Table 6: Existing renewable electricity capacity

*The technologies highlighted in light purple refer to Building Integrated Renewables. It is important to note the technology categories of current installed capacity, but particularly the combined installed capacities of BIR electricity generating technologies in order to populate Table 16 (modelling electricity generating BIR uptake) and the 'Accessible Resource Summary Table' 32

Name of scheme	Technology	Capacity [MWe]	Status	Source
Castle Pill Farm	Wind Onshore	3.2	Operational	Ofgem
Withyhedge	Landfill Gas	1.74	Operational	Ofgem
Narbeth Waste Water Treatment Works	Sewage Gas	0.11	Operational	Ofgem
Preseli Hydro	Hydro	0.07	Operational	Ofgem
Cerrig Hydro	Hydro	0.01	Operational	Ofgem
Y Gaer Hydro	Hydro	0.00	Operational	Ofgem
Caerfai Farm	Wind Onshore*	0.02	Operational	Ofgem
-	PV*	0.03	-	Grant bodies
-	Wind Onshore*	0.06	-	Grant bodies
Total	**-**	**5.24**	**-**	**-**

Table 7: Existing renewable heat capacity

Name of scheme	Technology	Capacity [MWt]	Status	Source
Bluestone holiday park	Biomass Boiler (District Heating)	1.60	Operational	Council Staff
Pembrokeshire College	Biomass Boiler*	0.35	Operational	Council Staff
Pembrokeshire Technium	Biomass Boiler*	0.15	Operational	Council Staff
Pembrokeshire Schools	Biomass Boiler*	0.45	Operational	Council Staff
-	Solar water heating*	0.50	-	Grant bodies
-	Heat pump*	0.04	-	Grant bodies
-	Biomass Boiler*	0.05	-	Grant bodies
Total	**-**	**3.14**	**-**	**-**

*The technologies highlighted in light purple refer to Building Integrated Renewables (<0.5MW). It is important to note the technology categories of current installed capacity, but particularly the combined installed capacities of BIR heat generating technologies in order to populate Table 18 (modelling heat generating BIR uptake) and the 'Accessible Resource Summary Table' 33

E1.3 Task 3: Wind Energy Resource

As mentioned in the Introduction to this toolkit, for the purposes of planning policy in Wales large scale wind power has been defined in TAN 8 as wind farms of between 25MW and 50MW. Those above 50MW are the responsibility of the Independent Planning Commission under the Electricity Act. TAN8 provides details of 'Strategic Search Areas, [SSAs], sites identified as suitable and potential locations for large scale wind. These should be investigated and noted as part of any evidence base developed with the toolkit. TAN8 states that 'outside of SSAs wind farms are allowed up to 25MW capacity on urban brown field sites and less than 5MW elsewhere' However, because the focus here is on establishing the wind resource, this exercise should not be constrained by such guidance.

Further constraints to onshore wind development not included within the toolkit include the practical access to sites required for development, landowner willingness for development to go ahead, political will, the time to complete planning procedures and an economic distance to the nearest appropriate electricity grid connection. None of these constraints were considered in estimating the available resource.

Wind farms, by nature, are most usually situated in rural settings away from residential development and where the wind resource is least constrained. This can mean that there is often no opportunity to utilise on-site the outputs from wind farms leaving export of electricity to grid as the only option. The toolkit has not utilised national grid data but the local authority may wish to investigate overlaying GIS layers of the energy networks data available to them. Also, the impact of wind farms on landscape character was not taken into account.

Some key issues to note in relation to wind farms and opportunities to LA's are:

- Investment interest of Energy Services Companies [ESCOs] may be secured through the identification of appropriate sites.
- Some organisations are actively marketing support services to enable LAs to exploit their estates through installation of renewable energy technologies.
- Large scale renewable installations can provide significant revenue streams to LA's or off-set significant carbon emissions to assist with meeting their obligations under the Carbon Reduction Commitment Energy Efficiency Scheme.

For the purposes of this assessment it was considered that 6m/s at 45m above ground level [agl] is a minimum economic wind speed, that there should be maximum economic use of the resource in line with constraints; the notional turbine used was a 3rd generation 2MW, 120m diameter, 80m hub height unit, there is a maximum capacity of 5 x 2MW turbines per km^2 of available land and that the distribution grid capacity would not be a significant constraint. Topple distance and buffer distances are included within the method description, which is set out in Project Sheet B.

Example output

The table below shows the total land area [km^2], capacity [MW] and annual energy generated [MWh] that is potentially available for wind turbine development across Pembrokeshire County.

Table 8: Example of accessible wind resource output for Pembrokeshire County, allowing for cumulative impact buffer

Potential wind farm	Area (km^2)	Potential capacity (MW)
1	1.17	11.68
2	0.68	6.84
3	0.36	3.55
4	0.24	2.37
5	0.19	1.91
6	0.05	0.53
7	0.03	0.28
Total	**2.72**	**27.17**

E1.4 Task 4: Biomass Energy Resource

The recent publication of the BAP [2009] revealed targets of 5TWh of energy generation incorporating a minimum of 2.5TWh thermal by 2020 from bio-energy resources.

According to the National Assembly Sustainability Committee "The [Renewable Energy] Route Map … predicts Wales could produce approximately 6TWhr per year of electricity from sustainable biomass sources by 2025.

Unlike wind farms, biomass can be utilised for the generation of both electricity and heat & domestic hot water (DHW). The use of energy crops, forestry residues and recycled wood waste for energy generation can have a number of advantages:

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

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

Example Output

Table 9: Example output of total available biomass resource for Pembrokeshire

Outputs	Energy crops	Woodland	Total
Available area [ha]	70,335	13,934	84,269
Percentage of area that can be used	10%	n/a	-
Usable area [ha]	7,034	13,934	20,968
Yield [odt per ha]	12	0.6	-
Yield [odt]	84,402	8,360	90,762
Electricity			
Required odt per 1MWe	6,000	n/a	-

Outputs	Energy crops	Woodland	Total
Installed capacity [MWe]	**14.0**	**n/a**	**14.0**
Heat from CHP			
Required odt per 1MWt	3000	n/a	-
Installed capacity [MWt] from CHP	**28.0**	**n/a**	**28.0**
Heat from boilers			
Required odt per 1MWt	660	660	-
Installed capacity [MWt] from boilers	**0.8**	**13.0**	**13.8**

Odt: oven dried tonnes
Ha: hectares

E1.5 Task 5: Energy from Waste

The detailed method for calculating the potential energy from Municipal Solid Waste (MSW) and Commercial and Industrial (C&I) waste streams can be found in Project Sheet D.

Local Waste Planning Authorities [LWPAs] will have developed detailed plans on how to treat the Municipal Solid Waste [MSW] stream arising in the LWPA area. Some LWPAs will have worked with neighbours and Regional Waste Teams to investigate preferred options for the treatment of waste. It is these plans that will inform which particular technologies will be employed, their capacities and preferred locations. The toolkit should be utilised for the development of future waste strategies to ensure that planned generation of energy from waste plant is utilised to the fullest extent

Less will be known about the plans of commercial waste operators to treat commercial and industrial waste streams. Organisations involved in such activity should be fully engaged to ensure that opportunities to utilise energy are not lost.

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

In order to comply with Welsh Assembly Government requirements, the National Waste Strategy for Wales [NWSW; 2002], at least 40% of the municipal waste stream should be either composted or recycled with a minimum of 10% recycled and 10% composted [p5.29]. It is understood that targets may be revised in the future. In such circumstances the accessible resource will require amending as appropriate.

Other targets for consideration include no more than 75% of the 1995 BD element of the municipal waste stream can be land-filled by 2010 and that waste fuelled CHP must achieve an operating efficiency of a minimum of 65%. The NWSW is currently under review which is likely to generate targets for future treatment of waste.

Additional potential energy sources derived from waste as reported on in the Bioenergy Action Plan for Wales include:

- Food waste
- Agricultural wastes
  - Animal manure
  - Poultry litter
- Sewage sludge

Given the nature of the energy sources mentioned above, with a higher water content than Refuse Derived Fuels (RDF), the sources would be best utilised through anaerobic digestion facilities (discussed in Project Sheet E 'Centralised Anaerobic Digestion').

Example outputs taken from the Pembrokeshire County Council pilot study for each of the waste resources mentioned are provided in the tables below:

Table 10: Predicted MSW and C&I waste resource to 2020 for Pembrokeshire County Council area

Outputs	MSW	C & I	Total
Total Waste [tonnes]	74,463	123,548	198,011
Total residual [30%]	22,339	37,064	59,403
Total Biodegradable [renewable] element [35%]	7,819	12,972	20,791
Electricity			
Required wet tonnes per 1MWe	10,320	10,320	-
Potential installed capacity [MWe]	-	-	-
Heat			
Required wet tonnes per 1MWt	1,790	1,790	-
Potential installed capacity [MWt]	**4.4**	**7.2**	**11.6**

*Assumes the biodegradable element of residual waste is utilised by heat generating plant only

There is no output table for Pembrokeshire County Council landfill gas as no capacity, additional to what is already installed (identified in Table 6), has been identified. With policy in place to prevent further biodegradable material being sent for landfill, no further opportunities for energy from landfill gas are anticipated. Some authorities may have identified additional capacity and discussions should take place with waste management to identify future plans.

Table 11: Potential installed Centralised Anaerobic Digestion capacity from total available MSW and commercial and industrial food resource

Current MSW food waste	Predicted tonnes per annum [2019/2020]
Total waste	5,761
Electricity	
Required tonnes for 1MW	32,000
Potential installed capacity [MW]	**0.2**
Heat	
Required tonnes for 1MW	10,667
Potential installed capacity [MW]	**0.3**

Table 12: Potential installed capacity from total available animal manure resource

Livestock	Number	Available resource per head/yr (t)
Cattle	188,500[18]	1.50
Pigs	0	0.15
Electricity		
Total wet tonnes required per MWe		225,000
Potential installed capacity [MWe]		**1.3**
Heat from CHP		
Total wet tonnes required per MWt		150,000
Potential installed capacity [MW]		**1.9**

Table 13: Potential installed capacity from total available poultry litter resource

	Existing Resource
No. birds from mass producing farms[19] (>10,000)	143,600
Litter (tonnes)/1,000 birds/year	42
Total available litter (tonnes)	6,031.2
Electricity	
Required tonnes for 1MW	11,000
Potential installed capacity [MW]	**0.5**
Heat	
Required tonnes for 1MW	7,333
Potential installed capacity [MW]	**0.8**

Table 14: Potential installed capacity from total available sewage sludge resource

	Existing Resource	Predicted tonnes per annum [2019/2020]
Total sewage sludge	2,471	3,969
Electricity		
Required dry solid (tonnes) for 1MW	13,000	13,000
Installed capacity [MW]	**0.2**	**0.3**
Heat		
Required tonnes for 1MW	8,667	8,667
Installed capacity [MW]	**0.3**	**0.5**

The heat is currently used by the AD plant and is not an 'accessible' resource

E1.6 Task 6: Hydropower Energy Resource

This toolkit seeks to facilitate an assessment of the accessible resource of large, small scale hydro sites [under 10MW] and potential micro-hydro schemes, through the identification of existing feasibility studies.

This toolkit does not provide guidance in relation to wave power, tidal stream or tidal barrage. Constraints upon the use of sites for hydropower schemes include the seasonality of water flows, financial viability of projects, the willingness of landowners and riparian rights of owners to advance projects. However, the major constraint is environmental issues and the need for Environment Agency acceptance and permitting.

Example Output

As indicated in Project Sheet F, there is currently no satisfactory way for local authorities to assess the potential hydropower resource in their areas, from using existing data sources in the public domain. As such there is no table with installed capacity in this section.

The quantity of existing hydropower that exists in Pembrokeshire, as referred to in Project Sheet A, is given section 'E1.1: Existing and proposed LZC energy technologies' (table 6) under existing renewable electricity capacity.

References

[18] Based on an average of 130 cattle per farm. Total number of cattle farms, including dairy farms in Pembrokeshire, circa 1,450. Information provided by Animal Health, Pembrokeshire County Council

[19] Information provided by Animal Health Department, Pembrokeshire County Council

E2 Building integrated renewables uptake assessment

This section provides an introduction to building integrated renewable (BIR) energy technology uptake assessments and provides an example taken from an uptake assessment completed for Pembrokeshire County Council based on the method detailed in this toolkit. The following table indicates the tasks that are associated with this component and the questions that this toolkit helps you answer.

Reference is made to various appended sections. Each Project Sheet contains a method for completing a task. Completion of these tasks will provide the necessary evidence base relevant to the section heading (e.g. "Building integrated renewable energy technology uptake assessment").

Table 15: Tasks associated with the BIR Uptake Assessment' section

Building Integrated Renewables Uptake Assessment		
Task	**Questions that this toolkit helps you answer**	**Local Authority Action Required**
1.Introduction	What is the role of microgeneration in the energy mix of Wales? How is 'microgeneration' defined in this toolkit? What is the difference between 'microgeneration' and 'building integrated renewables'? How much energy is generated from BIR currently installed? What is the potential energy generated by building integrated renewables in your local authority area in 2020?	Read E2.1 Complete Project Sheet H
2. Modelling BIR uptake - overview	What are the 2 key sectors to consider in modelling BIR uptake?	Read E2.2

Building Integrated Renewables Uptake Assessment (Cont'd)		
Task	**Questions that this toolkit helps you answer**	**Local Authority Action Required**
3. Modelling BIR uptake - simplified method	What are the assumptions on which the 'Simplified Method' is based? What is the level of new residential development in your local authority area? What is the level of non-residential new development in your local authority area? What is the number of existing dwellings in your local authority area? What is the existing BIR capacity in your local authority area? What will the level of BIR uptake for renewable electricity will there be for your area by 2020? What will the level of BIR uptake for renewable heat for your area by 2020?	Read E2.3 Project Sheet A Complete Table 16 Complete Table 18

E2.1 Task 1: Introduction

The Welsh Assembly Government has set out its renewable energy route map which envisages a role for microgeneration in the energy mix of Wales. There is likely to be an increasing emphasis on the uptake of microgeneration technologies. The role that microgeneration plays in an area can make up an important part of any area wide renewable energy target. It is considered that microgeneration technologies, for the most part can be installed on a variety of buildings, but unlike the other renewable energy technology types highlighted in this report it is demand led, rather than supply led. Therefore predictions should be made on the take-up of microgeneration technologies in an area. Therefore, it is important to try to quantify this contribution. However, to do this is fairly complex.

The official definition of microgeneration is given in the Energy Act 2004[20] as electricity generating capacity of 50kW or less, and heat generating capacity of 45kW or less. However, for the purposes of this toolkit, and the uptake modelling, we are using the broader term Building Integrated Renewables (BIR). BIR can include systems that are larger than microgeneration, such as biomass boilers for schools, which can be up to 500kW of heat output or more. However, BIR technologies are still linking to existing or new buildings and are therefore distinct, in terms of how their potential can be modelled, from the larger scale stand alone technologies that are covered elsewhere in this toolkit.

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

BIR are taken to cover the following technologies:

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

E2.2 Task 2: Modelling BIR uptake – Overview

There are two key sectors to consider when modelling the uptake of BIR technologies, and each has to be modelled differently owing to different factors influencing the level of uptake.

The first sector is that of future new buildings, both residential and non-residential. For this sector, uptake is likely to be predominantly driven by future Building Regulations and planning policies, requiring new buildings to reduce carbon dioxide emissions. In particular, this will be driven by the UK trajectory towards zero carbon dwellings by 2016 and for zero carbon non-domestic buildings by 2019[21]. The key factors affecting uptake of any particular technology for this sector are likely to be the combination of technical viability, carbon savings, and the level of capital cost to a developer.

The second sector is that of existing buildings, both residential and non-residential. For this sector, the uptake is likely to be driven more by how financially attractive installing a system would be to a building owner or occupier and how easy they perceive it would be to install such a system, i.e. it has a significant dependence on consumer attitudes and willingness to adopt new technology.

As part of developing the toolkit, AECOM carried out a study to model the uptake of BIR technologies in Pembrokeshire. A worked example is presented below:

E2.3 Task 3: Modelling BIR uptake – Simplified Method

In this section we present a simplified method for you to estimate the level of BIR uptake in your local authority area. The method is based on simply scaling the uptake results for Pembrokeshire, for renewable energy BIR for heat and electricity, on a pro-rata basis depending on the level of existing and projected new build development in your area compared to that assumed for Pembrokeshire.

This simplified method inevitably will only provide a rough estimate of the level of uptake in your area. More detail on the assumptions we used for the modelling for Pembrokeshire are given in Project Sheet H, and also in the report on the Pembrokeshire case study that accompanies this toolkit. For a more accurate assessment of the uptake in your area, we recommend that you follow the more detailed method set out in Project Sheet H to define the different market segments for BIR uptake and that you engage an external consultant to carrying out the modelling for your area.

Inevitably, the uptake model for Pembrokeshire was based on a number of assumptions that, although based on the best available information at the time of writing the toolkit, are subject to change in the future. These include assumptions about the following:

- The level of financial support available for generation from BIR, in terms of the Feed-in Tariff, due to start in April 2010, and the Renewable Heat Incentive, due to start in April 2011.
- Future Part L of the Building Regulations.
- BIR technologies, in terms of their performance, and future capital costs.

In modelling the level of BIR uptake, the uptake of non-renewable forms of microgeneration is also included, as this in effect displaces the potential uptake for renewable forms of microgeneration. Therefore, the figures for BIR uptake for Pembrokeshire that we present below are net of any uptake of non-renewable microgeneration that is predicted by the model.

Step 1: Quantify the level of new residential development in your area

You will have this information already from targets for new housing that you are required to meet, and you are likely to already have a target (or some options for targets) for new net dwelling completions for your draft LDP. The figure that you need to calculate is the net completions per annum. If you have different targets for different timeframes, calculate the average annual completions up to 2020.

Once you have this figure, you should calculate the ratio of your target (to be referred to as NDR) for annual completions compared to the target assumed in our modelling for Pembrokeshire assumed in the BIR uptake model. Therefore, you can calculate the NDR as follows:

NDR = (average planned net annual completions for your local authority)/ (average planned net annual completions assumed for Pembrokeshire uptake model)

Avoiding double counting

Note - if you are also assessing the potential for district heating and CHP at strategic sites (see section E1), and including the output from CHP at those sites as part of area wide installed capacity targets, then the new buildings included in these sites should not be included in the BIR uptake assessment. Otherwise, the strategic sites will be assumed to have district heating/CHP and microgeneration, which would overstate the potential. This caution does not apply to existing buildings, as any supply of renewable heat to them via heat networks is likely to be additional to any BIR uptake.

Step 2: Quantify the level of non-residential new development

For the purposes of this simplified approach, the key number that is required is an average figure for the amount of new non-residential floor area, in m^2 of gross internal floor area (GIFA) to be built each year up to 2020. You may have figures for this already as part of the emerging LDP evidence base. If not, you can develop a figure for this from a combination of some or all of the following:

- Looking at historical levels of new development, from planning consents and employment land and retail studies
- Employment land and retail studies that may have been carried out in relation to future land requirements for your area
- The capital spend programme for your local authority to give an indication of the level of public sector new build
- Discussion with other public sector stakeholders in relation to their proposed capital spend programmes

You may wish to consult with colleagues who are responsible for economic development who may have some useful data on this topic. Project Sheet G gives details of how you can convert land areas to GIFA of different use classes.

Once you have a figure, you then need to calculate the ratio of this number (to be referred to as the FNR), to the figure that was assumed for the Pembrokeshire analysis. Therefore, you can calculate FNR as follows:

FNR = (predicted annual new floor area (in m^2 GIFA) for your local authority)/ (level of annual new floor area assumed for Pembrokeshire analysis)

NB - the note on avoiding double counting given for step 1 also applies to step 2.

Step 3: Quantify the number of existing dwellings in your local authority area

You can readily obtain this information from the Census 2001 data for your local authority, combined with recent Council tax data to identify and dwellings built since 2001. Once you have this figure, you should then calculate the ratio of this number (to be referred to as EDR) to the number of existing dwellings assumed for the Pembrokeshire uptake model. Therefore, you can calculate EDR as follows:

EDR = (number of existing dwellings in your local authority)/(number of existing dwellings assumed in Pembrokeshire model)

For this simplified approach, we have assumed that the level of existing non-residential buildings is proportional to the level of existing dwellings. Therefore, you do not need to estimate the floor area, and type, of existing non-residential buildings in your area.

Step 4: Quantify the existing BIR capacity in your local authority area

Assess the amount of existing BIR capacity that is already in your area. A method for doing this is set out in Project Sheet A.

Step 5: Calculate level of BIR uptake for renewable electricity for your area by 2020

Based on the information you have collated as part of the previous steps, you should complete the table below to derive an uptake figure for your area. The table has the relevant number and results for Pembrokeshire already inserted. A worked example for a local authority is given after the table. The total for RE electricity is an aggregate covering PV, micro wind and small wind. The total for RE heat is also an aggregate, covering solar water heating, heat pumps and biomass boilers.

Table 16: Predicting level of BIR renewable electricity uptake by 2020

Row no.			Units
1	**Existing dwellings and non-residential buildings**		
2	No. of existing dwellings in Pembrokeshire	55,592	
3	No. of existing dwellings in your LA	insert number here	
4	Calculate EDR (divide row 3 by row 2)	insert EDR here	
5	Predicted RE electricity capacity for Pembrokeshire by 2020	2.2	MWe
6	Predicted RE electricity capacity for your LA by 2020 (multiply row 5 by row 4)	insert result here	MWe
7	**Future dwellings**		
8	No. of average net annual completions assumed for Pembrokeshire	585	
9	No. of average net annual completions planned for your LA	insert number here	
10	Calculate NDR (divide row 9 by row 8)	insert NDR here	
11	Predicted RE electricity capacity for Pembrokeshire by 2020	4.3	MWe
12	Predicted RE electricity capacity for your LA by 2020 (multiply row 11 by row 10)	insert result here	MWe
13	**Future non-residential buildings**		
14	Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000	m^2 GIFA
15	Future new non-residential average annual new floor area estimated for your LA by 2020	insert number here	m^2 GIFA
16	Calculate FNR (divide row 15 by row 14)	insert FNR here	

Row no.			Units
17	Predicted RE electricity capacity for Pembrokeshire by 2020	6.32	MWe
18	Predicted RE electricity capacity for your LA by 2020 (multiply row 17 by row 16)	insert result here	MWe
	TOTALS		
19	**Total predicted new BIR RE electricity capacity for your LA by 2020 (sum of rows 6, 12, 18)**	**insert result here**	**MWe**
20	Existing BIR RE electricity capacity in Pembrokeshire County Council area	0.1	MWe
21	**Total predicted new and existing BIR RE electricity capacity for your LA by 2020 (row 19 plus row 20)**	**insert result here**	**MWe**

17: Predicting level of BIR electricity uptake by 2020 – worked example

The analysis contained within Table 16 above provides the method for calculating the BIR electricity uptake for 2020 for the Pembrokeshire County Council area. Table 17 provides a method for demonstrating how other local authorities can predict their level of BIR electricity uptake for 2020 utilising the Pembrokeshire analysis.

Row no.			Units
1	**Existing dwellings and non-residential buildings**		
2	No. of existing dwellings in Pembrokeshire	55,592	
3	No. of existing dwellings in your LA	100,000	
4	Calculate EDR (divide row 3 by row 2)	1.80	
5	Predicted RE electricity capacity for Pembrokeshire by 2020	2.2	MWe
6	Predicted RE electricity capacity for your LA by 2020 (multiply row 5 by row 4)	3.96	MWe
7	**Future dwellings**		
8	No. of average net annual completions assumed for Pembrokeshire	585	
9	No. of average net annual completions planned for your LA	1,000	
10	Calculate NDR (divide row 9 by row 8)	1.71	
11	Predicted RE electricity capacity for Pembrokeshire by 2020	4.3	MWe
12	Predicted RE electricity capacity for your LA by 2020 (multiply row 11 by row 10)	7.35	MWe
13	**Future non-residential buildings**		
14	Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000	m^2 GIFA
15	Future new non-residential average annual new floor area estimated for your LA by 2020	75,000	m^2 GIFA
16	Calculate FNR (divide row 15 by row 14)	1.34	

Row no.			Units
17	Predicted RE electricity capacity for Pembrokeshire by 2020	6.32	MWe
18	Predicted RE electricity capacity for your LA by 2020 (multiply row 17 by row 16)	8.46	MWe
	TOTALS		
19	**Total predicted new BIR RE electricity capacity for your LA by 2020 (sum of rows 6, 12, 18)**	**19.77**	**MWe**
20	Existing BIR RE electricity capacity in your LA	1.5	MWe
21	**Total predicted new and existing BIR RE electricity capacity for your LA by 2020 (row 19 plus row 20)**	**21.27**	**MWe**

Step 6: Calculate level of BIR uptake for renewable heat for your area by 2020

To do this, follow a similar approach as for step 5, using the table below.

Table 18: Predicting level of BIR renewable heat uptake by 2020

Row no.			Units
1	**Existing dwellings and non-residential buildings**		
2	No. of existing dwellings in Pembrokeshire	55,592	
3	No. of existing dwellings in your LA	insert number here	
4	Calculate EDR (divide row 3 by row 2)	insert EDR here	
5	Predicted RE heat capacity for Pembrokeshire by 2020	3.7	MWt
6	Predicted RE heat capacity for your LA by 2020 (multiply row 5 by row 4)	insert result here	MWt
7	**Future dwellings**		
8	No. of average net annual completions assumed for Pembrokeshire	585	
9	No. of average net annual completions planned for your LA	insert number here	
10	Calculate NDR (divide row 9 by row 8)	insert NDR here	
11	Predicted RE heat capacity for Pembrokeshire by 2020	4.3	MWt
12	Predicted RE heat capacity for your LA by 2020 (multiply row 11 by row 10)	insert result here	MWt
13	**Future non-residential buildings**		
14	Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000	m^2 GIFA
15	Future new non-residential average annual new floor area estimated for your LA by 2020	insert number here	m^2 GIFA
16	Calculate FNR (divide row 15 by row 14)	insert FNR here	MWt

Row no.			Units
17	Predicted RE heat capacity for Pembrokeshire by 2020	1.23	MWt
18	Predicted RE heat capacity for your LA by 2020 (multiply row 17 by row 16)	insert result here	MWt
	TOTALS		
19	**Total predicted new BIR RE heat capacity for your LA by 2020 (sum of rows 6, 12, 18)**	**insert result here**	**MWt**
20	Existing BIR RE heat capacity in Pembrokeshire County Council area	1.5	MWt
21	**Total predicted new and existing BIR RE heat capacity for your LA by 2020 (row 19 plus row 20)**	**insert result here**	**MWt**

Table 19: Predicting level of BIR renewable heat uptake by 2020 – worked example

The analysis contained within Table 18 above provides the method for calculating the BIR heat uptake for 2020 for the Pembrokeshire County Council area. Table 19 provides a method for demonstrating how other local authorities can predict their level of BIR heat uptake for 2020 utilising the Pembrokeshire analysis.

Row no.			Units
1	**Existing dwellings and non-residential buildings**		
2	No. of existing dwellings in Pembrokeshire	55,592	
3	No. of existing dwellings in your LA	100,000	
4	Calculate EDR (divide row 3 by row 2)	1.8	
5	Predicted RE heat capacity for Pembrokeshire by 2020	3.7	MWt
6	Predicted RE heat capacity for your LA by 2020 (multiply row 5 by row 4)	6.7	MWt
7	**Future dwellings**		
8	No. of average net annual completions assumed for Pembrokeshire	585	
9	No. of average net annual completions planned for your LA	1,000	
10	Calculate NDR (divide row 9 by row 8)	1.71	
11	Predicted RE heat capacity for Pembrokeshire by 2020	4.3	MWt
12	Predicted RE heat capacity for your LA by 2020 (multiply row 11 by row 10)	7.4	MWt
13	**Future non-residential buildings**		
14	Future new non-residential average annual new floor area assumed for Pembrokeshire by 2020	56,000	m^2 GIFA
15	Future new non-residential average annual new floor area estimated for your LA by 2020	75,000	m^2 GIFA
16	Calculate FNR (divide row 15 by row 14)	1.34	

Row no.			Units
17	Predicted RE heat capacity for Pembrokeshire by 2020	1.23	MWt
18	Predicted RE heat capacity for your LA by 2020 (multiply row 17 by row 16)	1.7	MWt
	TOTALS		
19	**Total predicted new BIR RE heat capacity for your LA by 2020 (sum of rows 6, 12, 18)**	**15.7**	**MWt**
20	Existing BIR RE heat capacity in your LA	2.5	MWt
21	**Total predicted new and existing BIR RE heat capacity for your LA by 2020 (row 19 plus row 20)**	**18.2**	**MWt**

E3 Heat opportunities mapping

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

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

The reason for the different levels of complexity relates to the timing of when each level of analysis should be employed. For instance, heat opportunities mapping should provide sufficient levels of detail for sieving candidate sites whereas to set specific CO2 reduction targets for an identified strategic site or to set a policy requiring a developer to connect to a DHN will require in addition to the heat opportunities map, a more detailed economic and technical appraisal.

For the above reason this section outlines the process for "heat opportunities mapping" and the development of an energy opportunities plan which is most relevant to achieving the policy objective of sieving and allocating sites for development. The method for the detailed technical and financial assessment of DHNs assessment is contained within the next section (E4).

The following table indicates the tasks that are associated with the component 'heat opportunities mapping' and the questions that this toolkit helps you answer. Reference is also given to the relevant appendices that should be referred to for further technical guidance.

Table 20: Tasks associated with the 'Heat Opportunities Mapping' section

Heat Opportunities Mapping		
Task	**Questions that this toolkit helps you answer**	**Local Authority Action Required**
1. Background	Why is it important to understand the nature of existing and future energy demand and infrastructure?	**Read E3.1** **Project Sheet G**
2. Identify anchor heat loads (AHLs)	What and where are the key anchor **'heat' loads** in your local authority?	**Read E3.2** **Project Sheet G**
3. Identify off gas areas (OGAs)	Where are the areas not served by the gas mains network in your local authority?	**Read E3.3** **Project Sheet G**
4. Map residential heat demand and density	What is the residential heat demand and density for your local authority?	**Read E3.4** **Project Sheet G**
5. Identify areas of high fuel poverty	Where are the areas of fuel poverty in your local authority?	**Read E3.5** **Project Sheet G**
6. Identify existing DH & CHP schemes and sources of waste heat	Where are the existing district heating and combined heat and power schemes and sources of waste heat in your local authority?	**Read E3.6** **Project Sheet G**
7. Map the location of strategic new development sites	Where are the proposed strategic development sites in your local authority?	**Read E3.7** **Project Sheet G**
8. Develop an Energy Opportunities Plan for DHNs	What is the nature of new development on proposed strategic sites in your local authority? How do you develop an energy opportunities plan for an area/site in your local authority?	**Read E3.8** **Project Sheet G**

E3.1 Task 1: Background

There are a number of reasons for identifying and understanding the nature of existing and future energy demand and infrastructure:

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

This section of the report addresses the following main tasks:

1. Identify anchor 'heat' loads (AHLs
2. Identify off gas areas (OGAs)
3. Map residential heat demand and density
4. Identify existing DH and Combined Heat & Power (CHP) schemes and sources of waste heat
5. Map spatially the location of the strategic new development sites

Items 1 to 4 are covered in more detail in Project Sheet G.

E3.2 Task 2: Identify anchor heat loads (AHLs)

'Anchor heat loads' or 'point loads' (PLs) pertain to existing buildings with an energy demand that could provide economically viable and practical opportunities for utilising heat. It is known as an 'anchor' load because further opportunities (e.g. from nearby buildings) may arise for connecting nearby buildings to the original anchor load.

A 'point load' therefore refers to a non-residential energy demand that can act as a base for a District Heating (DH) schemes

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

- Complementary energy demand profile
- Planned development programme
- Commitment to reduce CO2 emissions

The identification of PLs and clusters requires the mapping of:

- Buildings owned by organisations with corporate climate change mitigation policies and an active commitment to reducing their carbon footprint: this more often than not, but not always, means the public sector, and;
- Planned new development/refurbishment by the 'anchor heat load' organisation. New development is likely to be the catalyst for such change. CHP/DH schemes are most cost-effective when installed as part of new development rather than retro-fitting (this is covered under "energy demand from proposed development and infrastructure).
- Social housing schemes. These organisations are often tasked with achieving greater than the minimum environmental performance standards. The inclusion of such developments in DH/CHP schemes often enhance the energy profile to provide further evening, weekend and night time energy demands.

AHLs are required in order for a CHP/DH schemes to become a realistic prospect and there are usually particular conditions that need to be in place, such as planned new development and/or a commercial building/group of buildings with a significant demand for heat and/or with an energy profile suitable for the installation of a CHP unit.

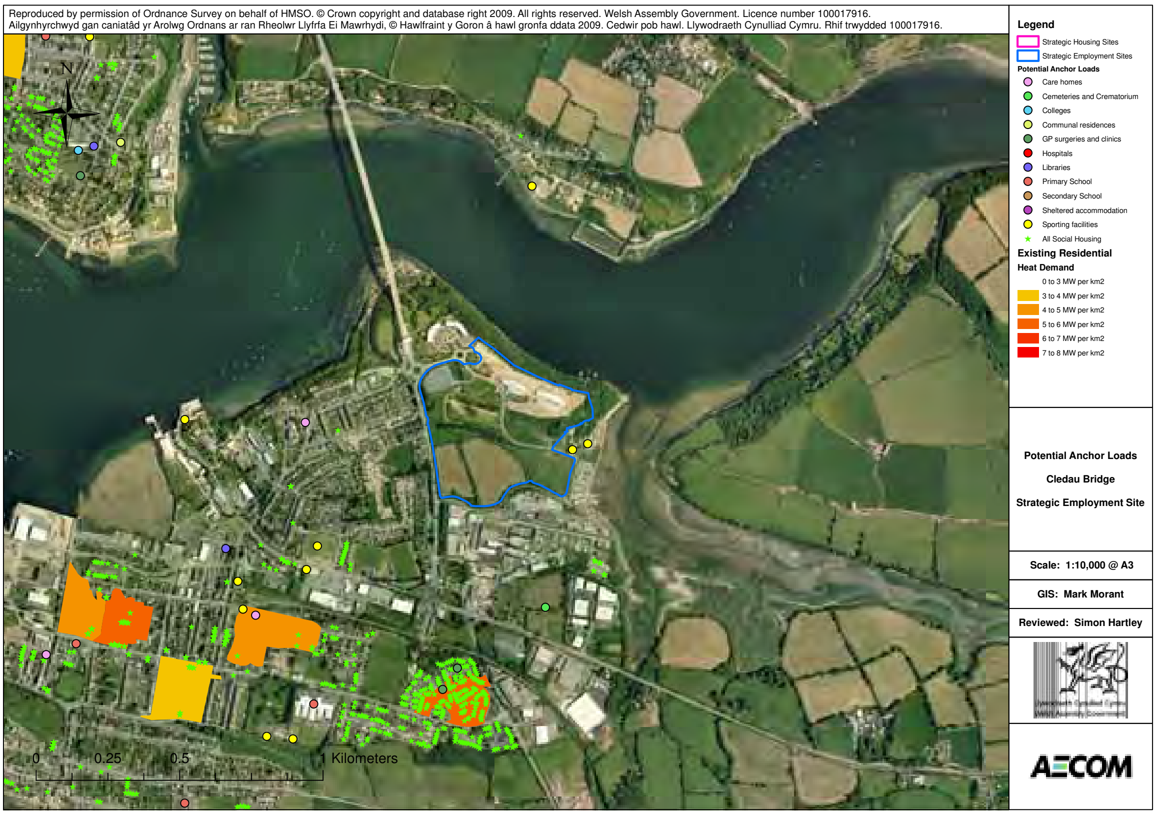
Given the responsibilities placed upon LAs and the public sector in general for driving the climate change mitigation agenda, AHLs are often provided by buildings such as council administration centres, leisure buildings (particularly those with swimming pools) and hospitals; although shopping arcades and precincts have also been utilised in this way.

When it is proposed that private commercial buildings provide an 'AHL' the issue of 'ownership' is not as significant as when residential units are proposed for this role. The reason for this is that it is often impractical for developers to have to negotiate with many individual private householders whereas social landlords can more readily act on behalf of their tenants.

It should be noted that UK competition rules means that householders can change their energy supplier by giving 28 days notice. This also the same for social housing tenants and, if required to do so, the developer of the scheme would be obliged to offer alternative energy suppliers access to the DH network in exchange for a fee. The DH provider retains the clients its needs to financially support the scheme by undercutting the prices of potential competitors.

Investment interest of ESCOs may be secured through the identification of an anchor 'heat' load with the intention of development into DH scheme.

Figure 3: Key property types considered to be potential AHLs as identified within the LLPG:



E3.3 Task 3: Identify off gas areas (OGAs)

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

There are several important reasons for identifying OGAs.

The use of fuels other than natural gas for heat and DHW often incur additional cost to the user. Whereas the economic case for the installation of renewable energy technologies may not be particularly attractive in relation to natural gas, these increased costs may enable the development of a solid business case for the installation of building integrated LZC technologies.

The reason DH schemes are often not developed in rural locations is often the same as the reason why the gas network has also not been extended - financial viability. It is the case however that rural housing can contribute to providing a useful energy demand profile to counterbalance the energy demands of commercial organisations (daytime requirement only) that may have installed CHP or plant large enough to supply DH scheme.

CHP/DH fired by alternative fuels such as waste or biomass are often located in rural areas or on the urban fringe due to the space requirements necessitated by storage and vehicle access. They also tend to be located on industrial estates which offer opportunities to co-located businesses.

Unfortunately LAs have relinquished much of their stake in industrial estates although they still tend to retain highways depots in such locations. The difficulty with the energy demand of industry is that they often require energy delivered in a particular way e.g. high pressure steam, etc. The heating of water to high temperature reduces the potential for electricity generation in CHP units, detracting from the economic case for DH/CHP due to the comparative lack of value of heat compared with electricity. This scenario may also detract from the appeal to ESCOs of investing in the plant or necessary infrastructure.

E3.4 Task 4: Map residential heat demand and density

'Density' of heat demand refers to kiloWatt hour (kWh)/square kilometre (km^2) of energy consumed in dwellings. Information relating to heat densities can be used to inform:

- The identification of AHLs by providing, or adding to, a viable opportunity for the introduction of renewable heat.
- A mix of buildings and energy uses which, together, represent a potential complementary energy demand profile (dwellings providing evening, weekend and night time energy demands as opposed to the normal weekday energy demands of commercial organisations).

- The identification of opportunities relating to social housing providers who are often tasked with achieving greater than the minimum environmental performance standards.

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

When allocating energy consumptions to buildings utilising Valuation Office Agency (VOA) or Technical Memorandum (TM) 46 conversions used are average figures for particular buildings assuming particular fuels are employed (e.g. natural gas is used for heating). Outputs from the toolkit can achieve greater accuracy and add considerable value to functionality if the age and type of buildings, particularly dwellings, can be identified.

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

- the potential demand for heat in any one particular area
- contributing to the identification of AHLs
- feeding into the analysis of potential LZC solutions
- contributing to the identification of energy and carbon baselines to inform area wide target setting.

Example output

Table 21: Space heating and domestic hot water energy demand (kWh) by dwelling type

	Solid Wall	Un Insulated Cavity Wall	Insulated Cavity Wall	Building Regs 2002
Detached	32,328	21,718	16,026	10,702
Semi Detached	22,949	14,379	9,814	7,000
Terraced	13,583	10,253	11,919	6,144
Flat	9,257	6,688	4,973	4,671

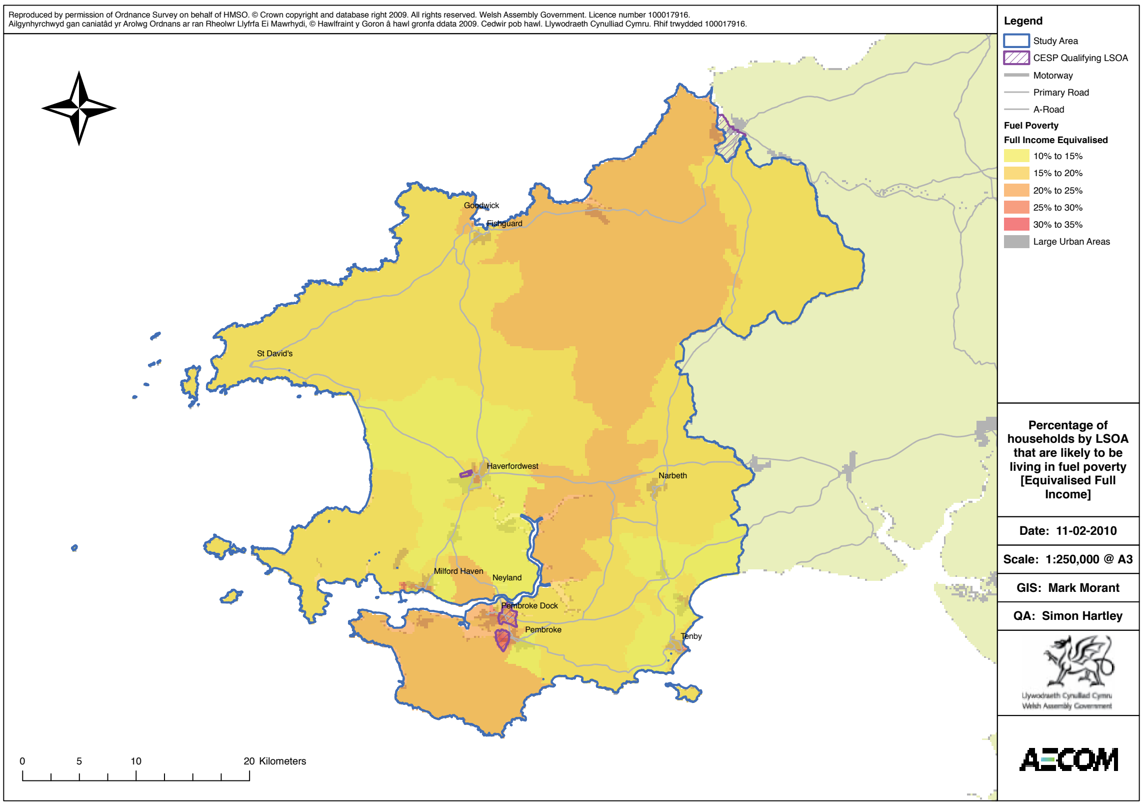
E3.5 Task 5: Identify areas of high fuel poverty

Fuel poverty is a key concern of national governments and LAs alike. LAs produce reports relating to the number of people or households regarded as 'fuel poor'. Often, it is those living in rural parts of the country who suffer disproportionately form fuel poverty and this is attributable to a number of factors. For example, typically, wages are lower than for those employed in more urban areas, there is often a higher proportion of unemployed and fewer job opportunities, etc. A greater proportion of households are not connected to mains services and pay higher prices for fuels such as Liquefied Petroleum Gas (LPG) and heating oil. The combination of factors means that energy bills can constitute a greater proportion of the household costs than for many urban households.

A contributory of fuel poverty can also be the lack of energy infrastructure in rural locations. Often gas networks have not been connected in very rural areas due to high capital cost in relation to revenue generated. This means that residents of rural locations are forced to seek alternatives to natural gas such as LPG, heating oil or some form of solid fuel. The upside is that where the installation of a renewable energy technology is considered in such locations the economic payback and the potential CO2 reductions are proportionately better than when considered against natural gas.

The inclusion of an analysis of fuel poverty adds value to the toolkit by assisting LAs in their targeting of resources and to integrate this with the tools to assess potentially effective ways of addressing the issue.

Figure 4: Fuel Poverty Map for Pembrokeshire County Council area



E3.6 Task 6: Identify existing DH & CHP schemes and sources of waste heat

This section delineates the methods employed for identifying relatively large scale existing commercial LZC energy capacity. This exercise currently involves researching a number of disparate data sources. The process would benefit from a more consistent approach to record keeping and a centralised system for managing data.

It is important to establish existing energy infrastructure as it may provide opportunities for expanded connectivity or increased efficiency/viability. Identification of current utilisation of renewable energy resources will also be included in the assessment of current proportion of area wide targets being met.

Identifying existing CHP of any size can relatively easily be achieved through analysis of the Renewable Obligation Certificates (ROCs) register and through discussion with relevant LA officers (energy & planning). Although similar incentives, and therefore record keeping, has not been available until now for renewable heat, the extensive nature of DH schemes means that LPA officers will likely have details of any existing DH scheme in its area.

It can be difficult to identify waste heat without direct questioning of organisations. A number of website based resource have been identified and included within the useful references. Local Land and Property Gazetteer (LLPG) data, although providing categories of industrial, warehouse, manufacturing, etc, is not specific about the particular activity or the energy efficiency practices. Discussions with the LA Energy Manager and planners revealed some further sources of waste heat.

The utilisation of current sources of waste heat can provide opportunities to improve fuel efficiency and secure CO2 emission reductions. Extending existing infrastructure to additional users can increase viability of a particular scheme. In order to maximise current CHP/DH installations and/or utilise any waste heat capacity, locations of existing infrastructure should be cross-referenced against:

- Existing public sector/social housing development
- Planned public or private sector development
- Accessible renewable energy resource
- Potential for co-location of complimentary activities
- Planned infrastructure (energy networks or significant plant/transport) upgrades

Table 22: Example of existing District Heat, CHP or sources of waste heat for Pembrokeshire County Council

Name	LZC Energy Technology	LC Fuel Source	Capacity (MW)
Bluestone Holiday Park	District Heating	Biomass	1.6
Milford Haven Oil Refinery	Waste Heat?	Unknown	Unknown
Haverfordwest Cheese Ltd	Waste Heat?	Unknown	Unknown
Pembroke Oil Refinery	Waste Heat?	Unknown	Unknown
Narberth Waste Water Treatment	CHP	Sewage Sludge	0.1
Withyhedge	Electricity Generator	Landfill Gas	1.74
Total	-	-	**3.44**

E3.7 Task 7: Map the location of strategic new development sites

This involves mapping the location of the strategic sites using GIS. This task may already be carried out as part of the local development plan site sifting and candidate site selection process. (Check LDP guidance on mapping candidate sites)If you do not have a "red line" plan yet available for the sites, you can map the location of areas of search. The key objective is that this spatial mapping means that you can superimpose the location of the sites on GIS layers showing existing anchor loads in close proximity to the sites, as well as areas of existing high heat density.

By "strategic" we mean the largest sites that you have already allocated or are considering allocating. It is for you to define and select which sites are "strategic" in your context. As a rough guide, they should be at least 0.5ha in size, or with the potential for 50 or more dwellings, or over 1,000m^2 of non-residential floor area.

E3.8 Task 8: Develop an Energy Opportunities Plan for DHNs

The bringing together of the various data layers of heat opportunities described above, together with the location of your strategic sites for new development, creates what we are calling an Energy Opportunities Plan.

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

The practical realisation is a centrally located energy centre building transmitting heat (as hot water) along buried pipes to a number of buildings in the local area. The pipes are known as heat mains. The scale can be anywhere from a few blocks of flats to a significant proportion of a city. The practicalities for building owners are limited: the heat exchanger in each building is controlled and operated in the same way as a gas boiler it replaces, and buildings can retain a conventional distribution system, such as radiators.

Heat is sold to consumers in the same way that gas or electricity is sold traditionally, i.e. by metering of end use and regular billing. This is combined with a service charge to cover maintenance of the shared distribution system.

Combined heat and power (CHP) is simply where the energy centre produces heat as a by-product of electricity generation. The heat is used to supply the DH network in the conventional way, whilst the electricity is either sold locally or onto the wholesale electricity market. The heat from CHP units can also be used to meet cooling demands via the use of absorption chillers. This can involve either a centralised chiller, distributing “coolth” via a chilled water network, or decentralised absorption chillers in individual buildings. This approach is sometimes referred to as “trigeneration” or CCHP (Combined Cooling Heat and Power).

The process for identifying key spatial opportunities for DHNs is set out below.

Step 1: Produce GIS heat map

The key to producing this Plan is the use of GIS heat mapping, as described in the section above. The heat map should produce a visual spatial representation of all of the opportunities for district heating. This in turn draws together all of the information gained from the processes which relate to understanding existing and future heat demand. The table below describes what the heat map should (ideally) include, and also explains the rationale for including each item, in terms of the opportunity that it creates for a DHN.

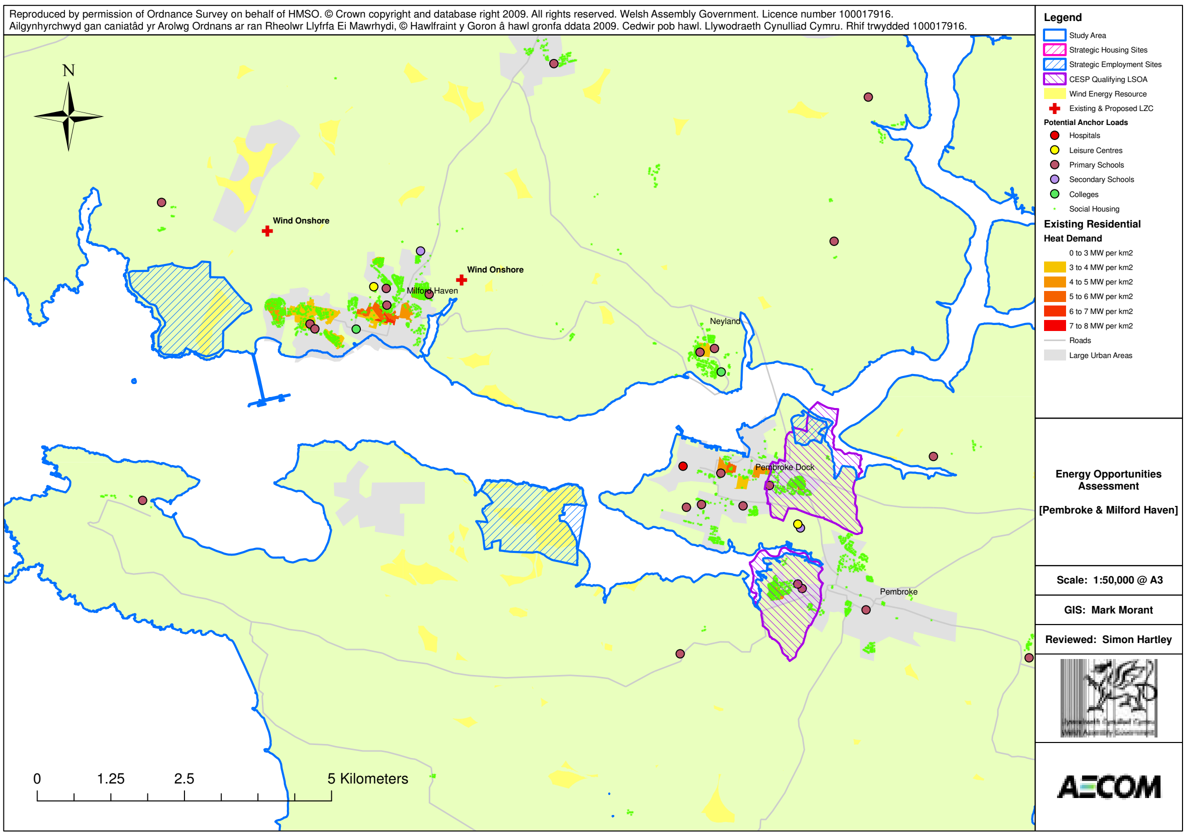
Table 23: Opportunities to maximise the viability of district heating

Opportunity areas to map	Rationale for identifying
Public buildings such as schools, hospitals and leisure centres	Secure heat loads and early revenues
Social housing	Secure heat loads and early revenues, typically higher heat density, fuel poverty issues
Existing housing heat density	High density housing may have sufficient return on investment allow connection of DHN giving large carbon savings
Areas of high fuel poverty/areas with a high index of multiple deprivation	These areas may attract funding under CESP funding which may be used to fill gap funding
Existing or proposed CHP/DHNs	Existing CHP or DHNs may benefit from the addition of heat loads such as new development
Existing or proposed waste heat sources including: • Power stations • Landfill gas stations • Industries with waste heat including: • Food • Paper and pulps • Chemicals • Petroleum • Stone, clay and glass • Primary metals (steel works) • Potential energy from waste sites	Co-location of waste heat and development can give large carbon savings. For instance: typical electrical generating efficiencies are around 35% - with an additional 40% of potentially useful heat wasted. This heat can potentially be used to supply a DHN, raising the overall efficiency from 35% to 75%.
• Existing large industrial building with heating or cooling demands	Industrial buildings can potentially have large heating or cooling demands, for process use, that can be served by a DHN. The benefits are both in the size of heat load and the added diversity (i.e. time of day)

Opportunity areas to map	Rationale for identifying
Off mains gas sites	By displacing the most carbon intensive fuels (direct electric heating, oil and solid fuel) district heating can achieve the greatest carbon savings. A DHN could also be more attractive to potential customers relative to more expensive fuels.
Large commercial buildings such as: offices, hotels, department stores	The heat and/or cooling loads for these buildings can potentially be served by a DHN.
Strategic new development sites	Whereas DHNs may be hard to retrofit to existing building stock, new development may act as a 'spring board' to located energy centres, establish heat revenues and aid acceptability. Planning policy can also be used in these areas to encourage DHNs.
Local authority/WAG land ownership	Control of development on publically owned land gives potentially greater leverage to encourage DHN deployment

The heat map should clearly show the strategic new development sites, and other opportunities, such as potential anchor heat loads, either within or in close proximity to the sites should also be clearly visible on the map.

Figure 5: Example of an Energy Opportunities Plan



Step 2: Test Energy Opportunities Plan with key stakeholders

At this stage, we recommend testing the accuracy of the heat map with other key stakeholders within the local authority, outside of the planning team. Some of these may have been involved already with providing the information required in chapter 2. We suggest that these stakeholders would include officers responsible for the following:

- Energy management in the corporate estate, including schools, public buildings, leisure centres, etc
- Waste management (due to the potential connection with energy from waste)
- Procurement and delivery of new development (e.g. a "project champions" team)
- Housing
- GIS

These stakeholders can provide a sense check of the heat map. They may identify additional opportunities or they may identify particular constraints.

Following these discussions, the heat map can be revised to account for any new opportunities or constraints.

E4 Detailed viability appraisal of strategic sites

There are a number of different types of policies that an LPA may wish to consider including in their LDP to help facilitate the delivery of strategic (i.e. larger scale) renewable energy projects in specific locations. Section P of this toolkit sets out each of these policy options and the evidence base required to support them. Key elements of the evidence base may include:

- Modelling potential energy demand (to facilitate the setting of CO2 reduction targets for strategic sites)
- The identification of broad areas suitable for wind development and/or other technologies
- Assessing technical and financial viability of DHNs

This component sets out a process to enable the identification of opportunities for renewable energy on strategic sites which may inform the setting of energy/carbon reduction targets for new strategic development sites as part of the planning process.

The following table indicates the tasks that are associated with the component and the questions that this toolkit helps you answer. Reference is also given to the relevant appendices that should be completed in order to develop the necessary evidence base.

Table 24: Tasks associated with the 'E4: strategic sites' section

Detailed viability appraisal of strategic sites		
Task	**Questions that this toolkit helps you answer**	**Local Authority Action Required**
1. Background	What processes does this section outline?	Read E4.1
2. Assessing energy demands of strategic new development sites	What is the potential energy demand (MW) for each proposed strategic sites in your local authority?	Read E4.2
3. Identify areas for strategic stand-alone renewable energy development	Which areas might be suitable for strategic stand-alone renewable energy development?	Read 4.3 Complete E1, E3
4. Assessing the technical feasibility and financial viability of DHNs	How do you assess the technical feasibility and financial viability for a district heat network for an area/site in your local authority?	Read E4.4 E1, E3 & Project Sheet J

E4.1 Task 1: Background

This section outlines a process for:

- Estimating the future energy demands that would arise from strategic new development sites. This is necessary in order to be able to assess the technical and financial viability of renewable energy technologies for those sites.
- Identifying areas for strategic stand-alone renewable energy development
- Assessing technical feasibility and financial viability of DHNs

E4.2 Task 2: Assessing energy demands of strategic new development sites

If you want to consider setting carbon reduction targets for strategic new development areas (see chapter P3), or if you want to assess the viability of DHNs (chapter P4), the starting point is to assess the potential energy demands of the new development. We do not expect that local authorities will complete this task without external support. Therefore, we have set out below the baseline information that the local authority would need to provide to a consultant to do this analysis, as well as the issues to be covered by the consultant and the nature of the outputs they should produce.

Step 1: Quantify the nature of new development in each strategic site (local authority)

Step 1a: Residential new development

Ideally, for each strategic site, you should estimate:

- The total number of new dwellings for each site (if any).
- This will be informed by:
  - Joint Housing Land Availability Studies (JHLAS).
  - Your emerging LDP site assessment process.
  - An indicative number provided by a submitted candidate site
- The split of dwelling types (broadly, whether detached, semi-detached, terraced or flats).

This is important because the type of dwelling affects the energy demand, both in terms of floor area, but also because detached dwellings have a higher heat demand per unit of floor area as they have more expose external walls.

The estimated split of dwelling types can be based on other recent sites in similar geographical that may have received planning consent or already started construction, such as those allocations already in the Unitary Development Plan (UDP). It may also be informed by any density standards that you may be considering setting for some sites, or from discussion with local agents and house builders. The split is usually set out in percentage terms i.e. 20% terraced.

- The expected start date for construction and number of annual completions

This is important, as it will affect what energy standards it will be expected to meet under future Building Regulations, and hence energy efficiency standards. You will also need to take into account the phasing of buildings within the development. This, in turn, will affect the energy demand.

The start date for construction will need to be a best guess, based on what is known about current developer interest in any site and infrastructure requirements.

For annual completions, when there is strong demand, a typical build out rate is 50-100 dwellings per year for a single developer or house builder.

The output from this step should be a table or spreadsheet similar to the one below:

Table 25: Table showing split between cumulative number of completions and timings

Development reference	Cumulative number of completions			
	2010	2011	2012	Years … to final date i.e. 2020
e.g. Smith Lane site				
Detached	10	20	30	N
Semi	40	80	120	N
Terrace	40	80	120	N
Flat	10	20	30	
Total	100	200	300	Etc.

Step 1b: Non-residential new development

As with step 1a, ideally you should provide the following information for each strategic site:

- Expected floor areas for each type of development, at least in terms of use class (e.g. B1, B2, B8, etc.) for non-residential development to be provided on the site.

In practice, you may only know the potential hectares for each use class. Information on this would be informed by any employment land studies or retail studies that you may have had carried out for your area. These may provide historical data that you could project forward, or they may provide future projections and requirements.

If the areas in hectares of sites with the potential to be developed are known, but floor areas are not, CLG ratios between site area and floor space for various building types can be used to estimate potential floor space developed.

Table 26: Plot ratios for employment use (gross floor-space to site area) from CLG Employment Land Reviews - Guidance Note.

	Roger Tym (1997)[22]	Other Studies
Business Park	0.25 to 0.30	0.25 to 0.40
Industrial	0.42	0.35 to 0.45
Warehouse	-	0.5
Town Centre Office	0.41	1.05

For example, if 1ha (10,000m²) land on a site is proposed for B1 use (office, light industrial), then from the table, a typical floor space to plot ratio would be 0.3, giving a gross floor space of 0.3 x 10,000 = 3,000m².

- Details of any proposed major public buildings, such as schools and leisure centres that may go on the strategic sites.
  - If possible, it would be useful to know whether it would be a primary or secondary school and the estimated number of pupils, (as the energy demand can be deduced from this).
  - If a leisure centre, it would be useful to know whether or not it would have a swimming pool, as this would be a significant heat load.
- The expected start date for construction for each significant building or use class and when the non-residential plots would be expected to be built out.
  - based on this, a reasonable assumption would be that the completion of different floor areas of different use classes would be spread evenly over time.

The output from this step should be, for each strategic site, a table or spreadsheet similar to the one below:

Table 27: Typical floor space per proposed use class

Build Start	Build End	Gross internal floor areas						
		A1	A3	B1	B8	C1	D1	D2
2010	2020	1,000m²	3,000m²	N	5,000m²	n/a	n/a	n/a

Step 2: Estimate potential energy demand of strategic new development sites (Consultant)

New buildings will use energy for heating and electrical services, and this new energy demand will increase the energy consumption of an area and its associated carbon emissions. The Welsh Assembly Government has set out an aspiration for all new buildings from 2011 to be built to zero carbon standards.

The planning for sustainable buildings policy[23] expects minimum sustainable building standards to be met for most planning applications in Wales. These standards will reduce the demand for energy and associated carbon emissions generated by these new buildings. However the MIPPS also enables local planning authorities to identify strategic sites where there are opportunities for higher sustainable building standards to be achieved. While this toolkit does not consider the potential for all the range of sustainability features covered in a new building, it is expected that meeting the higher energy and carbon requirements will play an integral part in realising any opportunities.

A concentration of future heat demand, either isolated or near existing buildings can present the opportunity for strategic renewable energy development.

Energy demand can be estimated from the types of proposed buildings, the quantity of development and the energy efficiency level. Energy efficiency can reduce the energy consumption, so it is important to estimate the future requirements in this regard. The locations of new development will be needed for assessments of strategic opportunities.

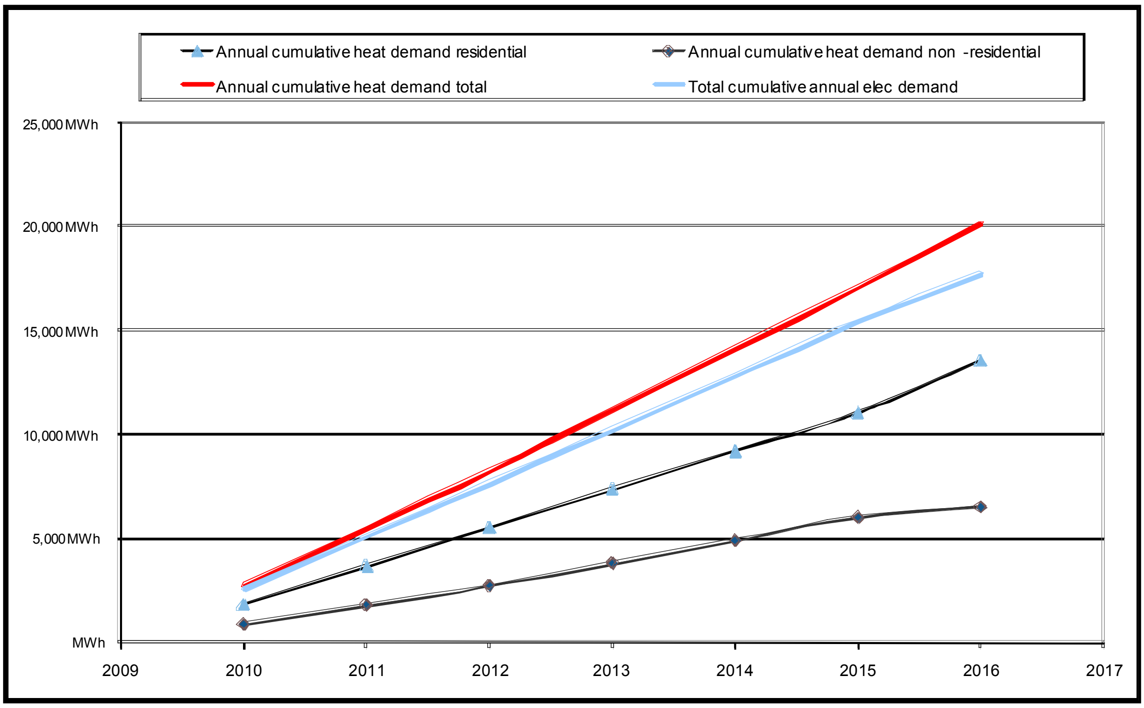
For dwellings, assess cumulative heat demand for each year, allowing for the impact of future energy efficiency standards (which are likely to reduce heat demand). The consultant will need to assume standard floor areas for each of the four dwelling types and estimate the energy demand using the output from SAP models

For non-residential buildings, the consultant would base the energy demands on published benchmarks for energy use per m^2 for different building types, such as those produced by Chartered Institute of Building Services Engineers (CIBSE).

The heat demands for both dwellings and non-residential buildings should be "degree day" adjusted to the region of Wales you are located in. This allows for the fact that the north of Wales has colder winters than the south.

As an output, the consultant should produce a profile of the estimated annual heating, cooling and electricity demand for each site, over the full build out period, showing how the energy loads build up over time. An example of the sort of output required is shown below:

Figure 6: A profile of the estimated annual heating, cooling and electricity demands



E4.3 Task 3: Identify areas for strategic stand-alone renewable energy development

Based on the analysis carried out in sections E1 and E3, a local authority could consider identifying, in the LDP, certain geographical areas that may be particularly suitable for larger scale renewable energy development. The value in doing this is that it sends an invitation to potential developers that the local authority is interested in seeing suitable development in those sites and that there is a greater likelihood of securing planning consent for applications in those areas[24].

This could include the following:

- Least constrained areas for wind development. The wind mapping described in section 5.4 would identify certain areas that had the greatest potential for wind development. However, we would recommend that a local authority should also carry out a separate assessment of landscape sensitivity for those areas (as described in TAN 8) if in rural areas. If the mapping shows potential in brownfield or industrial areas, this may be less of an issue
- Potential areas for locating biomass power generating plant, where they may be close to large heat loads, as well as having good transport infrastructure and potentially in close proximity to possible sources of fuel[25].

- The above point could also be applied to potential areas for locating energy from waste plants, although the local authority may be identifying these anyway as part of preparing a waste development plan.

E4.4 Task 4: Assessing the technical feasibility and financial viability of DHNs

Step 1: Define the boundary of the DHN areas to be analysed (local authority)

Based on the Energy Opportunities Plan produced as part of applying section E3, you are then in a position to define the geographical boundary of each DHN area that you wish to analyse in more detail. This should show the geographical extent of the DHN area on a map, as well as providing details of the existing and new buildings that could be connected.

It is assumed that the energy demand for these buildings will be known already from the processes carried out in chapters E3 and above. The table below summarises the information that should be provided for each area.

The number of areas to be analysed will depend on the number of strategic development areas that a local authority is considering. However, we would recommend that about five areas would be a manageable number. Within each of these areas there may be two or more options, such as a core and extended extent of connection, or variations in future housing numbers, for example.

Table 28: Information to be provided for each DHN area

Data type	Format	Source	Data required
1. Future new development	Table, e.g. Excel	See section E4 above	a list of the new build sites that are considered within the opportunity the cumulative annual heat demand for each year until the site is complete (to be developed by consultant)
2. Existing dwellings to be connected	Table, e.g. Excel	See section E3	a list of the output areas (OAs) that are considered within the opportunity the total annual heat demand of each OA the number of social homes in each OA
3. Existing non residential buildings to be connected	Table, e.g. Excel	See sections E3	a list of the buildings that could connect to the district heating scheme the annual heat demands of the buildings

Data type	Format	Source	Data required
4. Geographical boundary of the DH opportunity	Plan	Taken from GIS heat map	spatial extent of new development listed in (1) spatial extent and location of output areas which are potentially connectable, as listed in (2) location of any existing non residential buildings anchor loads, as listed in (3) any other important features such as energy from waste sites, existing DH or CHP

In terms of existing non-residential buildings that could act as potential anchor heat loads, we assume that you should be able to obtain information on annual heat demand for public buildings within the DHN boundary either direct from your own local authority manager, or from discussion with stakeholders such as Welsh health Estates, for hospitals.

If the DHN boundary includes potential non-public anchor loads, then we suggest that the energy demands for these buildings can either be modelled by the consultant (see Project Sheet G), or for a small number of large buildings, obtained directly from the building occupant.

Step 2: Carry out detailed technical and financial viability of each of the DHN areas (Consultant)

The next stage is to carry out a high level assessment of the technical and financial viability of each of the DHN opportunity areas. This exercise should distinguish between sites that may be viable purely commercially and more marginal sites that may be viable with other sources of funding (or the involvement of delivery partners with a higher risk tolerance).

This process is unlikely to be practical for the local authority to complete internally and so no detailed method is set out. More likely it will involve the local authority supplying the data described above to a consultant or potential delivery partner (such as an ESCo) with the required technical and in-house cash flow modelling skills.

Therefore, this section sets out the scope of what you would expect the analysis to cover so that you could prepare a consultant's brief. The table below shows a list of the key parameters and variables that the analysis should consider.

Table 29: Summary of key parameters for DHN viability assessment

Parameter (inputs)	Detail
Lead low carbon energy generation technologies	Gas CHP Biomass boiler Biomass CHP
Capital costs of DHN	Energy centre - lead plant, building, auxiliary services District heating network Connection to buildings
Lead plant replacement capital	Expected lifetime of lead plant The fraction of the initial capital that is required for replacement

Parameter (inputs) (Cont'd)	Detail
Revenue streams	Heat sales: to residential/non-residential customers - benchmarked to current gas prices Electricity sales: either to wholesale market or via private wire directly at retail prices[26] Standing charges - benchmarked to annual gas boiler service Renewable obligation certificates (ROCS) or Feed in tariff on renewable generated electricity after 2010 Renewable heat incentive on renewable generated heat after 2011 Climate change levy exemption certificates Connection charges to developers in lieu of gas connection, heat provision and individual renewable generation Connection charges to householder in lieu of gas connection
Ongoing costs	Fuel costs for lead/top-up plant Electricity costs for pumping DHN Maintenance of plant Metering of customers Administration including billing Insurance Business tax

Parameter (inputs) (Cont'd)	Detail
Capital funding	Possibly - CSEP, ECAs. CERT
Discount factor for NPV	6% for public sector viability 12% for commercial sector viability
Parameter (inputs)	**Detail**
Carbon emissions reductions	In new and connected existing buildings
Financial metrics	Net Present Value (NPV) Internal Rate of Return (IRR) Gap funding Sensitivity analysis

A key output from the financial analysis will be an assessment of whether the schemes are commercially viable, or whether gap funding is required. If the latter, then there are two potential sources of gap funding that a local authority, or an ESCo, may be able to secure from developers of new buildings to provide this funding. These are:

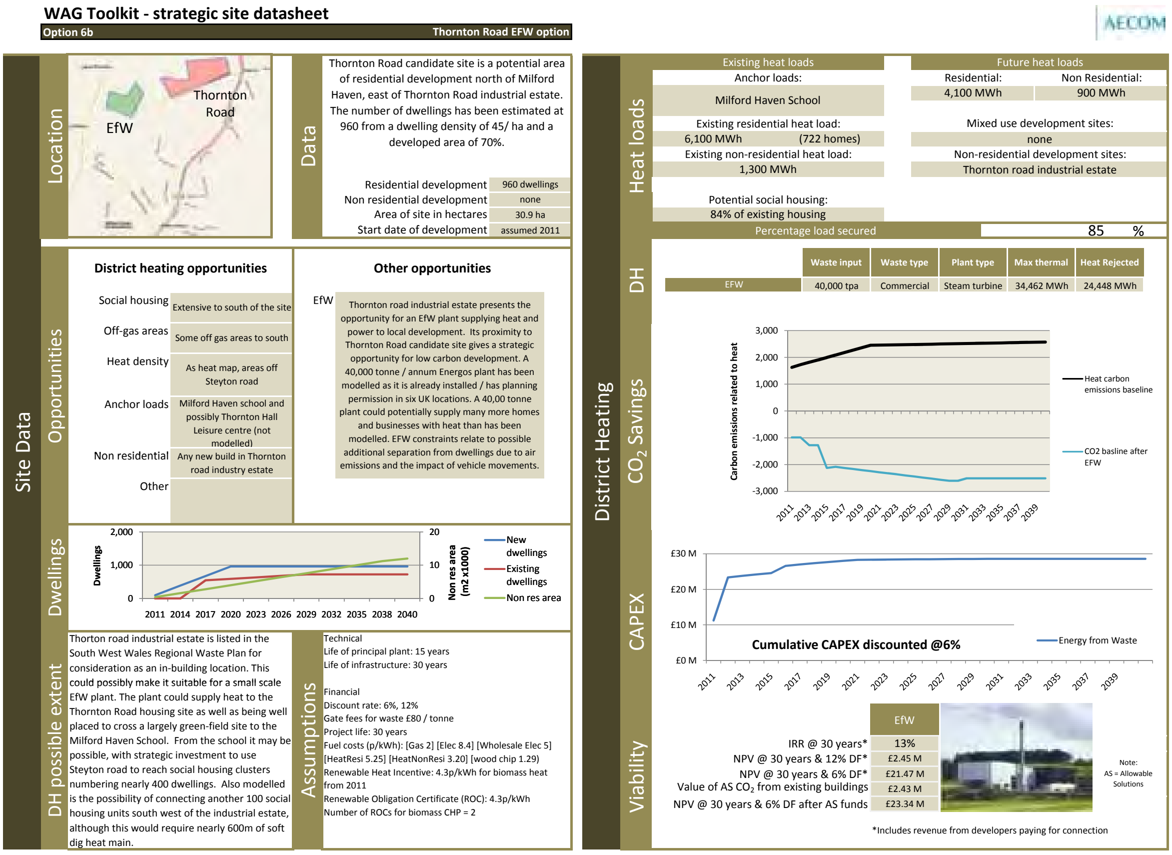
- Connection charges
- Allowable Solutions fund

Each of these is covered in more detail below, after step 3, and, where appropriate, they should be factored in to the financial analysis set out in the above section.

Another key output will be the level of carbon reduction that can be achieved on the strategic sites, as this will inform any carbon reduction target that you may wish to set (see also chapter P4).

An example of what the output from the consultant's assessment for a DHN area might look like is shown on the next page, taken from the Pembrokeshire case study.

Figure 7: Example output from consultant detailed assessment of viability of DHN area



Step 3: Test results of more detailed viability assessment with key stakeholders (local authority and consultant)

Once the detailed technical and financial assessment has been carried, we recommend that you should then consult with internal and external stakeholders to test out the results, but also to inform any actions for helping to deliver the opportunities (see section P5).

The choice of external stakeholders will depend on which opportunities are highlighted on the heat map. These stakeholders could include:

- Key stakeholders for other public sector anchor heat loads, such as: Health Trusts, social housing providers, further and higher education establishments, courts, prisons.
- Key stakeholders for potential private sector anchor heat loads, such as industrial users, large retail or office developments.

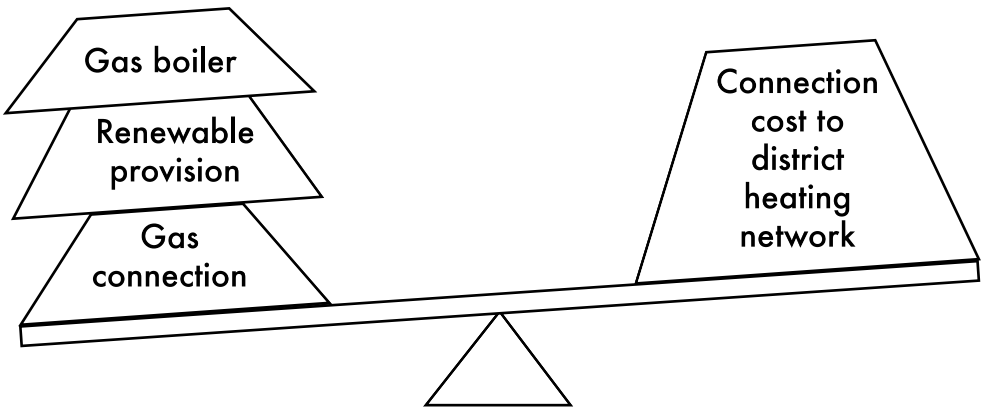
- Potential ESCos, who could operate and potentially invest in such schemes. This could include utility companies as well as specialist ESCo providers.

Funding from connection charges for new buildings

This is a charge to developers for connecting up new buildings to the heat network. There are two justifications for this, namely:

- In connecting up to the DHN, developers will avoid the cost of individual gas boilers in each building, as well as potentially also the cost of a gas connection[27].
- In connecting to a DHN fuelled from low carbon sources, the carbon savings will enable the developer to meet the carbon reductions required by the Sustainable Buildings Standard and future part L of the Building Regulations (including the requirements for zero carbon), which avoids the cost of having to achieve this in some other way[28].

Figure 8: Illustration of the balance between DHN connection cost levied to developers and the avoided costs allowed by the DHN



This connection charge could either be paid direct from a developer to an ESCo, or could potentially be collected by the local authority through CIL or a 106 contribution. An advantage of the latter could be that the value of the charge could be published in advance (as part of a general schedule of charges) which would give greater certainty to developers.

Whoever carries out the financial modelling should make an assessment of the reasonable value of a connection charge, in terms of a cost per m^2. If this charge were set to be no higher than what a developer would have to pay anyway, if they weren't connected to the DHN, then clearly the charge would not present an undue burden. On the contrary, connection to a DHN may well make it simpler and less costly for developers to meet future requirements for zero carbon development.

Funding from connection charges for existing buildings

It may also be possible to secure revenue from charges to existing building owners who connect up to the network. There are two broad categories of existing buildings where connection charges could be paid, namely:

- Existing owner occupied housing. It is reasonable to assume that when their existing boilers reach the end of their working life (after 15-20 years, typically), they will consider connecting to a DHN if there is one in their vicinity. The amount they will pay will be driven by the opportunity cost of having to pay for the installation of a new boiler.
- Existing businesses. As with owner occupied housing, businesses are likely to consider connecting up to a DHN when their boiler plant reaches the end of its useful life. In some circumstances, they may also be keen to secure the carbon reduction benefits. However, the avoided cost from connecting to the DHN may be hard to quantify, unless this can be discussed directly with the businesses concerned.

The role of ESCos

Delivery will almost certainly involve the creation of a legal entity to contain the commercial risk and raise capital for the DHN and energy centre. This entity is generally known as an ESCo, and its nature will shape the delivered scheme and which of the aims are prioritised. The Council and other delivery partners may take a degree of ownership/representation in the ESCo, as may the local community, or the ESCo may be a purely private sector entity.

The advantage of the former is that a local authority, or a public/private partnership, can take a longer term view of the investment and accept a lower rate of return and may also be able to take advantage of prudential borrowing. A purely private ESCo may prioritise financial return over carbon savings, community involvement, fuel poverty issues and so on, whereas, a partially community owned ESCo may focus on the social benefits and retaining the community's wealth in the area.

A large Multi-Utility Services Company (MUSCo) is a specialist organisation which has licenses to operate a number of utilities. It may be able to offer cost effective, fully serviced sites for the developers. This may include the energy centre and heat mains, gas supplies, water mains, waste water, electricity and fibre optic broadband. The infrastructure would be funded partly by the MUSCo and partly by the developers. Therefore capital investment for the developer may be minimised.

Allowable Solutions

One Wales' sets out the Assembly Government's commitment to combat the effects of climate change. A key part of this commitment is to deliver change within the built environment, including the aspiration for all new buildings to be zero carbon by 2011.

Following up the UK Government's commitment to consult further on the definition of zero carbon, in December 2008 the UK Government published Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation[29]. This proposed an approach based on:

- high levels of energy efficiency in the fabric of the home;
- a minimum level of carbon reduction to be achieved onsite or through directly connected heat; and
- a list of allowable solutions for dealing with the remaining emissions (including from appliances).

The UK Government has recently confirmed that the level of "carbon compliance" for dwellings will be set at 70% below the current Part L Target Emission Rate (TER) - i.e. a reduction of 70% of regulated emissions (unregulated emissions such as cooking and appliances and the remaining 30% can then be met by allowable solutions).

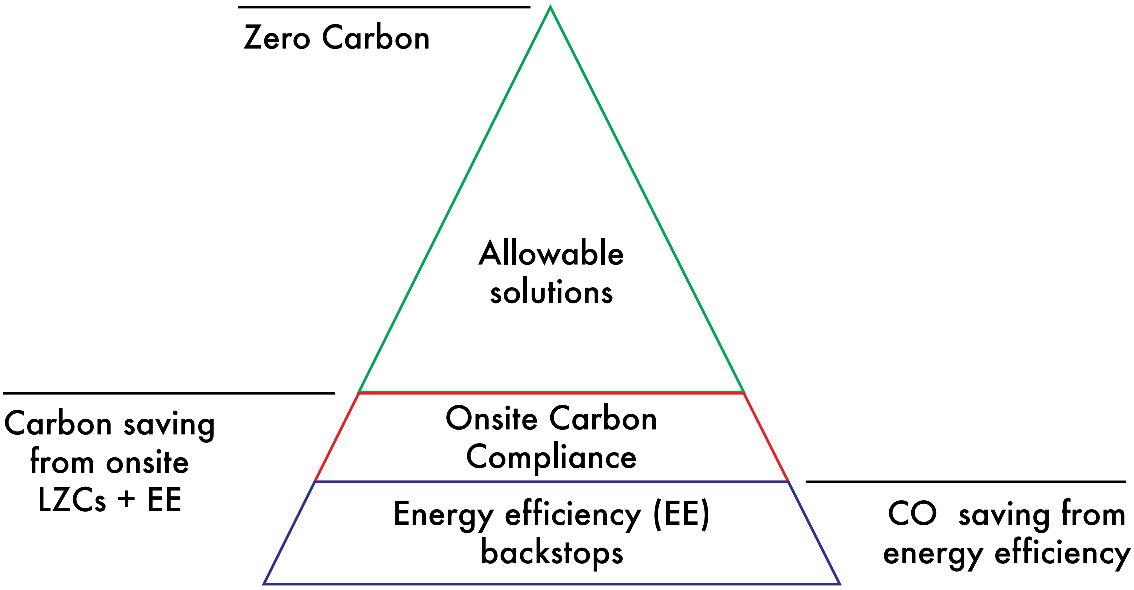
The 70% reduction should be met through energy efficiency or on-site low and zero carbon energy options (including small-scale wind) or though 'near site' - physically connected district heating or CHP (excluding large wind connected by direct physical connection).

The remaining residual emissions, including the unregulated emissions are to be dealt with by "allowable solutions". These include: further carbon reductions on site, beyond the regulatory requirements; exports of low carbon or renewable heat to surrounding developments, or investments in LZC energy infrastructure.

In England, all new build developers after 2016 (for housing) will have to cover the difference in carbon emissions between their onsite solution and full net zero carbon (approximately 150% of regulated emissions) by using allowable solutions. One of a selection of allowable solutions proposed would allow credit for carbon emissions where heat is exported from the site to nearby existing buildings via a DHN.

Although yet to be decided, should Wales follow the route of England, any DHN based on a new build site which exports heat to existing buildings may have the opportunity to benefit financially from the carbon savings made on those buildings. The revenue available will depend on the quantity of carbon savings achieved in the existing buildings and the 'market' price of allowable solutions carbon. Again, the financial modelling should factor in the potential funding from this source, if the local authority is prepared to consider managing an Allowable Solutions fund.

Figure 9: The Government's proposed tiered approach to achieving zero carbon



Other funding sources

As well as connection charges and Allowable Solutions, there are other potential funding sources that a local authority or ESCo may be able to tap into, that should be factored in to the financial model, where appropriate.

- **The Carbon Emissions Reduction Target (CERT)**. The CERT is an obligation placed on energy suppliers to reduce the carbon emissions from housing in England. In February this year the Government issued a consultation on expanding the CERT programme, to raise target by 20% and to increase the proportion of savings that could come from "innovative" measures to 10% of a supplier's obligation. Potentially, district heating could fall under the latter. The latest on the proposed amendments to CERT is available at http://www.decc.gov.uk/en/content/cms/consultations/open/cert/cert.aspx

- **The Community Energy Saving Programme (CESP)**. In February this year the Government issued a consultation on CESP, a new £350 million programme to support improving energy efficiency and reducing fuel bills in existing homes. This is a related programme to CERT, but aims to specifically target geographical areas of high fuel poverty - more specifically, those areas that have an index of multiple deprivation in the lowest 10% in the country[30]. The programme will run to December 2012. http://www.decc.gov.uk/en/content/cms/consultations/open/cesp/cesp.aspx
- **Enhanced Capital Allowances (ECAs)** enable a business to claim 100% first-year capital allowances on their spending on qualifying plant and machinery, including energy efficiency and low-carbon technologies. Businesses can write off the whole of the capital cost of their investment in these technologies against their taxable profits of the period during which they make the investment. The Government introduced the ECA scheme in 2001 to encourage businesses to invest in low carbon, energy-saving equipment. There are three ECA schemes which provide enhanced tax relief for spending on equipment which has environmental benefits: energy-saving equipment, water-efficient equipment and low carbon dioxide emission cars.
- **Low Carbon Buildings Programme (LCBP) Phase 1** provides grant funding of up to £2,500 per property to householders wishing to generate their own heat or electricity. The grants are administered by the Energy Savings Trust on behalf of the Department for Energy and Climate Change (DECC). Phase 2 of the programme relates to grants for microgeneration technologies for a public sector building (hospitals; schools; local authorities; housing associations), community or charitable bodies. This sees the current programme deadline for grants to be made and installations to be completed extend up to the introduction of Feed-in Tariffs and the Renewable Heat Incentive.
- **The Renewable Heat Incentive (RHI) (Feed-In Tariff)** - In 2011, the UK Government has announced it will introduce the RHI for generators of renewable heat. This is likely to provide producers of renewable heat with guaranteed premium revenue for all the heat they sell. Although the full details of the scheme are yet to be consulted on, this is likely to provide a significant source of revenue for DHNs fed by renewable fuels, such as biomass.
- **Arbed**: A Wales-wide strategic energy performance investment programme http://www.adjudicationpanelwales.org.uk/topics/environmentcountryside/energy/efficiency/arbed a Wales-wide funding concentrated on the Strategic Regeneration Areas (SRAs). For social housing providers in the SRA's, the Assembly Government proposes to help fund home energy efficiency/renewable energy retrofit projects. The most energy inefficient homes will be targeted first to maximise the reduction of those that are in fuel poverty improvement/and increase carbon emission reductions.

References

[20] See http://www.opsi.gov.uk/acts/acts2004/ukpga_20040020_en_9#pt2-ch1-l1g82

[21] As the Building Regulations are to be devolved in Wales after 2010, the dates of this trajectory may become different in Wales

[22] Roger Tym & Partners, 1997 and ERM Review

[23] MIPPS (01/2009) Planning for Sustainable Buildings

[24] I.e. this could function in much the same way as site allocations for new housing or commercial development

[25] E.g. food waste, wood waste, energy crops

[26] If private wire is assumed then the cost of operation private wire should also be included

[27] If they choose to use all electric cooking, as opposed to the most common option of gas hob and electric oven

[28] Which is likely to be some combination of energy efficiency and microgeneration

[29] http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

[30] See http://www.imd.communities.gov.uk/InformationDisplay.aspx for a map which identifies, to Lower Super Output Area, the rating for different areas according to the Index of Multiple Deprivation and identifies whether they fall within the lower decile

P Policy options: Translating the evidence base into policies and targets

Introduction

The aim of this section is to give you guidance on how to translate an evidence base for renewable and low carbon energy potential (as covered in sections E1 to E4) into practical targets and policies in your LDP's, and also into wider action that is required to help deliver some of the opportunities identified. Therefore, this section is split into five sub-headings, each of which covers the five policy options set out in the navigation table in chapter 3. These are as follows:

1. Develop area wide RE targets
2. Inform site allocations
3. Identify opportunities and set targets for renewable energy on strategic sites
4. Develop policy mechanisms to support District Heating Networks (DHNs) for strategic sites
5. Identify further actions for LA's, public sector and wider stakeholders to support the delivery of strategic renewable and low carbon energy opportunities.

Each of these is covered in detail in the remainder of this section.

P1 Develop area wide RE targets

Introduction

This task consists of the following four steps:

- Step 1: Define scenarios
- Step 2: Prepare summary tables
- Step 3: Test and discuss with stakeholders
- Step 4: Refine and select preferred scenario

Each step is described in detail below.

Step 1: Define scenarios

For each technology, the extent to which the maximum accessible resource can be delivered by a target date (e.g. 2020) is likely to be determined by a combination of the following:

- Technical maturity, covering both the extent to which new technologies prove to be viable[31], as well as the extent to which capital costs are expected to fall over time.
- Commercial viability, driven by future energy prices, and levels of Government subsidy and financial incentives, and other Government support.
- Extent of institutional and infrastructural support, covering the likelihood of securing planning consent (i.e. issues of political and social acceptability), as well as the availability of suitable grid infrastructure, transport infrastructure and so on.

Clearly, trying to predict the impact of these different variables is not a precise science, and trying to make such predictions will involve a combination of expert knowledge of the technologies and the policy context they operate in, together with detailed local knowledge of the local politics, infrastructure and projects in the pipeline.

We recommend that the best way to approach this is to use target scenarios to test the impact and feasibility of different assumptions for these key variables.

The precise nature of the variables to be covered under each scenario is likely to be specific to each local authority area, and therefore the description of the assumptions for each scenario should be tested with key stakeholders in each authority. This could include, for example, knowledge about whether there are proposals for a waste to energy facility to be located in the area, or it could be that a local authority was considering two housing growth scenarios, that would affect the levels of uptake of microgeneration depending on which was adopted.

We recommend that, based on the maximum accessible resource, the approach should present two or three scenarios for deployment of low and zero carbon energy generation. Typically, these could represent "Low" and "High" deployment scenarios, i.e. the latter representing the case where a high proportion of the accessible renewable energy resource is harnessed.

These scenarios can then be tested with stakeholders, and a preferred scenario identified, which may well be a combination of, or modified version of the original scenarios. This approach enables stakeholders to discuss the scenarios and understand the key assumptions and parameters that will affect the level of deployment for each technology. This in turn should improve the robustness of assumptions, as well as help to achieve some buy-in to any targets, as stakeholders are not presented with a single target figure as a fait accompli.

We present in the table below, as a rough guide only, some of the assumptions that could make up different target scenarios. We have split this into two categories, for renewable heat and electricity.

Step 2: Prepare resource summary tables

Once the scenarios have been defined, a summary table for each target scenario can be developed. These would draw on the accessible resource information that would be gathered as described in components E1 & E2. We suggest having two sets of summary tables, one for renewable heat and the other for renewable electricity. For ease of use an empty table has been reproduced below containing an illustration of where the results of your assessment should be located within the summary table.

Table 30: Resource summary for renewable electricity

Energy technology	Capacity factor (Project Sheet J)	Accessible resource		Current installed capacity		Target scenarios for 2020			
						Low		High	
		MWe	GWh/yr	MWe	GWh/yr	MWe	GWh/yr	MWe	GWh/yr
Onshore wind	0.27	**Project Sheet B**							
Energy crops	0.9	**Project Sheet C**							
Energy from Waste	0.9	**Project Sheet D**							
Landfill gas	0.6	**Project Sheet A**							
AD (animal and food)	0.9	**Project Sheet E**		**Project Sheet A**		**From discussion with key stakeholders**			
Sewage	0.42	**Project Sheet E**							
Hydropower	0.37	**Project Sheet F**							
Building integrated	0.1	**Project Sheet H**							
Total	-								
Local authority projected electricity demand in 2020						**Project Sheet I**			
Percentage electricity demand in 2020 potentially met by renewable energy resources						-	%	-	%

Table 31: Resource summary for renewable heat

Energy technology	Capacity factor (Project Sheet J)	Accessible resource		Current installed capacity		Target scenarios for 2020			
						Low		High	
		MWt	GWh/yr	MWt	GWh/yr	MWt	GWh/yr	MWt	GWh/yr
Biomass CHP or large scale heat only[32] (energy crops/AD)	0.5	**Project Sheet C and E**		**Project Sheet A**		**From discussion with key stakeholders**			
Heat from energy from waste (CHP or heat only)	0.5	**Project Sheet D**							
Building integrated (solar water heating, biomass boilers, heat pumps)	0.2	**Project Sheet H**							
Total									
Local authority projected heat demand in 2020						**Project Sheet I**			
Percentage heat demand in 2020 potentially met by renewable energy resources						-	%	-	%

Examples of how these should look when they are populated with the resource for a particular local authority area, in this case Pembrokeshire County Council, are shown below. As well as showing the installed capacity and the potential annual energy output, these should also show the annual energy output as a % of heat or electricity demand in 2020.

Table 32: Example resource summary for renewable electricity for Pembrokeshire

Energy technology	Capacity factor	Accessible resource		Current installed capacity		Target scenarios for 2020			
						Low (50%)		High (75%)	
		MWe	GWh/yr	MWe	GWh/yr	MWe	GWh/yr	MWe	GWh/yr
Onshore wind	0.27	30.4	64.3	3.2	7.6	13.5	31.9	20.3	48.0
Energy crops	0.90	14.0	110.4	-	-	7.0	50.4	10.5	75.6
Energy from Waste	0.90	-	-	-	-	-	-	-	-
Landfill gas	0.60	1.7	8.9	1.7	8.9	1.7	8.9	1.7	8.9
Anaerobic Digestion	0.90	1.8	14.2	-	-	0.9	7.1	0.9	7.1
Sewage gas	0.42	0.3	1.0	0.1	0.4	0.1	0.4	0.3	1.1
Hydropower	0.37	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
Building integrated	0.10	12.9	11.3	0.1	0.1	6.4	5.6	9.7	8.5
Total	**-**	**58.0**	**210.4**	**5.2**	**17.3**	**29.7**	**104.6**	**43.5**	**149.5**
Local authority electricity demand projected in 2020						-	1,039.0	-	1,039.0
Percentage electricity demand in 2020 potentially met by renewable energy resources						**-**	**10.1%**		**14.4%**

Table 32 Clarifying Notes

Current installed capacity from wind turbines was removed when producing the accessible wind resource maps. Therefore, for the summary table, the installed capacity is added to the accessible resource.

There is currently no electricity generation utilising energy crops in Pembrokeshire. However, should plant be installed using this resource, the capacity figure should not be added to the accessible resource.

The currently installed 1.6MWt capacity relates to Bluestone District Heating system. We have assumed 50% of fuel from energy crops and 50% fuel from woodland resource. The appropriate tonnage of energy crops has been removed from the accessible energy crop resource and allocated to heat generation.

The potential 0.2MWe generation from the AD of MSW and C&I food waste is excluded as it is anticipated that any new AD facility using this resource as a fuel will be located out of county.

The accessible resource figures for landfill gas, sewage gas, hydropower and BIR should and do include the currently installed capacity.

Table 33: Target summary for renewable heat

Energy technology	Load Factor	Accessible resource		Current installed capacity		Targets for 2020			
						Low (50%)		High (75%)	
		MWt	GWh/yr	MWt	GWh/yr	MWt	GWh/yr	MWt	GWh/yr
Biomass CHP or large scale heat only (energy crops/AD)	0.5	32.0	140.2	1.6	7.0	16.0	70.1	24.0	105.1
Heat from energy from waste (CHP or heat only)	0.5	11.6	50.8	-	-	5.8	25.4	8.7	38.1
Building integrated (solar water heating, biomass boilers, heat pumps)	0.2	10.7	18.7	1.5	2.6	5.3	9.3	8.0	14.0
Total	**-**	**54.3**	**209.7**	**3.1**	**9.6**	**27.1**	**104.8**	**40.7**	**157.2**
Predicted local authority heat demand in 2020						-	7,915.0	-	7,915.0
Percentage heat demand in 2020 potentially met by renewable energy resources						**-**	**1.3%**	**-**	**2.0%**

Table 33 Clarifying Notes

The heat from CHP will be informed by how much installed electricity capacity there is for each of the technologies given in the first table. How much heat will be produced for every unit of electricity generated will vary by technology[33], but a typical figure to use would be 2MW of heat for each 1MW of electricity. Realistically, not all of this heat output could be utilised all of the time, therefore a load factor of 0.5 (or 50%) has been assumed in the table.

The currently installed 1.6MWt capacity relates to Bluestone District Heating system. We have assumed 50% of fuel from energy crops and 50% fuel from woodland resource. The appropriate tonnage of energy crops has been removed from the accessible energy crop resource and allocated to heat generation.

The 1.6MWt installed capacity figure is included within the "CHP or large scale heat only (energy crops/AD)" accessible resource figure. No heat generation has been assumed for current sewage plant as the resource is employed by the sewage plant and is not therefore a usable resource.

No heat generation has been assumed for the currently installed landfill gas recovery engine.

The potential 0.3MWt generation from the AD of MSW and C&I food waste is excluded as it is anticipated that any new AD facility using this resource as a fuel will be located out of county.

The accessible resource figure for BIR should and does include the currently installed capacity.

In using these tables, it is important to not interpret the technology mix for each target as targets for each technology. The technology breakdown is used only to demonstrate that an overall target is deliverable and only the overall target (for either heat or electricity) will be used in any planning document. This is an important point, because otherwise stakeholders can become too focussed on the detail of the technology mix. It will also be easier to build support for an overall target, rather than individual technology targets, as some stakeholders may have concerns about particular technologies.

Step 3: Test and discuss with stakeholders

Once the scenarios and summary tables have been produced, these should then be tested with stakeholders, ideally as part of the LDP process. As a minimum, this could be a workshop held internal to a local authority, involving officers from relevant departments, such as officers responsible for:

- Planning policy and development management
- Waste
- Energy management
- Landscape/conservation
- Sustainability (if one)

The local authority may also wish to involve a wider range of stakeholders to help ensure buy-in from key stakeholders. These could include:

- Elected Members
- Statutory agencies, such as the Environment Agency Wales (EAW)
- Other local stakeholders, such as developers, National Farmers Union (NFU), local energy agencies, etc.

The aim of the workshop would be to:

- Test the key assumptions
- Build understanding of the target scenarios, and support for the need for targets and whichever target is adopted.

Step 4: Refine and select preferred scenario

Following this stakeholder engagement, preferred targets can be chosen. These may be based on one of the original scenarios, or a modified scenario based on the discussions. The target would then be tested with wider stakeholders as part of the standard LDP consultation and approval process.

References

31 e.g., such as biomass CHP, using gasification, or the widespread growing of energy crops, or use of gasification/pyrolysis technology for waste to energy

32 Over 1MWt

33 Depending on whether a steam turbine or gas engine technology is used for the generating plant

P2 Inform site allocations

Introduction

This policy option involves making use of the information developed out of the area wide renewable energy resource assessment (E1) and the heat opportunities mapping (E3) to inform the selection of land for development (allocations of sites for a development plan). The purpose is threefold, as follows:

- To identify, from the heat opportunities map, whether any candidate sites, (singly, or in clusters) are located in proximity to clusters of existing high heat demand or key potential anchor heat loads, or existing sources of waste heat. These sites could enhance the potential to develop district heating or CHP schemes for existing and proposed development.
- To identify whether any of the non-residential candidate sites lie in close proximity (say, within 500m) to potential sites for wind power.
- To identify whether any of the residential candidate sites may conflict with potential wind power sites. This could be an issue where they lie within 500m of a potential wind site.

In selecting a preferred strategy approach as part of preparing a Local Development Plan, local planning authorities will be identifying broad locations for development and areas including substantial growth areas and locations for specific types of development (i.e. housing, leisure, employment and waste). LDP guidance states that the identification of sites for specific uses (including mixed use) should be founded on a robust and credible assessment of the suitability and availability of land for particular uses or a mix of uses and the probability that it will be developed.

Whilst there will be a variety of factors[34] to be taken into account in identifying these broad locations for development and specific sites, the role of this policy option is to build in the spatial information on renewable and low carbon energy potential into the assessment of sites that may be incorporated into the plan (candidate sites). We recognise, of course, that renewable energy will be only one of many criteria used to assess sites, and we are not suggesting that the energy criterion should be prioritised over others. It is for individual local planning authorities to decide on the priority (if any) they give to renewable energy in their assessment of candidate sites.

The renewable energy toolkit can be used at the initial stage in identifying candidate sites or developing a strategy for distribution of development. There may be situations where in meeting local and/or national renewable energy or carbon targets, a local planning authority would identify a broad development area, or cluster sites together (of mixed energy and heat demand) so as to make the inclusion of LZC technologies more viable.

Method

Step 1: Map candidate sites in GIS onto wind constraints map developed from E1

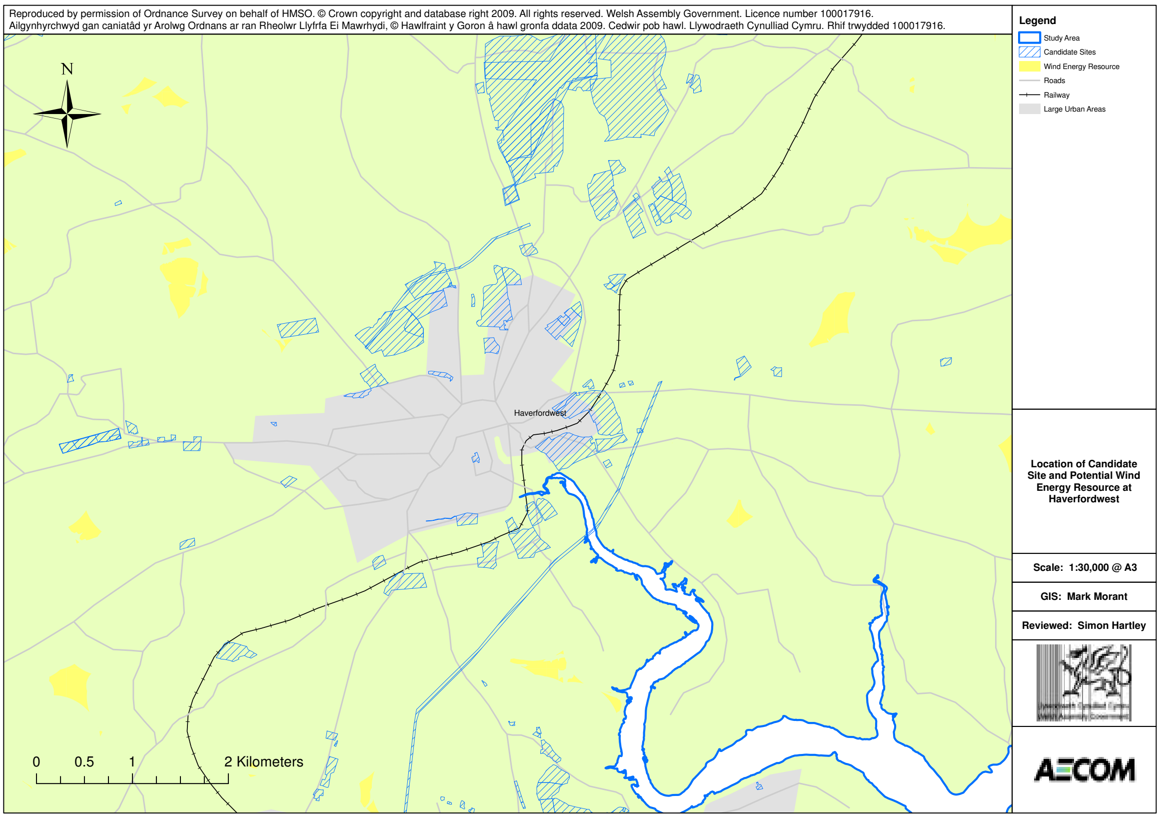
This mapping should indicate which sites are purely residential, and which are mixed, and which are non-residential. The mapping should show the geographical extent of each candidate site. Once you have mapped these sites onto the wind constraints map, you can then identify whether:

- Any of the non-residential or mixed use sites are within 500m of an area of wind resource. This means that these sites may have the potential for achieving significant carbon reductions by installing one of more wind turbines, as 500m represents a typical maximum distance, for cost reasons, to install a private wire connection from a large scale wind turbine to a proposed development site. The potential will be greatest where part of all of the potential wind area sits within the candidate site. If the potential wind site sits outside, this means that another landowner would need to be involved in taking forward any opportunity, which would add complexity.
- Any of the residential sites are within 500m of a potential wind site. If this is the case, residential development on this site is likely to preclude the potential for any large scale wind power development, for noise reasons. How significant the loss of this potential wind site would be would depend on its size and its location in relation to other potentially more favourable wind sites, as well as the feasibility of developing that site for wind power, given other constraints.

Once you have completed this assessment, you can then this information to form criteria in the assessment of candidate sites. The weight that you give to this is for you to decide.

An example of the output from this step, from the Pembrokeshire case study, is given below.

Figure 10: Example of using a wind constraints map to inform the assessment of candidate sites

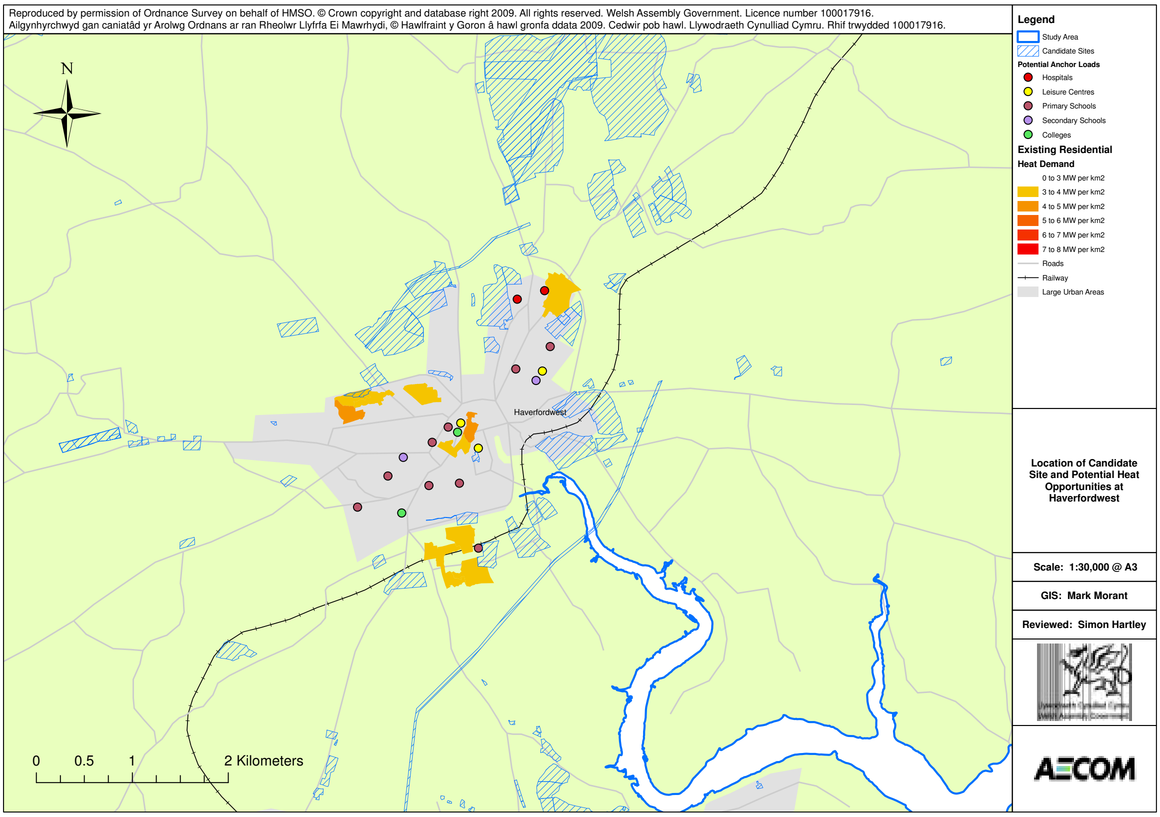


Step 2: Assess proximity to potential heat opportunities, identified in E3

You should overlay the map showing the location of candidate sites onto the heat opportunities map. You should clearly indicate whether the candidate sites are residential, non-residential, or mixed. As the opportunities for district heating are greater for larger sites, you may want to focus this assessment only on larger candidate sites, of over 0.5ha. The output of this will clearly show those candidate sites that have the greatest potential synergy with areas of district heating potential, either because they have high residential heat demand, are close to sources of waste heat, potential anchor heat loads, existing CHP, or potential energy from waste sites. As a guide, we suggest that candidate sites would need to be within about 1km, and preferably 0.5km, of these opportunities for them to be of interest.

You can then use this proximity to heat opportunity areas as a criterion in your assessment of candidate sites. The weight that you give to this is for you to decide. An example of the resulting map is shown in the Pembrokeshire case study'.

Figure 11: Example of using a heat opportunities map to inform the assessment of candidate sites



References

[34] Including requirements for SEA

P3 Identify opportunities and set targets for RE on strategic sites

We have used the term "strategic sites" to cover two different categories of opportunity for renewable and low carbon energy. The first category relates to strategic sites for renewable energy development not linked to new development. The second category relates to strategic sites for new development where there are significant opportunities for renewable or low carbon energy. Each of these is covered in turn below.

Category 1: Strategic sites for renewable energy not linked to new development

This could include, for example, wind farms, biomass power stations, and hydropower sites which produce electricity only and supply this to the grid. It may also include renewable energy schemes that produce and supply heat for existing buildings, and energy uses. For example, this could include energy from waste plant providing heat to an existing industrial processor. Planning can have an impact on these energy schemes as they would require planning consent from the local authority[35] prior to construction.

A possibility available to local authorities is that they could identify potentially suitable areas or sites for the above technologies as part of the LDP proposals map. This would signify to developers that planning applications for certain technologies in those areas would be welcomed, as long as they are not in conflict with other policies and do not cause significant adverse impacts[36].Some options for this approach, and the evidence that would be required, are suggested in the table below.

Table 34: Type of evidence base required to identify strategic sites for renewable energy

Example planning policies	Evidence base required
Identify potential sites or broad areas for biomass CHP or energy from waste plants due to close proximity to significant heat loads	Completed heat opportunities map (E3) to show location of heat loads Completed area wide renewable energy resource assessment (E1) to show that fuel resource is available, and to identify any schemes that may already exist Potential sites tested with relevant stakeholders (such as renewable energy developers) as part of the process of preparing E1 and E3 The local authority may also wish to carry out a more detailed constraints assessment for potential sites (as set out in E4), before identifying them on a proposals map.

Example planning policies	Evidence base required
Identify potential broad areas or sites for wind power development, e.g. on brownfield land	Completed wind power constraints assessment (part of E1), to show areas of least constraint Potential sites tested with relevant stakeholders (such as renewable energy developers) as part of the process of preparing the wind constraints map The local authority may also wish to carry out a more detailed constraints assessment for potential sites (as set out in E4), before identifying them on a proposals map.

Clearly, identifying sites in this manner has the potential to cause opposition from the public or other stakeholders. However, this can be tested as part of the LDP consultation process.

Category 2: Strategic sites for new development where there are significant opportunities for renewable or low carbon energy

These opportunities could include district heating networks (DHNs), which could be fuelled from a range of sources including: biomass[37] heat only, gas engine CHP, biomass CHP, energy from waste and fuel cell CHP. Potentially, for some sites, they could also include one, or more, large scale wind turbines[38].

For this category, it is worth noting that some of the opportunities could involve existing development and energy uses, as well as new developments. In fact, the viability, carbon reduction potential and wider benefits that can come from DHNs are likely to be maximised where new and existing development can be linked. Although planning can have a role to play in helping to deliver such schemes, through new development, it will require Local Authorities to play a wider role (for example, through their Corporate estate) to help deliver some of these opportunities, and this is covered further in section P5.

In order to identify whether there is significant potential for renewable or low carbon energy in close proximity to strategic new development sites, you should complete the area wide renewable energy assessment of E1, and the heat opportunities map of E3.

If there does appear to be significant potential, then a key way that you can encourage or require developers to harness this potential is to set a carbon reduction target for the strategic site, in excess of the current Sustainable Buildings standards[39]. We recommend that you should frame such targets in terms of a reduction in regulated CO_2 emissions, compared to the current (2006) edition of Part L of the Building Regulations. This is because this is in line with the approach used by the 'Sustainable Buildings' standards, and also means that compliance with the target can be assessed using the standard part L methodologies. In order to set such a target, however, you will need to demonstrate that the level of carbon saving is achievable, and that the cost will not represent an undue burden to a developer. To do this, you should also commission a more detailed assessment of the viability for the site, as set out in E4. The evidence required to set such targets is summarised in the table below.

As well as setting targets, or instead of, there are a range of other policy options for encouraging DHNs on strategic sites, which are set out in section P4.

Table 35: Type of evidence base required in relation to example planning policies for 'other' development sites

Example planning policies	Evidence base required
Set carbon reduction targets for strategic new development sites in excess of Sustainable Buildings Standards[40]	Energy opportunities plan made up of the output of the area wide renewable energy assessment (E1) and the heat opportunities mapping (E3) For non-wind sites, evidence to show that DHNs are financially and technically viable in these areas and that the level of carbon savings required can be delivered by a range of district heating/CHP technologies and fuels (section E4).

References

[35] Unless the scheme is large enough to fall under section 36 of the Electricity Act, in which case the local authority is a consultee, but the decision on planning consent is made by the relevant Secretary of State

[36] Which would be assessed as part of the normal Environmental Impact Assessment and planning application determination process

[37] This could include anaerobic digestion

[38] Where a sufficient separation distance from existing or proposed dwellings could be achieved to meet noise guidelines. This is typically in the range of 4-600m, depending on the size of turbine.

[39] Which is a 31% reduction in regulated CO2 emissions for new dwellings, and an EPC rating of 40 or less for larger non-domestic buildings

[40] Planning Policy Wales, Chapter 4 Planning for Sustainability

P4 Develop policy mechanisms to support District Heating Networks (DHNs) for strategic sites.

The long-term ambition of pursuing this policy options is to deliver a strategic district heating network across the district heating priority areas, identified as part of E3 and E4. To this end, encouraging district heating on new developments can provide a catalyst for developing wider district heating networks to serve existing buildings. For this to succeed, you local authority is likely to need to take a strong lead in developing such networks, fulfilling some of the roles set out in section P5 below.

Some of the potential policy options for encouraging DHNs on new development sites, and how they relate to the evidence base options, are set out in the table below.

Table 36: Potential policy options for DHNs and associated evidence base options

Example planning policies	Evidence base required
Designate areas as strategic (or priority) district heating areas (SDHAs) or Policies like this can be important to attract ESCos and to give them the confidence to invest in such sites.	Energy opportunities plan (from E3) Evidence to show that a DHN is financially and technically viable in these areas (from E4) Evidence to show that the connection cost not an undue burden
Within the SDHAs, set requirements that large and mixed-use developments (over 100 dwellings) should consider installing a district heating network to serve the site. This, in turn can act as a springboard for supplying heat to any surrounding heat loads in the SDHA in the future. Where appropriate, applicants may be required to provide land, buildings and/or equipment for an energy centre to serve existing or new development. In addition, new development should be designed to maximise the opportunities[41] to accommodate a district heating solution, considering: density, mix of use, layout and phasing.	Energy opportunities plan (from E3) Evidence to show that DHNs are financially and technically viable in these areas and that the level of carbon savings required can be delivered by a range of district heating/CHP technologies and fuels (from E4)

Example planning policies	Evidence base required
Within the SDHAs, you could require small developments (less than 100 dwellings or non-residential developments less than 10,000m^2) to connect to any available district heating networks. Where a district heating network does not yet exist, applicants should consider installing heating and cooling equipment that is capable of connection at a later date.	As above
Establish a Carbon Buyout Fund. Where applicants can show that achieving these policy requirements is unviable on a particular site, they will be subject to a financial payment. After 2016, this fund could be used as an Allowable Solutions fund, to enable developers to offset their residual carbon emissions. As described in section E4, this fund could be used to support district heating networks in the locality.	Financial modelling to assess what level of payment into the fund would not represent an undue burden to developers (see section E4). After 2016, modelling to assess that the carbon savings from connecting existing buildings to a DHN could offset the residual carbon emissions from adjacent new development.

References

[41] Within the constraints of meeting other Council policy requirements, and principles of good urban design

P5 Identify further actions for LA, public sector and wider stakeholders

Developing and implementing planning policies is one way in which a local authority can facilitate the delivery of renewable energy projects. However, there is a wide range of other actions that a local authority can (and will need to) take at a wider corporate level to facilitate the delivery of the renewable energy opportunities that would be identified as part of forming the evidence base for targets. A summary of some of these actions, which is not exhaustive, is provided in the table below.

Table 37: LA corporate actions to deliver renewable energy opportunities

Role of Local Authority	Examples of potential actions
Land owner	Develop wind power and other stand-alone renewable energy resources on Council land. Host energy centres for district heating/ CHP networks on Council land or within Council buildings.
Procurement of energy services for existing corporate estate	Commit to installing biomass boilers when boiler plant is being refurbished, particularly in off mains gas areas Commit to connecting up large public buildings, or Council housing to district heating networks as key anchor loads.
Financing and delivery vehicles	Consider forming a public/private ESCO to develop district heating networks. Use status to help lever in additional sources of funding for renewable energy or DHN projects - e.g. from Convergence funds or the Community Energy Saving Programme.
Property developer	For new Council buildings, such as schools, commit to connect to district heating networks or set targets for using renewable energy systems
Procuring and maintaining transport infrastructure	When new roads are being designed or existing roads upgraded, consider the potential for installing heat mains

Role of Local Authority	Examples of potential actions
Procuring and managing waste management services	Ask bidding contractors for waste management to consider the use of advanced thermal treatment options, and the linking of heat output to sources of local heat demand Consider the potential for biomass waste (e.g. wood waste at civic amenity sites, arboricultural residues from park trees, municipal food waste), to be used as a resource for energy production.
Leadership and facilitation	Play a leadership role to encourage other public bodies (e.g. Health Trusts, Universities) to also commit to the sort of actions listed above. This could be, for example, through developing a wider climate change or renewable energy strategy for the County or Unitary. Local service boards could also act as a forum where local authorities could play this role.

The process of developing these actions, to form a delivery plan, can be started as part of the stakeholder meetings and workshops held as part of developing the evidence base, and, if strategic sites are involved, as part of the engagement process. As a basic starting point, completing a heat opportunities map, as set out in section E3, will identify some of the opportunities for district heating and the potential role that the local authority could play in developing those further.

However, a more useful basis for informing corporate action would be to combine the heat opportunities map with an area wide renewable energy assessment (as set out in E1), and to produce an Energy Opportunities Plan. This would also identify potential wind power sites where the local authority, or other public sector agencies, may have land holdings. It would also identify the potential for other larger scale renewable energy options where the local authority may have a key role to play, such as energy from waste, or anaerobic digestion of food waste.

Finally, and this may be an initial corporate action to come out of the above, the local authority may wish to commission more detailed information on the viability of certain strategic sites (as set out in E4) identified in the Energy Opportunities Plan. Completing this will provide more detailed information on the key actions required to develop renewable or low carbon energy opportunities (if they are still shown to be viable) and the role that the local authority can or should play in that.

Project Sheets

Project Sheet A: Existing and proposed LZC energy technologies

Before embarking on a resource assessment for renewable energy in your area, a useful starting point is to first establish what renewable energy capacity already exists. The reasons for this are as follows:

- In developing renewable energy targets, it is useful to know where you currently stand in relation to any particular technology, and it will help, in discussion with stakeholders, to put any targets into perspective.
- In some cases, the presence of existing capacity will affect the resource assessment and the targets themselves. For example, you may already have an 'energy from waste' scheme in your area, which would preclude any further contribution from that resource. In the case of an existing wind farm, this would have an impact on the resource assessment itself, as set out in Project Sheet B.

This assessment of existing capacity should cover electricity and heat generation, and large scale as well as BIR generation. For larger schemes, it should also include those that have received planning consent, but are not yet built.

We have broken this task into two stages. The first is the assessment of existing large scale renewable energy capacity and the second is for smaller scale and BIR generation capacity. Each is set out in detail below.

Identifying existing larger scale renewable energy capacity

There are two data sources that you can use to identify this capacity. The first is the Renewable Energy Statistics Database for the UK[42] which is compiled on behalf of the UK Government. The database is based on annual surveys carried out by AEA who manage the database. You should go to the "Planning Database" section of the website, and then download the "Database Planning Extract" as shown highlighted in the screen shot below. This will download an Excel file. You can then add filters in Excel to show only projects in Wales, and then filter again to show only projects for your County. You should then filter again by the "Post Consent" column, to only show projects that are "Operational", "Under Construction" or "Awaiting Construction". This is because the database also includes details of projects that did not receive planning consent and therefore did not proceed further.

The database will give you information on the installed capacity for different technology types (note that this is given in MW, not kW), as well as the location, in terms of easting and northings[43].You may find that the easiest way to identify the schemes in your area, or close to your boundaries, will be to plot the location of all the schemes shown for Wales, using the grid co-ordinates given in the database. This should be a quick and straightforward exercise using GIS software.

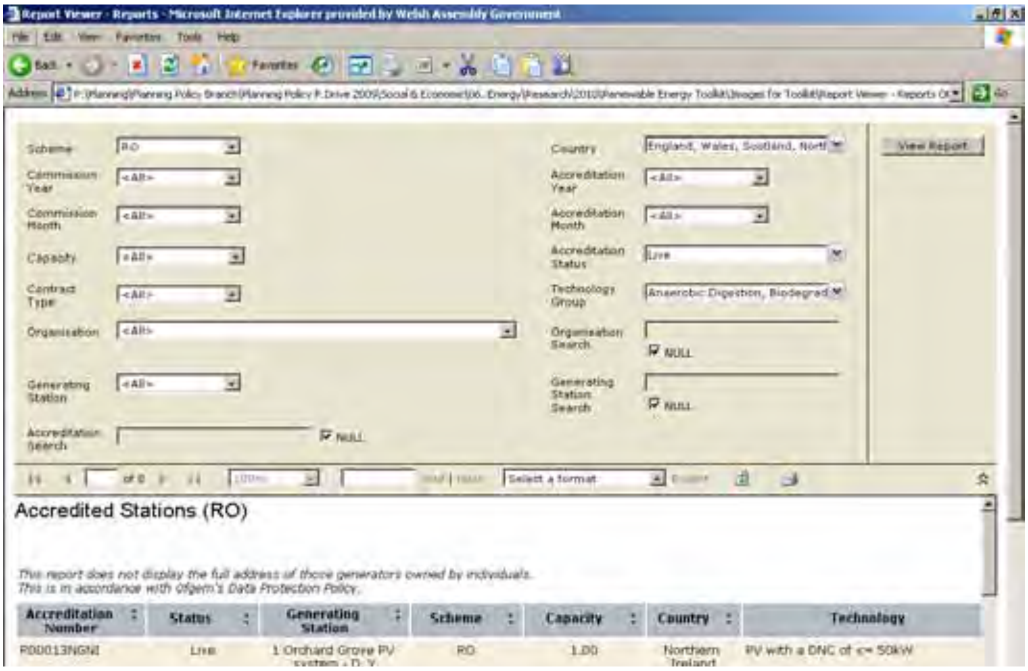
Sometimes a site may appear more than once, but with slightly different names and installed capacities. This can happen if, for example, a wind farm is repowered. If you are in any doubt, you should review the planning applications of the schemes concerned, which you can obtain from the Council website, under the planning section, or from discussion with your development management colleagues.

Figure 12: Screen print of RESTATS web page

RESTATS www.restats.org.uk

You should note that this database only includes details of schemes that required planning permission (therefore this would not include a lot of microgeneration), and it is only accurate up to the date of the last survey, and it may also not pick up smaller generating projects[44]. For this reason, we recommend that you should also cross check the existing capacity by referring to the Ofgem renewable and CHP register[45]. This provides a list of accredited generating stations that are, or are soon to be, operational, and eligible for Renewables Obligation certificates (ROCs)[46].From the home page, you should go to the "View Public Reports" section of the webpage, on the right hand side. You should then view the list of Accredited Stations. You will then be taken to a database page. Make sure that the options are set as per the screen shot below, and then click on "View Report".

Figure 13: Screen print of database page of OFGEM's renewable and CHP Register



Ofgem Renewables and CHP Register. https://www.renewableschp.ofgem.gov.uk/

This will then generate a report, for all renewable energy technologies in your area. You can then export this by first selecting a format (e.g. CSV file) and then clicking on the word "Export". This will then allow you to save the file as an Excel file. You can then review the Generating Station Address to see which schemes are in your area. For those schemes that don't give an address, you will need to review the name given to the scheme under the column headed "Generating Station" to see if you can identify whether this is in your area. You should note that this file gives the installed capacity for the scheme in kW and not in MW. This database records all schemes that are, or wish to claim ROCs, and therefore it will also include some microgeneration renewable electricity projects, as well as larger scale installations. However, it will only include schemes that generate renewable electricity and therefore will not include details of any renewable heat-only generation capacity (e.g. such as wood chip boilers).

Finally, once you have compiled these lists, we recommend that you should also consult internally with your development management colleagues to identify whether there are any more recent planning applications for renewable energy projects that they are aware of, that may have received consent, either by the planning authority, or at appeal.

Once you have this full list of projects, you may wish to plot the location of the larger scale projects using GIS. In particular, it would be useful to plot the location of existing or consented wind farms as this will inform the wind resource assessment. If you are carrying out an assessment of the potential for renewable energy linked to strategic new development sites (see chapter 6), it would also be useful for you to plot the location of existing energy from waste schemes and biomass schemes as these may potentially be able to supply heat to new development.

Identifying existing smaller scale and microgeneration capacity

The data sources described above will not provide information (at a local authority level) on any installed renewable heating capacity (such as wood chip boilers, heat pumps and solar water heating), and may also not include small scale electricity generation if the generator is not claiming ROCs. Most of these projects are likely to be smaller scale schemes, or microgeneration. In order to obtain information on these schemes, we suggest that you use the following sources of information:

1. Obtain data from grant making bodies. Microgeneration will have been historically installed by householders or organisations, including businesses, the public sector and community groups. Some will have been installed by early adopters without grants, but the majority will have been grant funded to some extent[47]. To obtain information on the number of grant funded installations in your area, we suggest you contact Energy Saving Trust Wales[48]. You need to make sure that you do not double count any smaller scale renewable electricity installations that may have been identified from both this source and the Ofgem database described earlier.
2. Talk to your local authority energy manager and officer responsible for schools, to identify whether renewable energy systems have been installed in Council buildings. You need to make sure that these installations are not double counted with the information provided from (1).

Example of Toolkit Output

Table 38: Existing renewable electricity capacity

Name of scheme	Technology	Capacity (MWe)	Status	Source
Castle Pill Farm	Wind Onshore	3.2	Operational	Ofgem
Withyhedge	Landfill Gas	1.74	Operational	Ofgem
Narbeth Waste Water Treatment Works	Sewage Gas	0.11	Operational	Ofgem
Preseli Hydro	Hydro	0.07	Operational	Ofgem
Cerrig Hydro	Hydro	0.01	Operational	Ofgem
Y Gaer Hydro	Hydro	0.00	Operational	Ofgem
Caerfai Farm	Wind Onshore	0.02	Operational	Ofgem
-	PV	0.03	-	Grant bodies
-	Wind Onshore	0.06	-	Grant bodies
Total	**-**	**5.24**	**-**	**-**

Note: As described in the methodology above, the RESTATS database reports on three additional schemes, Withyhedge Generation Plant (Landfill Gas), Castle Pill Farm (Wind Onshore), and Lodge Farm 1 (Wind Onshore). The Withyhedge Generation Plant data as reported in the RESTATS database has been superseded by the Ofgem dataset and has therefore been excluded from the table. By reviewing individual planning applications and the Ofgem register, for the Castle Pill Farm and Lodge Farm 1 schemes, as identified on the RESTATS database, it is apparent that both schemes refer to the same site. The total installed capacity of both of these schemes is superseded by the Ofgem dataset and has therefore been excluded from the table.

The column "heat available" refers to those technologies that potentially have the ability to produce waste heat. If there was the possibility of any renewable heat that could be used, this should be included in the table below.

Table 39: Existing renewable heat capacity

Name of scheme	Technology	Capacity (MWe)	Status	Source
Bluestone holiday park	Biomass Boiler	1.60	Operational	Council Staff
Pembrokeshire College	Biomass Boiler	0.35	Operational	Council Staff
Pembrokeshire Technium	Biomass Boiler	0.15	Operational	Council Staff
Pembrokeshire Schools	Biomass Boiler	0.45	Operational	Council Staff
-	Solar water heating	0.50	-	Grant bodies
-	Heat pump	0.04	-	Grant bodies
-	Biomass Boiler	0.05	-	Grant bodies
Total	**-**	**3.14**	**-**	**-**

References

[42] See www.restats.org.uk

[43] Note that the location given is sometimes that of the applicant/landowner, rather than the precise location of the generating station (s). You can obtain the latter, if required, by referring to the original planning application.

[44] However, it does have the advantage that it can identify larger scale schemes that have received planning consent but are not yet generating

[45] See https://www.renewablesandchp.ofgem.gov.uk/

[46] Note that this database will not include energy from waste incinerators without CHP or large hydro schemes as these are not eligible for ROCs

[47] There have been several schemes, both national and Wales specific. The national ones include Clear Skies, the PV Major Demonstration Programme, the Bioenergy Capital Grants Programme and the current Low Carbon Buildings Programme. In Wales, there is, for example, the Wood Energy Business Scheme.

[48] http://www.energysavingtrust.org.uk/Energy-Saving-Trust-advice-centre-Wales/Working-with-Local-Government

Project Sheet B: Wind energy resource

Introduction

A strategic, high level assessment of the accessible wind power potential for an area can be made using GIS to map a variety of different constraints, such as wind speed, national environmental designations, proximity to dwellings and so on. This process is referred to as "constraints mapping". The outcome of this process is to identify the total area of land that is potentially suitable for wind development. This area can then be converted to a potential installed capacity and energy output. A further refinement on this is then to reduce this resource further to allow for cumulative visual and landscape impact.

We ask you to note that this approach is really only suitable for a high level assessment, for the purpose of informing an area wide target. In particular, you should bear in mind the following:

- Firstly, even though the mapping may show that the locating of wind turbines may be constrained in a particular area, this does not mean that turbines could not be located there in practice. This is because, for example, environmental designations in those areas may not be impacted on by a wind development (e.g. if the designation is for flora or invertebrates), or it may be possible to achieve a "technical fix" for radar interference at a particular site. Therefore, the constraints maps should not be used to preclude wind development in constrained areas. It is for each planning applicant to demonstrate whether the impacts are within acceptable limits, and meet relevant policy and guidance.
- Secondly, although this high level process can inform the potential for individual sites, it is not in itself enough to fully assess their technical viability. Some of the further site level constraints that would need to be assessed (and this is not meant to be an exhaustive list) include:
  - site slope
  - the practical access to sites required for development
  - proximity to power lines, public rights of way, bridle ways
  - landowner willingness for development to go ahead
  - the distance to the nearest appropriate electricity grid connection
  - consultation with telecommunications operators to identify whether any links were passing over the site
  - formal consultation with the MoD and Civil Aviation Authority to identify any potential objections in relation to radar interference
  - impact on birds, bats and other ecology
  - issues of cumulative impact in relation to other existing or proposed wind power installations.

It is not appropriate, or possible, to consider all site level issues as part of a high level assessment to inform area wide targets.

The method set out below is for assessing the potential wind resource outside of the TAN 8 Strategic Search Areas (SSAs). The resource assessments for the SSAs have already been carried out, and therefore there is no need to repeat this. If a local authority has an SSA within its boundaries, either entirely or partly, then the potential contribution from the SSA should be added on at the end of the assessment set out below.

It should be noted that the method set out below not does include any assessment of the sensitivity of landscapes to wind farms, although it does make an allowance for cumulative impacts (see step 9), as this was outside the scope of the work to develop the toolkit. However, local authorities may wish to commission work in this area to support their assessments, if landscape is likely to be a key issue.

Methodology

You can access the accessible wind resource for your local authority area, using GIS constraints mapping, by following the steps below:

Step 1: Decide on typology of wind turbine to use for the assessment

Step 2: Map average annual wind speeds

Step 3: Map environmental and heritage constraints

Step 4: Map transport infrastructure constraints

Step 5: Map existing dwellings and a noise buffer

Step 6: Map existing aviation and radar constraints

Step 7: Prioritise available wind resource

Step 8: Assess potential installed capacity and energy output

Step 9: Assess cumulative visual and landscape impact issues and reduce resource accordingly

Step 1: Decide on typology of wind turbine to use for the assessment

Before starting the assessment, you should first decide on the size of wind turbines to be used for the assessment. This is because this will affect the size of different buffers used in the constraints mapping. The standard size of commercial wind turbines is constantly changing and wind turbines have become increasingly larger over the last few years. At the time of writing this toolkit, a typical size of onshore wind turbine, and the one we propose you use for this assessment is as follows:

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

All of the buffers set out in the steps below are based on this size of turbine. You may need to revise this typology in the future, as the technology evolves.

Step 2: Map average annual wind speed

The average annual wind speed (AAWS) has been estimated for each 1km² throughout the UK and is reported at 10m, 25m and 45m above ground level (agl). The data uses an air flow model to estimate the effect of topography on wind speed. This database is available from the DECC website[49] as a GIS datalayer.

The level of AAWS that is required to make a site commercially viable changes over time, depending on the size and height of available machines, the costs of construction and grid connection and the value that developers can achieve from their generation. The latter is influenced by the value of Renewable Obligation Certificates (ROCs), or, for smaller installations, Feed-in Tariffs. There is no established guidance on this. However, at the time of writing this toolkit, the standard industry approach is, for 80m hub height machines, to look for a minimum AAWS of 6.0m/s at 45agl, and ideally in excess of 6.5m/s.

You should establish a 1km² grid GIS data layer for your study area and associated AAWS at 45m agl attributed to each respective 1 km² cell. Grid cells with an AAWS of less than 6.0 m/s, between 6.0 and 6.5 m/s, and greater than 6.5 m/s should be classified as 'low', 'moderate' and 'high' wind speed respectively. You should then assume, for the assessment, there is no wind potential in areas with an AAWS of less than 6.0m/s.

Step 3: Map environmental and heritage constraints

The location of potential wind turbines can be restricted by existing environmental and heritage constraints and as such could be refused planning approval if they fall within such areas. You should therefore map in GIS the geographic extent of the following national environmental and heritage constraints:

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)

Areas of Outstanding Natural Beauty

You should assume, for the purposes of the assessment, that there is no potential for wind development in these areas, although in practice some of these sites may not be particularly sensitive to wind power.

It is recognised that the above list is not exhaustive and where additional environmental and/or heritage constraints exist they should also be taken into consideration.

Step 4: Map transport infrastructure and other physical constraints

To minimise potential disruption to transport infrastructure in the unlikely event that a wind turbine should 'topple' you should apply minimum exclusion zones, depending on the classification of transport infrastructure. These exclusion zones are referred to as 'topple distances' (hub height plus rotor radius) and can be defined as follows:

Table 40: Transport infrastructure constraints

Transport Classification	Minimum exclusion zone	Source
Principal transport network (motorways, trunk roads and rail network)	Topple distance (the same as tip height) plus 50 metres	Highways Agency See http://www.highways.gov.uk/business/documents/Wind_Turbines_SP_12-09.pdf. We are not aware of any specific guidance from Network Rail in relation to separation distance from railways, but we have assumed it to be the same as that for trunk roads
Secondary transport network (other local authority transport network)	Topple distance plus 10%	The PPS 22 companion guide states that "Although a wind turbine erected in accordance with best engineering practice should be a stable structure, it may be advisable to achieve a set-back from roads and railways of at least fall over distance, so as to achieve maximum safety." For non-trunk roads we have assumed a separation distance of topple distance plus 10% which is slightly more conservative than PPS 22.

You should use Ordnance Survey MasterMap® to establish the geographic extent of transport infrastructure, and then apply the appropriate exclusion zones around each transport network. Ordnance Survey MasterMap does not differentiate between principal and secondary transport classifications. Therefore, you will need to manually identify the principal transport network elements in GIS, and apply the larger buffer. As an alternative, if you hold the Ordnance Survey Strategi® dataset, this can be used to differentiate between principal and secondary transport networks.

In addition you should also map the following physical constraints:

- Woodland (Forestry Commission Wales)
- Inland waters (lakes, canals, rivers, reservoirs)

Again, for the purposes of the assessment, you should assume that there is no potential for wind development in these areas.

Step 5: Map existing dwellings and a noise buffer

Large wind turbines are further restricted in their location due to the potential impact of night time noise concerns associated with the aerodynamic noise of blades moving through the air and mechanical rotation of the gear box within the hub. The definitive guidance on this for planning applications does not provide a separation buffer, but rather gives a noise threshold[50]. However, a number of rules of thumb are used in the industry for the early assessment of sites to translate this guidance into the size of separation buffers to avoid noise becoming an issue. The size of buffer required increases with the size of machine.

For the purposes of this assessment, we suggest that for a 2MW machine, you should assume an exclusion buffer of 500m around existing dwellings[51].

You can use the Local Land and Property Gazetteer (LLPG) dataset to identify which buildings are dwellings, and then apply the noise exclusion zone.

Consideration should also be given to properties that could be affected by noise outside of the local authority area. Assuming that the location of building types cannot be established outside of the local authority boundary, we recommended that you should assume a noise constraint on all land that is within the first 500m of an adjacent local authority boundary.

Step 6: Map existing aviation and radar constraints

Wind turbines can have negative impacts on radar systems and can represent obstructions for low flying aircraft. The Ministry of Defence (MoD), the Civil Aviation Authority (CAA) and the National Air Traffic Service (NATS) have a statutory duty to safeguard certain sites and airspace from radar interference in the interests of national security and for the safe operation of passenger and military aviation. Individual airports can also be affected by wind development[52]. The potential for impacts on stationary radar for civil and military sites can only really be established through consultation with the MoD and CAA on specific sites. Therefore, we do not propose that this is mapped as part of this toolkit. Data on the potential impacts on en-route radar for civilian aircraft is available and can be mapped and a method for doing this is presented below. Information on flight approach and take off safety zones around airports can also mapped, and again a method for doing this is presented below.

Civil Aviation Authority (CAA) VFR Charts

The CAA Visual Flight Rules (VFR) Charts indicate the location and extent of CAA and MoD aviation exclusion zones to avoid any physical obstruction to air traffic. These maps are available as hard copy maps for different areas of the UK. You will need purchase the relevant map from a relevant stockist, and you can find a list of stockists for VFR maps on the CAA website. You will then need to digitally scan and georeference the hard copy map against your OS base layer. The VFR maps show the following constraints which can then be digitised and displayed as a separate constraint on your GIS:

- Controlled airspace (including military aircraft low flying zones, or Tactical Training Areas)
- UK aerodrome traffic zones (ATZ)
- Military aerodrome traffic zones (MATZ)
- High intensity radio transmission areas
- Aerodromes with instant approach procedures outside controlled airspace

The maps will shows relevant buffers or exclusion zones around each of these. For the purposes of this assessment, you should assume no wind development within these exclusion zones.

National Air Traffic Service

NATS is the United Kingdom's main air navigation service provider. It provides air traffic control to all en-route aircraft in UK airspace.

NATS En Route Plc ("NERL") is responsible for the safe and expeditious movement in the en-route phase of flight for aircraft operating in controlled airspace in the UK. To undertake this responsibility NERL has a comprehensive infrastructure of radars, communication systems and navigational aids throughout the UK, all of which could be compromised by the establishment of a wind farm. In this respect NERL is responsible for safeguarding this infrastructure to ensure its integrity to provide the required services to Air Traffic Control (ATC).

NERL have produced GIS data layers that identify areas which will, or may affect NERL operation, depending on the blade tip height of the project. Blade tip heights range from 20 to 140 metres which are believed to be representative of the heights of the majority of potential developments. Based on step 1, you should download the GIS layer that relates to the tip height for the turbine size you have selected.

Figure 14: Potential Interference with NERL Infrastructure

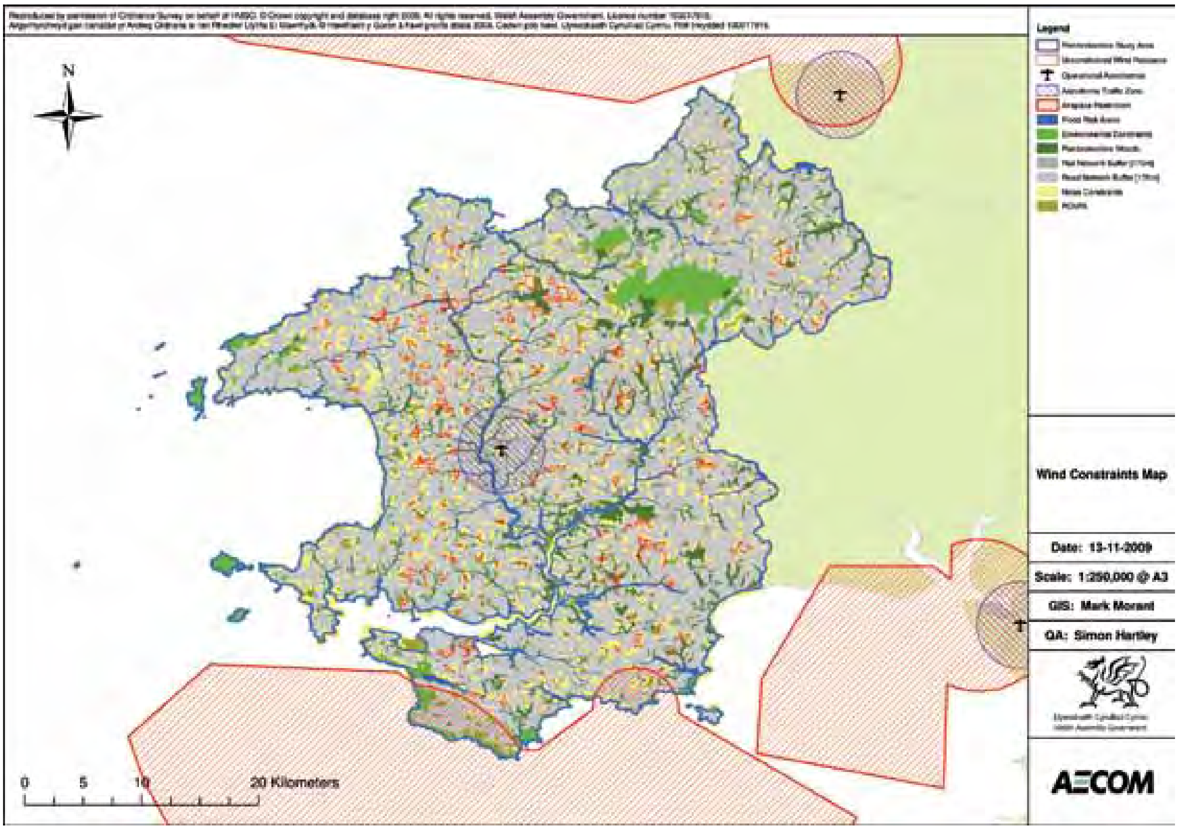
NATS (National Air Traffic Services) www.nats2008.mwdev.co.uk/10491/
NERL-Self-assessment-maps

The GIS data layer identifies 'high risk areas', which are those where wind farm developments are likely to interfere with the operational infrastructure of NERL, and 'moderate risk areas' where there remains a potential to interfere with this infrastructure. Based on this dataset, we suggest that you classify the available wind resource into low, moderate and high risk areas for en-route radar interference.

The image above indicates an example of the NATS En Route Plc safeguarding map for a wind turbine with a blade tip height of 120m. High risk areas are referenced blue and moderate risk areas are referenced yellow.

Figure C.1 below provides an example of a completed wind constraints map including environmental, cultural heritage, transport infrastructure, noise, and aviation and radar constraints across Pembrokeshire.

Figure 15: Example of a completed wind constraints map for Pembrokeshire



Step 7: Prioritise available wind resource

We suggest that you prioritise the unconstrained wind resource according to the following categories.

Table 41: Wind resource priority

Wind Resource Priority	Average Annual Wind Speed	Potential disruption to the National Air Traffic Service
Priority 1	High (>6.5m/s)	Low
Priority 2	Moderate (6.0-6.5m/s)	Low
Priority 3	High	Moderate
Priority 4	Moderate	Moderate
Priority 5	High	High
Priority 6	Moderate	High

Step 8: Assess potential installed capacity and energy output

The above step will have provided a figure for the total area of unconstrained land potentially available for wind power development, broken down into different categories of wind speed and potential NATS radar interference. You now need to convert this to a potentially installed generating capacity, (in MW) and a potential annual energy output (in MWh). Guidance on the capacity factors utilised for this toolkit is provided in Project Sheet J and use of the relevant capacity factor for on-shore wind summarised below.

1. To assess the potential installed capacity.

Based on the use of 2MW turbines (see step 1), it is possible to fit 5 turbines of this size into 1km^2 (or 100ha)[53], which equates to a potential installed capacity of 10MW/km^2. Therefore, you should multiply the land areas in the table in step 7 by 10, to give the potential MW installed capacity for each category.

2. To assess the potential annual energy output.

The installed capacity figure given above represents the maximum power output that a particular turbine can produce. However, for much of the year, depending on the wind speed at any given moment, a turbine may be generating less than its maximum, or, on very clam days, not generating at all. A simple way to estimate the potential annual energy output from a wind turbine is to use an assumed **capacity factor**. This factor is a measure of how much energy a wind turbine typically produces in a year, compared to what it would produce if it were to run at full power all of the time. A typical capacity factor for onshore wind turbines is 0.27 (or 27%)[54].

To estimate the annual energy output from a wind turbine, you multiply the installed capacity by the number of hours in a year times the capacity factor. For example, for a 2MW wind turbine, assuming a capacity factor of 0.27, the annual energy output would be:

2 x 24 x 365 x 0.27 = 4,730MWh

The table below shows what the output from this step should look like, taken from the Pembrokeshire County Council case study.

Table 42: Example of unconstrained wind resource output for Pembrokeshire County Council

Wind Resource Priority	Unconstrained Area (km²)	Potential Energy Generated (MWh)	Capacity (MW)
Priority 1	3.9	92,243	39.0
Priority 2	0.9	21,050	8.9
Priority 3	5.5	131,032	55.4
Priority 4	1.1	26,254	11.1
Priority 5	13.0	307,476	130.0
Priority 6	4.7	111,637	47.2
Total	**29.1**	**589,692**	**291.5**

Step 9: Assess cumulative visual and landscape impact issues and reduce resource accordingly

The output from the above steps will give an estimate of the maximum accessible wind resource in your local authority area, outside of the SSAs. However, in reality, harnessing all of that resource may cause significant cumulative visual and landscape impacts, particularly in more rural areas. Therefore, this potential impact needs to be incorporated as a constraint and the accessible resource revised accordingly. We set out below a potential method for doing this, which culls the wind resource to assume a minimum separation distance between wind farms. We propose the use of a 7km separation, which has been used in a number of other wind studies[55], the rationale being that beyond this distance, wind farms no longer appear dominant in the landscape. However, we suggest that local authorities may wish to use different figures for this if this is informed by local assessments of landscape sensitivity to wind power. If your area has relatively low landscape value or low landscape sensitivity to wind power, you may choose to use a lower separation distance, or none at all, or vice versa if your area has higher landscape sensitivity.

Again, it is important to note that this separation distance is considered for the purposes of this high level resource assessment only, and should not be used for assessing individual planning applications. For the latter, the cumulative impacts of an application will need to be assessed on a case by case basis, supported by the relevant landscape and visual assessments. The proposed method is as follows:

1. The first step is to amalgamate all unconstrained wind resource parcels (or "clusters") in priority areas 1 to 6 that are within 4 times the rotor diameter (see step 1) of one another to establish potential wind farm areas. You should start with the biggest parcel first, and amalgamate it with adjacent parcels. You should then move on the next biggest parcel, until all parcels have been amalgamated.

2. Once you have identified the potential wind farm clusters, consideration should be given to existing and consented wind turbine developments as identified in Project Sheet A that may visually constrain potential sites based on their spatial location and proximity. A simple way of representing the visual impact of wind farm clusters is to place a constraint on all wind farm clusters that are located within 7km distance of an existing or consented wind development. You should also include existing and consented wind development outside of your local authority area as visual impacts are likely to transcend local authority boundaries. Consideration could also be given to expanding existing wind development where appropriate.

3. You should the rank the remaining unconstrained wind resource clusters by area (km^2). The wind resource cluster with the greatest area should then be selected as a potential wind farm. Any other clusters within 7km should then be discounted. Then repeat the process with the next largest remaining cluster until all the clusters have been accounted for.

4. Convert the land area of each cluster identified as the output from step 3 above to an installed capacity and energy output (see step 8). Note, wind farm clusters should not exceed 25MW in capacity unless they are located in a Strategic Search Area as identified in TAN 8.

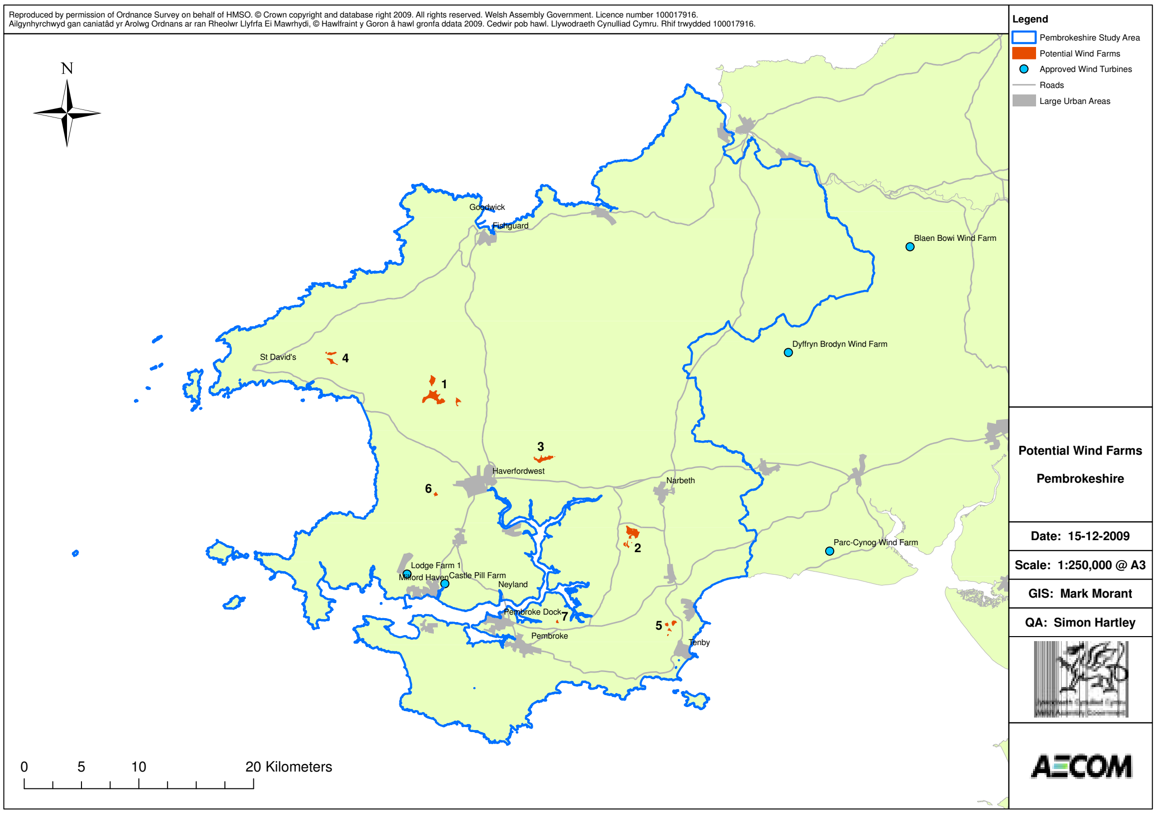
The above steps included priority areas 5 and 6, which are identified as high risk in terms of impacts on NATS en-route radar. You can regard the accessible resource figure that this produces as an upper bound for your area. As a refinement, you may wish to re-run the assessment just for priority areas 1 to 4. The output from that process you could take as a lower bound for the wind power resource.

Based on the methodology as described in Step 9 above, seven potential wind farm locations were identified across Pembrokeshire. The table and figure below illustrates the outputs from step 9, based on considering priority areas 1 to 4 only. As explained above, this could be taken as a lower bound for the accessible resource.

Table 43: Potential wind farms across Pembrokeshire County Council

Potential wind farm	Area (km²)	Potential capacity (MW)
1	1.17	11.68
2	0.68	6.84
3	0.36	3.55
4	0.24	2.37
5	0.19	1.91
6	0.05	0.53
7	0.03	0.28
Total	**2.72**	**27.17**

Figure 16: Potential wind clusters – priority areas of least constraint



References

[49] See http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/wind/windsp_databas/windsp_databas.aspx

[50] See "The Working Group on noise from wind turbines (1996) assessment and rating of noise from wind farms" (ETSU-R-97)

[51] 500m was the figure used by Arup for the analysis of the Strategic Search Areas for TAN 8

[52] For more information on this issue, see See "Wind Power in the UK", by the Sustainable Development Commission, May 2005, and the BWEA website www.bwea.com/aviation/index.html

[53] Assuming a spacing between turbines of 4 blade diameters perpendicular to the prevailing wind direction, and 6 blade diameters downwind. See the PPS22 Companion Guide, for England

[54] See "Wind Power in the UK", by the Sustainable Development Commission, May 2005, for a discussion of wind capacity factors

[55] See Revision 2010 study, for the South West of England region, and Entec, 2008, "Review of Guidance on the Assessment of Cumulative Impacts of Onshore Windfarms", for BERR

Project Sheet C: Wood fuel and energy crops resource for heat and power generation

Introduction

This section provides you with guidance on how to assess the potential available resource in your area for harvesting wood fuel from sustainable forestry and woodland management and the growing of "woody" energy crops. This section does not consider the potential for growing energy crops to provide liquid biofuels for transport, as this is outside the scope of this Toolkit.

In terms of wood fuel, in the context of this resource assessment, we have taken that to cover virgin wood harvested from the sustainable management of forestry and woodland. This could cover small roundwood from thinnings, as well as so-called "lop and top" from timber trees. The energy crops that are considered in this section are miscanthus (elephant grass) and short rotation coppice (SRC) willow.

Energy crops

The proposed method for you to assess the resource for your area for growing energy crops is as follows:

Step 1: Establish the area (in hectares) of existing agricultural land

Step 2: Identify any constraints to planting energy crops from environmental and heritage designations

Step 3: Establish the percentage of suitable agricultural land that could be planted with energy crops

Step 4: Establish the potential annual fuel yield from the total available land

Step 5: Establish the potential installed power and heat generation capacity

Each of these steps is set out in detail below.

Step 1: Establish the area (in hectares) of existing agricultural land

There are two nationally available GIS datasets that you can use to establish the location and extent of available agricultural land in Wales, namely:

Agricultural Land Classification (ALC) data

National Forest Inventory

Each is described in more detail below.

Agricultural Land Classification (ALC)[56]

The ALC dataset identifies all agricultural land across Wales according to five grades. Grade one is best quality and grade five is poorest quality. Generally speaking, miscanthus and SRC can be grown on land grades 1 to 4. You should download the GIS information and bring it in as a GIS layer superimposed onto the OS base for your area.

National Forest Inventory (NFI)[57]

The NFI is a GIS data layer that confirms the type and geographic extent of all woodland in Britain. The data layer was derived from automated imaging analysis of 2006 aerial photography and is matched directly to OS MasterMap® for an accurate geographic reference. The NFI dataset can be supplied by the Forestry Commission Wales. You should download the GIS information and bring it in as a GIS layer superimposed onto the OS base for your area.

You should then calculate the total area (in hectares) of land grades 1 to 4, minus any woodland that may be within those areas, as this would preclude the planting of energy crops.

Step 2: Identify any constraints to planting energy crops from conservation and heritage designations

You will have established the total available agricultural land from step 1 above. However, for the purposes of this assessment exercise, consideration needs to be given to protecting existing environmentally designated sites. You should remove the following conservation and heritage designated sites from the total available biomass resource area where they overlap in geographic extent:

- Site of Special Scientific Interest
- Scheduled monument

As for step 1, you should then calculate the new total area (in hectares) of suitable land minus these designated areas.

You may also wish to exclude additional environmentally sensitive areas if you, or other local stakeholders feel that it would not be feasible to plant energy crops in those areas, and if you have data on the size and location of those areas. Such areas could include: common land, permanent pasture/grassland and biodiversity action plan areas.

Step 3: Establish the percentage of suitable agricultural land that could be planted with energy crops

Although step 2 establishes the theoretical maximum area that could be planted with energy crops, in reality only a proportion of that would be achievable. This is for a range of factors, including:

- Competition with food, other crops and livestock. Farmers may be able to get a higher return from growing other crops, 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

There is no firm guidance on what proportion of suitable land could be planted with energy crops. As a starting point, for estimating the available resource for 2020, we suggest that you assume that 10% of the suitable land area identified from step 2 could be planted with energy crops[58] .

However, we recommend that you should consult with relevant stakeholders in your area, such as NFU Cymru, and FUW to gain a local assessment on the feasibility of planting energy crops, and the % uptake that is likely to be viable.

Step 4: Establish the potential annual fuel yield from the total available land

Once you have established the total available area for planting energy crops, from step 3, you then need to estimate the potential quantity of energy crops that could be harvested, and, therefore, the amount of heat and power generation that this could support.

In terms of yield, an average figure between miscanthus and SRC is about 12 oven dry tonnes (odt) per year per hectare . 'Oven dry tonnes' is a theoretical figure which is used for this type of assessment, and means the weight of crop if it had 0% moisture content.

Therefore, if the total available land area was 5,000 ha, the annual fuel yield would be:

5,000 x 12 = 60,000 odt/annum

Step 5: Establish the potential installed power and heat generation capacity

You now need to work out how much energy the potential quantity of fuel identified from step 4 could produce. This will depend on whether the fuel is burnt in facilities that only generate electricity (and the waste heat is not usefully used), or produce Combined Heat and Power (where the heat is usefully used), or is burnt in a boiler to produce heat only. The amount of fuel required in each case will depend on the efficiency of the combustion process as well as the number of hours in a year a facility is operating. To work this out, you can use the following assumptions:

1. For electricity generation, a biomass facility will require about 6,000 odt of energy crops for each 1MWe of installed power generation capacity[60].
2. A CHP facility will require the same amount of fuel as (1) for each 1MWe of electricity generation capacity, but will also produce about 2MWt of thermal output at the same time[61] from the waste heat.
3. A heat only facility (i.e. a biomass boiler) will require about 660 odt of energy crops for each 1MWt of installed thermal generation capacity[62].

We recommend that, for the purposes of this resource assessment, you should assume that the energy crop resource is used to fuel either electricity only or CHP biomass facilities[63].

Therefore, to give a worked example, based on the 60,000odt/annum of fuel available, given from step 4, you would calculate the amount of biomass electricity and/or CHP generation this could support as follows:

60,000/6,000 = 10MWe (and a further 20MWt of heat, if CHP)

To convert this installed capacity to an annual energy output, in MWh, use the relevant capacity factor, as set out in Project Sheet J.

Wood fuel

You can use an assessment of the potential wood fuel resource in your area to inform the potential contribution of wood fuelled heating to any renewable heat target. However, the renewable heat target is likely to be informed more by the results of any assessment of uptake in existing and new buildings as set out in Project Sheet G. Nonetheless, an assessment of the wood fuel resource can be a useful sense check for any renewable heat target and an important component of the evidence base.

The section explains how to assess the potential wood fuel resource from forestry residues and woodland management. More specifically, this concerns the resource that is available from the management of existing woodland, by the extraction of "thinnings", and the residues produced from the extraction of timber trees, the so-called "lop and top" (i.e. tips and branches) and small roundwood.

This section does not cover the wood fuel resource from the following sources, as this is outside the scope of this toolkit:

- Arboricultural residues. This is residues from tree surgery and Council management of street and park trees.
- Clean wood waste. This is the residue from sawmills, and may also include that from joinery workshops.

The first could be established by a survey of the local authority's operations as well as a survey of tree surgeons in the local authority area. In practice, this resource may be difficult to harness, due to the low quality of the fuel, and inconsistencies over chip size.

The second could be established, again, from a survey of relevant local businesses. This resource may be more viable to collect, but there are likely to be competing alternative markets for the offcuts (such as particle board manufacture).

A method for you to establish the available resource from forestry residues is as follows:

Step 1: Establish the location and extent of the total available forestry and woodland resource in your area

Step 2: Establish the potential wood fuel yield from this area

Each of these is set out in more detail below.

Step 1: Establish location and extent of total available resource

Two nationally available GIS datasets can be used to establish the location and extent of woodland in Wales:

- National Forest Inventory
- Forestry Commission Legal Boundaries

National Forest Inventory

The National Forest Inventory (NFI) is a GIS data layer that confirms the type and geographic extent of all woodland in Wales and is owned and maintained, and can be supplied, by the Forestry Commission Wales.

The data layer was derived from automated imaging analysis of 2006 aerial photography and is matched directly to OS MasterMap® for an accurate geographic reference.

You can use this data layer to establish the total area (in hectares) of woodland in your area.

Forestry Commission

The geographic location and extent of Forestry Commission owned and managed land can be provided by the Forestry Commission Wales as a GIS data layer and is referred to as Forestry Commission Legal Boundaries.

Using a GIS the total available biomass resource can be split established for forested areas owned and managed by the Forestry Commission and those areas that are not.

Strictly speaking, you don't need this data to assess the resource, but you may want to collate to provide additional context and analysis for the evidence base.

Step 2: Establish the potential wood fuel yield from this area

Once you have established the area of available woodland you then need to estimate how much wood fuel could be usefully and sustainably extracted on an average annual basis. Based on data contained in the draft Bioenergy Action Plan for Wales, we recommend that you assume a figure of 0.6 odt of available wood fuel per ha of woodland, per annum, for the maximum accessible resource.

This is a long term, annually averaged sustainable yield, based on wood fuel that can be harvested from the small roundwood stems, tips and branches of felled timber trees and thinnings, as well as poor quality roundwood. This figure takes account of competition from other markets in Wales, such as particle board manufacturing[64]. The figure also takes into account technical and environmental constraints.

To give a worked example, if you identified a total area of woodland for your area of 10,000 ha, then you would calculate the potential wood fuel resource as follows:

10,000 x 0.6 = 6,000odt/annum

Step 3: Establish the potential installed power and heat generation capacity

You now need to work out how much energy the potential quantity of fuel identified from step 2 could produce. This will depend on whether the fuel is burnt in facilities that only generate electricity (and the waste heat is not usefully used), or produce Combined Heat and Power (where the heat is usefully used), or are burnt in a boiler to produce heat only. The amount of fuel required in each case will depend on the efficiency of the combustion process as well as the number of hours in a year a facility is operating.

To work this out, you can use the same assumptions as given in step 5 of the Energy Crops section.

For example, 660 odt of wood fuel is required for each 1MW of heat power output. Therefore, this resource could support:

6,000/660 = 9.1 MWt of wood fuel heating

This is equivalent to about 30 x 300kW wood chip boilers, which is an approximate size for a large new secondary school.

References

56 This dataset can be obtained from the Welsh Assembly Government

57 Forestry Commission Wales

58 This figure is mentioned in the executive summary of the draft Bioenergy Action Plan for Wales, February, 2009. It was also used as the basis of the energy crops resource assessment for the South West of England region in the Revision 2020 project, which developed regional renewable energy targets for 2020

59 This figure was used in the draft Bioenergy Action Plan for Wales. The biomass energy centre website www.biomassenergycentre.org.uk/gives a figure of 9 odt/ha/annum for SRC and 13 odt/ha/annum for miscanthus. However, in reality, the actual yield will vary within a range, depending on a number of factors such as: land grade, crop species, soil types, how many years a particular crop has been established at a site, and so on

60 This is an average figure to cover a range of different technology types, and sizes, with different efficiencies. For example, a smaller scale facility (about 2MWe) using a steam turbine with an efficiency of about 20%, might require up to 8,000odt/annum. However, a larger facility (5-10MWe), using gasification, with an efficiency of up to 30%, might require about 5,000odt per annum. For all options, the facility is assumed to generate at full power for about 8,000 hours per annum. The energy content of the fuel is assumed to be 5MWh/odt (taken from the Biomass Energy Centre website which gives a figure of 18MJ/odt)

61 Again, this is only a rough average, for a range of technology types and scales

62 Assuming a boiler efficiency of 80% and a capacity factor of 0.3 (see Project Sheet J)

63 In practice, of course, energy crops, particularly SRC (as it takes the form of wood chip rather than bales), may be used to also fuel biomass boilers

64 See section 5.1.2 in the draft Bioenergy Action Plan for Wales. The figure of 0.6 is based on a potential resource of 153odt/yr from stemwood (7-14cm diameter), poor quality stemwood, stem tips and branches, in the presence of competing markets, from a total area of woodland in Wales of just over 270,000 ha. The latter figure is taken from table 6 of the National Inventory of Woodland and Trees, Wales, Forestry Commission, 2002

Project Sheet D: Energy from waste

This section, and Project Sheet E, considers the potential energy sources derived from waste. This section addresses:

- Municipal waste
- Commercial & industrial waste

Municipal Solid Waste (MSW) and Commercial and Industrial (C&I) Waste

The steps for estimating the energy resource from MSW and C&I are as follows:

Step 1: Establish the quantity of residual MSW and C&I waste

Step 2: Establish the installed capacity this could support

Step 3: Establish the biodegradable fraction that would qualify as renewable energy

Each of these steps is set out in more detail below.

Step 1: Establish the quantity of residual MSW and C&I waste

Your waste officer should be able to provide you with figures for the total MSW produced annually for your authority area, in tonnes per annum[65]. They should also be able to provide you with projections for the projected quantity of waste in 2020. Based on the proposed targets set out in the Wales Waste Strategy[66], you can assume that 30% of the total MSW would be available for energy recovery. At this level, there should be no conflict with recycling targets.

Environment Agency Wales should be able to provide two datasets relating to commercial and industrial waste in. The two datasets will comprise details of tonnes per annum of:

Hazardous wastes

Environment Agency Permitted Site Data

Data on projections for commercial and industrial waste are available from Regional Waste Strategies 2020 but only for the region as opposed to individual local authority areas. There is inherent uncertainty in the robustness of future waste projections, particularly as far ahead as the year 2020. However, either the regional projections, if available, can be adopted or the growth rates as per the Municipal Waste Stream. It can also be assumed that 30% of the total Commercial & Industrial waste would be available for energy recovery.

As a worked example, if your total MSW and Commercial & Industrial waste for 2020 was projected to be 150,000 tonnes per annum, the amount available for energy recovery would be:

$0.3 \times 150{,}000 = 45{,}000$ tonnes/yr

When compiling data on tonnages of waste, make a note of the food waste from both the MSW stream and from Commercial and Industrial Waste in order to populate the table in the next section on Centralised Anaerobic Digestion

Step 2: Establish the potential installed power and heat generation capacity

You now need to work out how much energy the potential quantity of fuel identified from step 1 could produce. Energy from Waste facilities in Wales is required to be at least 65% efficient and therefore cannot generate electricity without using some of the heat. The fuel will therefore be burnt in facilities that produce Combined Heat and Power (where the heat is usefully used or burnt in a boiler to produce heat only. The amount of fuel required in each case will depend on the efficiency of the combustion process as well as the number of hours in a year a facility is operating. To work this out, you can use the following assumptions:

1. To estimate the potential installed energy generating capacity, you should assume that 10,320 tonnes of waste per annum are required for each 1MWe of electricity generating capacity in a CHP plant[67].
2. A CHP facility will also produce about 2MWt of thermal output at the same time[68] from the waste heat
3. A heat only facility will require about 1,790t of waste for each 1MWt of installed thermal generation capacity[69]

We recommend that, for the purposes of this resource assessment, you should consult with the local authority waste manager to establish what technologies are planned for the area. If CHP is planned then follow steps 1 & 2 above and populate the table accordingly leaving out any figures for "heat only" generating plant and vice versa if heat only generating plant is planned for your area.

For example, if CHP is planned the potential capacity that could be supported by the waste stream would be:

45,000/10,320 = 4.4.MWe that could also generate:

4.4MWe x 2MW of heat = 8.8MWt

It is important to note that this would be the total capacity that could be supported, but the renewable energy element of that would be smaller as it would be only the biodegradable fraction (see step 3 below).

Step 3: Establish the biodegradable element (the renewable energy fraction)

Under the requirements of the EU Renewables Directive[70], which is the basis for the UK's target of 15% of energy to come from renewable sources by 2020, only the biodegradable fraction of energy generation from waste is eligible to count towards the target. There is no specific guidance in Wales on what to the biodegradable fraction should be assumed to be in future. The UK Government consultation on the re-banding of the Renewables Obligation suggested that the anticipated future biodegradable fraction, by 2020, would be about 35%, compared to a current nominal level of about 50%[71].

Therefore, we suggest that in developing targets for 2020, you use the assumption that 35% of the power and energy output of any waste facility would count as renewable. Therefore, based on the output of step 2 above, the renewable electricity capacity would be:

4.4MWe x 0.35 = 1.5MWe and;

8.8MWt x 0.35 = 3.1MWt

To convert this installed capacity to an annual energy output, in MWh, use the relevant capacity factor, as set out in Project Sheet J.

References

65 This should exclude construction and demolition waste

66 "Towards Zero Waste, One Wales: One Planet, A Consultation on a New Waste Strategy for Wales", April 2009

67 This assumes an electricity generation efficiency of 25%, based on a net calorific value of the fuel of 11MJ/kg, and a capacity factor of 0.9 (see Project Sheet J). This assumed calorific value of the fuel is a rough average as the actual value can vary widely depending on the composition of the waste, the extent to which recyclables and wet biodegradable waste has been removed or source separated, and whether the fuel has already been processed into RDF pellets

68 Again, this is only a rough average, for a range of technology types and scales

69 Assuming a boiler efficiency of 80% and a capacity factor of 0.5 (see Project Sheet J)

70 See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

71 See para. 9.10 of the Government Response to the Statutory Consultation on the Renewables Obligation Order 2009, December 2008, see http://www.berr.gov.uk/files/file49342.pdf

Project Sheet E: Anaerobic Digestion

Introduction

This section considers the following potential energy sources that would be best utilised through anaerobic digestion facilities:

- Animal manure (cattle and pigs)
- Food waste
- Poultry litter
- Sewage sludge

As 100% of the waste resource discussed in this section is biodegradable you can count it in its entirety as renewable energy.

Animal manure

This section covers how to assess the potential energy resource from slurry collected from cattle and pigs kept under cover in the winter months.

You should carry out the following steps to establish the total available energy resource from animal manure in your area:

Step 1: Establish number and location of cattle and pigs

Step 2: Establish potential energy yield from total available resource

Step 1: Establish location and extent of total available resource

The Welsh Assembly Government records the number of livestock within geographical locations, usually by local authority area.

Step 2: Establish total tonnages

Once the total number of cattle and pigs has been identified, the tonnage of available manure can be established. You can assume that livestock will produce the following amounts of slurry per month[72]

Cattle: 1 tonne per month per head[73]
Pigs: 0.1 tonnes per month per head[74]

Because the livestock will only be kept under cover for, approximately, 6 months of the year, you should assume that the slurry can only be collected for 6 months of the year. Therefore the **annual** quantity of slurry available is:

Cattle: 1 x 6 = 6 tonnes/head
Pigs: 0.1 x 6 = 0.6 tonnes/head

In practice, it will not be possible or practical to collect all of this potential resource. This will be because many farms will not use a slurry system, but will collect the excreta as solid manure mixed with bedding which is then spread on the fields. Furthermore, it will not be practical to collect the slurry from some of the farms, because they may be too small or too dispersed for this to be economically viable.

We recommend that you should consult with the NFU Cymru and FUW to identify what the split between the use of slurry and non-slurry systems on farms in your area. We suggest that you should also test with them what the future projections are for livestock numbers in your area up to 2020, as this may affect the resource. As a starting point we suggest that you assume that 50% of the farms use a slurry based system and that of these, it would be feasible to capture the slurry from 50%. This means that the available resource per head of livestock per annum would be as follows:

Cattle: 6 x 0.5 x 0.5 = 1.5 (wet) tonnes/head
Pigs: 0.6 x 0.5 x 0.5 = 0.15 (wet) tonnes/head

Step 3: Establish potential energy yield from total available resource

To estimate the potential installed capacity of generation that could be supported by animal slurry in your area, you should assume the following:

For electricity generation, 225,000 wet tonnes of slurry will be needed per 1MWe[75].

The AD plant can act as CHP, and therefore the waste heat can be usefully used, if there is a suitable heat load[76]. For a gas engine of this size, the typical heat to power ratio[77] is about 1.5 to 1, therefore a 1MWe engine would also produce about 1.5MWt.

The AD plant could also be used to just produce heat. In this case, the biogas is just burnt directly in a boiler. In this case, you should assume the following:

For heat only generation, 47,000 wet tonnes of slurry will be needed per 1MWt[78]

Example output

As an example, you have established that the number of cattle in your area is 200,000. You have spoken to the local Farmer's union and established that about 60% of the farms in your area with livestock use a slurry system, and they feel that you could realistically collect the slurry from 50% of these. Therefore the wet tonnes of slurry, available for an AD facility each year, are calculated as follows:

Annual slurry = 200,000 x 6 x 0.6 x 0.5 = 360,000 tonnes

From this, the potential installed capacity of electricity generation is:

Potential installed capacity = 360,000/225,000 = 1.6MWe.

This installation, if CHP, could also potentially provide the following amount of heat output:

Heat output = 1.6 x 1.5 = 2.4MWt

If all of the slurry were to go to heat only facilities, then the potential installed heat capacity could be:

Heat capacity = 360,000/47,000 = 7.7MWt

You will need to decide, from discussion with local stakeholders in your area, such as your waste officer, and local agricultural experts, whether the resource is likely to go to fuel CHP facilities or heat only facilities. As a default assumption, we suggest that you should assume that it would go into a CHP facility.

You should note that if you know that the animal resource in your area is currently going to a facility outside of your local authority, or there are firm plans for an AD plant in the near future in an adjacent authority that would take this resource, then you should not count this resource as contributing to your renewable energy targets.

Food waste

National context

The Welsh Assembly Government is developing a policy on the management of municipal waste which aims at retrieving over 300,000 tonnes of food waste per annum. The policy will also identify means for retrieving a similar amount of bio-waste from food processing plants.

This section covers how to assess the potential energy resource from harvesting both:

Food waste from the Municipal Solid Waste (MSW) stream (domestic)

Food waste from Industrial and commercial waste streams.

Step 1: Establish Annual Food Waste Arisings from MSW and C&I waste stream

From discussion with your waste officer, you should be able to obtain estimates on the quantities of household food waste that are produced each year, as well as an idea of how much food waste is currently collected (i.e. as part of a kerbside collection scheme), or may be collected in the future if there are plans for kerbside collection. If your authority does not have any plans for kerbside collection of household food waste, you should disregard this as an energy resource.

In terms of commercial food waste (e.g. from restaurants or food processing companies) tonnages of food waste can be extracted from the data supplied by Environment Agency Wales under European Waste Catalogue Code No. 2, and again your waste officer should be able to provide you with this information. Projections for increases in food waste can either be extracted from the relevant Regional Waste Strategy or figures recorded by your local authority waste management team for your local authority area.

Step 2: Establish potential energy yield from total available resource

You now need to work out how much energy the potential quantity of fuel identified from step 1 could produce.

1. To estimate the potential installed energy generating capacity, you should assume that 32,000 tonnes of food waste per annum is required[79] for each 1MWe of electricity generating capacity.
2. As for animal waste, a CHP facility will also produce about 1.5MWt of thermal output at the same time from the waste heat

It is unlikely that any centralised facility for the AD of food waste would be heat only rather than CHP therefore we suggest that you consider this resource as being for electricity generation and CHP only.

Example output

You have established, from discussion with your waste officer, that by 2020 there are projected to be 30,000 tonnes of household food waste collected per annum, along with a further 30,000 tonnes of commercial food waste. Therefore, the total quantity of food waste available for an AD facility is 60,000 tonnes/annum. Therefore, the potential electricity generating capacity this could support would be:

60,000/32,000 = 1.9MWe

This installation, if CHP, could also potentially provide the following amount of heat output:

Heat output = 1.9 x 1.5 = 2.9MWt

Poultry litter

You should carry out the following steps to establish the total available energy resource from poultry litter:

Step 1: Establish the number and location of mass producing farms (>10,000 birds) in your area. Other farms located nearby (within a few kilometres might also contribute)

Step 2: Establish the potential energy yield from the total available resource

Step 1: Establish location and extent of total available resource

The Welsh Assembly Government and Local Authority record the number of farms with bird numbers in excess of 400. For each farm over this threshold the number of birds is recorded. Where the number of birds exceeds 10,000 from farms which are within a few kilometres of each other, then the sum total of birds from these farms is also included.

Step 2: Establish total tonnage of poultry litter available

Once the total number of usable birds has been identified, the tonnage of available litter can be established. For mass producing farms, 100% of the litter can be assumed to be utilised.

Note: It should be noted that for turkey farms, the amount utilised will be dramatically less due to the seasonal nature of this particular industry.

Data is available from DEFRA which provides the amount of excreta produced by different types of poultry[80]. This suggests a figure of 42 tonnes of litter per year per 1000 birds[81].

Therefore, if the output from step 1 was a figure of 1 million birds, then you would estimate the annual amount of poultry litter available as follows:

(1,000,000/1,000) x 42 = 42,000 tonnes/yr

Step 3: Establish potential energy yield from total available resource

You can assume that about 11,000 tonnes of litter per annum are required for each 1MWe of electricity generating capacity[82]. Therefore, based on the output from step, you would work out the potential installed capacity as follows:

42,000/11,000 = 3.8MWe

In practice, if the potential capacity is less than 10MWe, it is unlikely that this would be enough to support a dedicated poultry litter power plant. However, if less than this figure the resource could go towards supporting anaerobic digestion facilities.

To convert this installed capacity to an annual energy output, in MWh, use the relevant capacity factor, as set out in Project Sheet J.

Example output

The example given below is based on the pilot study for Pembrokeshire where data was obtained directly from the local authority, though it is believed that the Welsh Assembly Government collects, collates and maintains the database.

For Pembrokeshire, the total number of poultry on intensive farms is 144,000 birds. Therefore, the total quantity of litter available is:

(144,000/1,000) x 42 = 6,048 tonnes per year

Therefore, the potential installed capacity this could support is as follows:

6,048/11,000 = 0.5MWe

This resource would be insufficient to support a dedicated poultry litter energy plant.

It should be noted that where a renewable energy resource is supplied to plant located in a different area, the area where the energy is generated should claim the generation towards targets.

Sewage sludge

The following steps should be undertaken to establish the total available energy resource from sewage sludge:

Step 1: Establish location and extent of total available resource

Step 2: Establish potential energy yield from total available resource

Step 1: Establish location and extent of total available resource

This data is only available from the water utility company and was not found to be publicly available.

An energy or plant manager may provide details about the installed capacity and/or energy generation from generating plant utilising sewage sludge as the primary fuel.

Local authorities may wish to contact the water utility company to discuss the potential of sewage for energy recovery and any plans for the construction of further energy generating plant.

National context

According to the Consultation on a Bioenergy Action Plan for Wales (February 2009), there is likely to be over 100,000 tonnes of dry sewage solids[83], available annually, for the generation of energy utilising anaerobic digestion plant. If the local authority is unable to obtain the necessary information from the water utility company then the following method might be employed:

Regional context

Using the figure quoted in the Consultation on a Bioenergy Action Plan for Wales (February 2009), use the figure of 100,000 tonnes quoted and assume an equal split of sewage based on population by unitary authority

Table 44: Proportion of national sewage sludge by local authority based on assumed population split

Local Authority	Population[84]	Sewage sludge (tonnes)
Anglesey	69,000	2,305
Blaenau Gwent	69,100	2,308
Bridgend	134,800	4,503
Caerphilly	172,400	5,760
Cardiff	324,800	10,851
Carmarthenshire	180,500	6,030
Ceredigion	78,000	2,606
Conwy	112,000	3,742
Denbighshire	97,600	3,261
Flintshire	151,000	5,045
Gwynedd	118,200	3,949
Merthyr Tydfil	55,700	1,861
Monmouthshire	88,400	2,953
Neath Port Talbot	137,600	4,597
Newport	140,700	4,700
Pembrokeshire	118,800	3,969
Powys	132,600	4,430
Rhondda Cynon Taf	234,100	7,821
Swansea	229,100	7,654
Torfaen	91,100	3,043
Vale of Glamorgan	124,900	4,173
Wrexham	132,900	4,440
Wales	**2,993,300**	**100,000**

Step 2: Establish potential energy yield from total available resource

To estimate the potential installed capacity of generation that could be supported by sewage sludge in your area, you should assume the following:

For electricity generation, 13,000 tonnes of dry solids will be needed per 1MWe[85].

As for animal slurry, the AD in CHP mode can also produce 1.5MWt of heat.

Example output

For Pembrokeshire, based on table 44, the potential amount of dry tonnes of sewage sludge available per annum is 3,969. Therefore, the potential installed capacity this could support would be:

3,969/13,000 = 0.3MWe

To convert this installed capacity to an annual energy output, in MWh, use the relevant capacity factor, as set out in Project Sheet J.

Potentially, this could also produce 0.3 x 1.5 = 0.45MWt, although this may well be used a part of the drying process to treat the sludge.

At present, about 0.11MWe is already being generated in the County, which is just under half the available resource. It may be that the remainder of the resource is too dispersed for generation to be practical, but this would need to be discussed with the local water company.

References

72 See the DEFRA leaflets on guidance to famers in Nitrate Vulnerable Zones, leaflet 3, table 1, see http://www.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/documents/leaflet3.pdf

73 This assumes a typical average figure of 1m^3 per month, and that 1m^3 of slurry has an approximate weight of 1 tonne

74 As for above, but assuming a typical average figure of 0.1m^3 per month per animal

75 This assumes the following: each wet tonne of slurry produces 20m^3 of biogas; 1m^3 of biogas has an energy content of 5.8kWh; an electricity generation efficiency of 30% and a capacity factor of 0.9 (see Project Sheet J). The biogas production figure is taken from the Andersons report for the National Non Food Crops Centre "A detailed economic assessment of anaerobic digestion technology and its suitability to UK farming and waste systems", April 2008, and is an average figure

76 The gas would normally be burnt in a gas engine (which is an internal combustion engine), and the waste heat comes from the flue gases and the cooling jacket for the engine

77 See http://chp.decc.gov.uk/cms/prime-movers-and-electrical-generators-a-summary

78 Assuming a boiler efficiency of 80% and a capacity factor of 0.5 (see Project Sheet J)

79 This assumes the following: 1 tonne of wet food waste produces 140m^3 of biogas; 1m^3 of biogas has an energy content of 5.8kWh; an electrical generating efficiency of 30% and a capacity factor of 0.9 (see Project Sheet J). The figure for biogas production is taken from a report by Eunomia for WRAP, "Dealing with Food Waste in the UK", March, 2007, table 10, and is an average of the high and low figures

80 See the DEFRA leaflets on guidance to famers in Nitrate Vulnerable Zones, leaflet 3, table 3, see http://www.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/documents/leaflet3.pdf

81 Based on the figure for laying hens, which is 3.5 tonnes per month

82 Based on the poultry litter plant at Westfield, in Scotland, which has a power output of 9.8MWe and consumes 110,000 tonnes of litter per annum

83 Or rather dry tonnes "equivalent" as the solids in the sewage will not actually be dry

84 www.nomisweb.co.uk

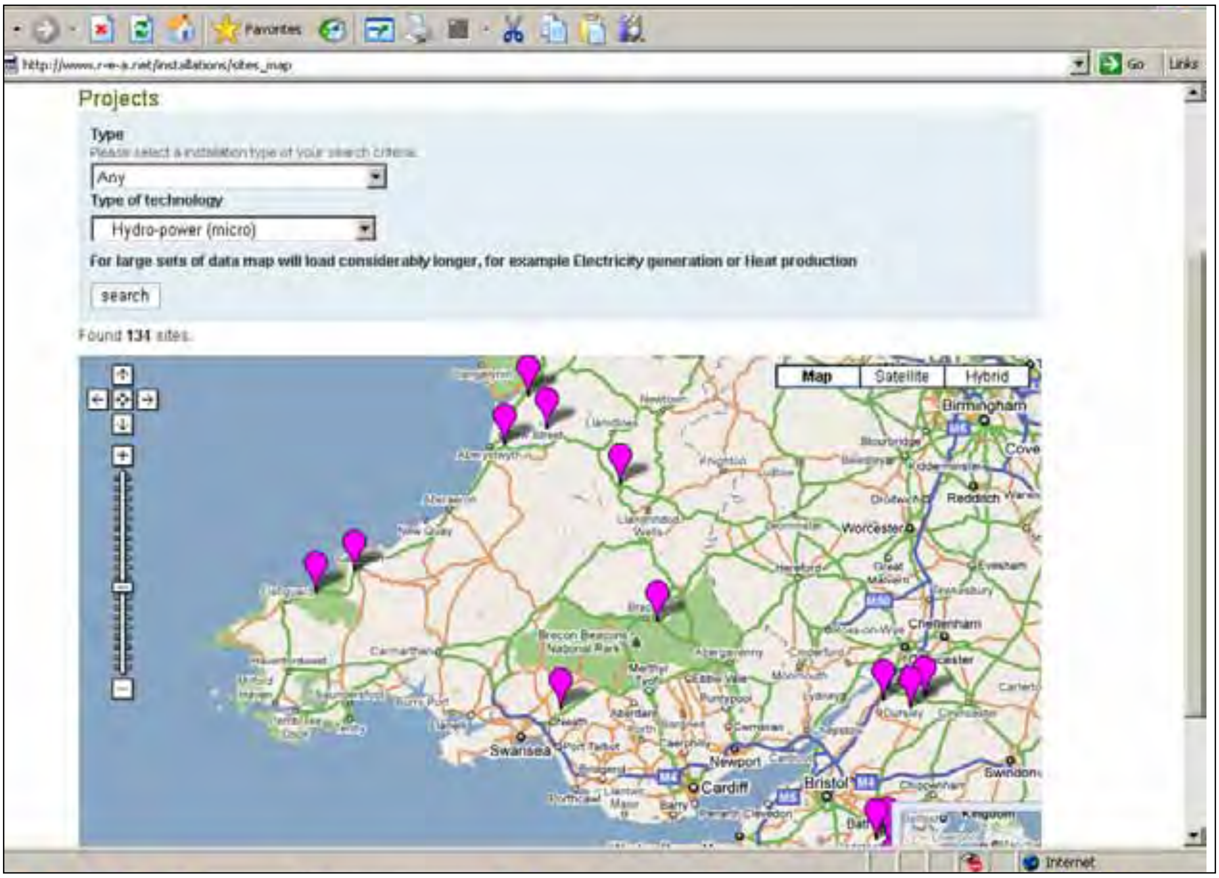
85 This assumes the following: 1 tonne of dry solids produces 340m^3 of biogas; 1m^3 of biogas has an energy content of 5.8kWh; an electricity generation efficiency of 30% and a capacity factor of 0.9 (see Project Sheet J). The biogas production figure was provided by AECOM engineers who are specialists in designing AD plants for the water industry

Project Sheet F: Hydropower energy resource

At the time of writing this toolkit, there is currently no satisfactory way for local authorities to assess the potential hydropower resource in their areas, from using existing data sources in the public domain. However, the Environment Agency is due to publish (by the end of 2009) the results of a project to map the opportunities for hydropower projects in England and Wales[86] and this will hopefully provide the data that is currently lacking.

You can assess the quantity of existing hydropower that may exist in your area, using the approach set out in Project Sheet A (hence there is no table with installed capacity in this section). To assist with that, you can also use the Renewable Energy Association website[87], to identify the location of hydro schemes in your area. An example of this is shown in the screen shot below. This identified two schemes in Pembrokeshire. These were both listed in the Ofgem database described in Project Sheet A, but without the map below, it would not have been clear that they were in Pembrokeshire.

Figure 17: Screen print of the REA website for locating hydro schemes



Renewable Energy Association www.r-e-a.net

You can also gain more information about the potential for hydropower in your area by finding out whether any feasibility studies have been carried out. Potential sources for this information are as follows:

- Your local Environment Agency Wales officers, particularly those dealing with watercourses, and abstraction licensing
- Local hydropower companies, both installers and suppliers. You can find a list of installers on the British Hydropower Association website[86]
- Local energy agencies

References

86 See http://www.environment-agency.gov.uk/static/documents/Research/(20)_Hydropower_mitigation_final.pdf

87 http://www.r-e-a.net/installations

88 http://www.british-hydro.org/hydro_in_the_uk

Project Sheet G: Heat opportunities mapping

This section of the report addresses the following main headings:

Identify anchor 'heat' loads (AHLs)

Residential heat demand and density

Existing DH and Combined Heat & Power (CHP) schemes and sources of waste heat

Identifying anchor "heat" loads (AHLs)

There are a minimum of two steps (Option 1) to identifying 'anchor' heat loads though a more detailed and comprehensive three step (Option 2) process can be adopted. The three steps are as follows:

1. Establish geographic location and types of property within study area
2. Establish energy demand of anchor loads
3. Identify potential 'heat' clusters

Option 1: Follow steps 1 & 3 only

Option 2: Follow all 3 steps

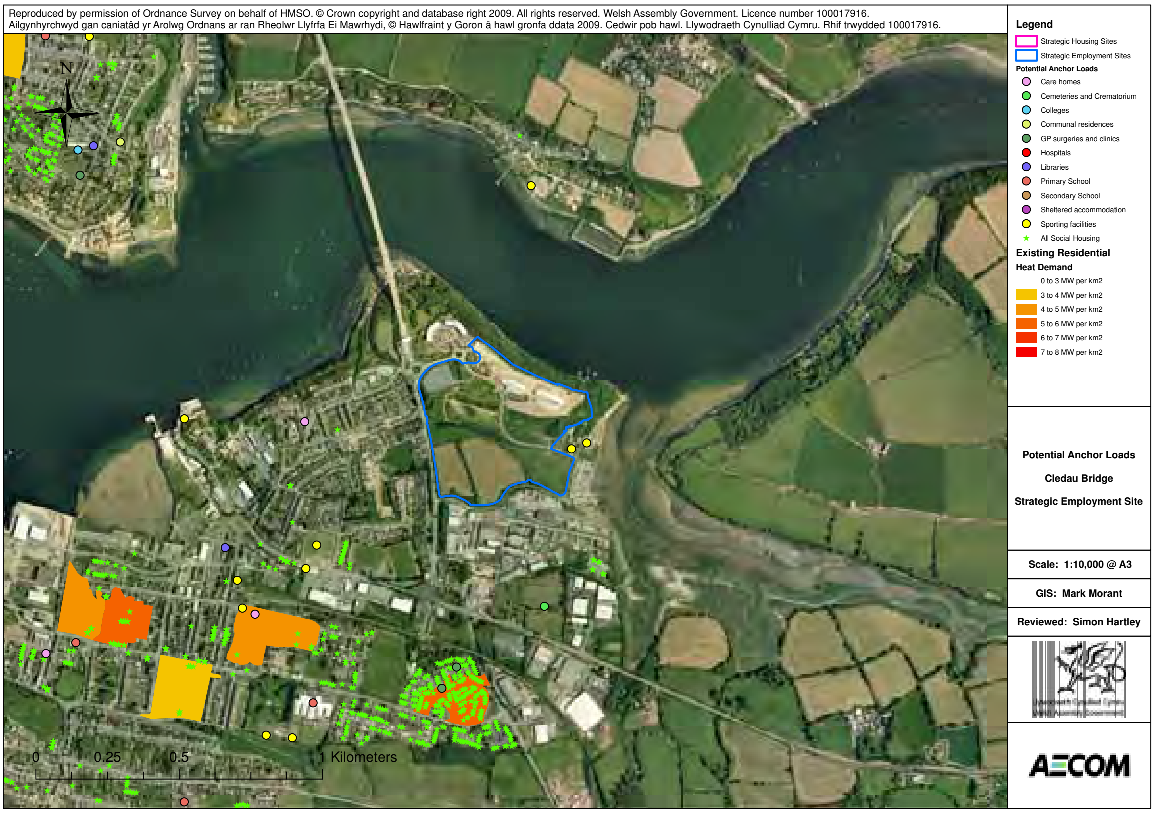
Step 1: Establish geographic location and types of property within study area

The Local Land use and Property Gazetteer (LLPG) is used to establish the exact geographic location and property type of all buildings within a defined area. The following key property types were considered to be potential AHLs as identified within the LLPG:

- Care Homes
- Colleges
- Factories and Manufacturing
- Fire, Police, and Ambulance Stations
- Hospitals
- Law Courts
- Leisure Centres
- Libraries
- Museums
- Offices
- Power Stations/Energy Production
- Primary, Junior, Infants or Middle School

- Secondary School
- Theatres/Arenas/Stadium
- Water/Sewerage Treatment Works
- Zoos and Theme Parks

Figure 18: Example of an anchor heat load map for an area in Pembrokeshire



Step 2: Establish energy demand of AHLs

Once the type and geographic extent of potential anchor loads has been identified the next step is to establish the energy demand.

There are a number of datasets that can be used to establish energy demand. These include:

Public sector data

Private sector data

Public sector data

Energy data should be available for all public buildings as collated by the LA's Energy Manager (EM) in order to contribute to their duty in relation to the Carbon Reduction Commitment Energy Efficiency Scheme (CRC EES).

Should energy data not be available then estimates can be made based on known gross internal floor area (GIFA) of each building. Chartered Institute of Building Service Engineers (CIBSE) Technical Memorandum (TM) 46 Energy Benchmark data can then be used to establish a proxy for each building.

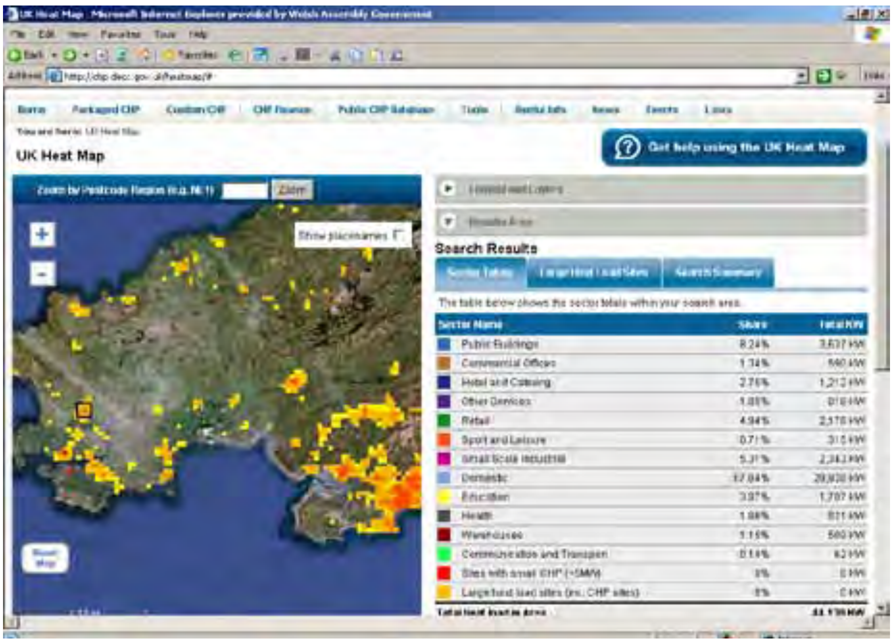
Annual energy consumption data for hospitals can be derived from Welsh Health Estates (WHE).

Private sector data

The Valuation Office Agency (VOA) records detailed information on GIFA of private assets. Each asset/building is given a Unique Property Reference Number (UPRN) which can be directly cross referenced to the LLPG to provide a geographic reference. CIBSE TM46 Energy Benchmark data can then be used to establish a proxy for each building.

Another method to identify large existing heat users is to refer to the DECC Heat Map website[89]. This identifies large heat users and estimates the size of the heat demand. It also tells you whether that user already has CHP installed or not, an example output from the map is shown below.

Figure 19: Example of heat map output for Pembrokeshire



UK Heat Map, Department of Energy and Climate Change
http://chp.decc.gov.uk/heatmap/

Step 3: Identify potential "heat" clusters

Clusters of offices and social housing can also be established as a potential heat demand in their own right. The location of offices can be derived from the LLPG. Social housing data typically is retained by the LA. Where this is not the case social housing providers may be approached directly for data. Detailed information on energy consumption/demand was not assessed for potential 'heat' clusters.

Residential heat demand and density mapping

Step 1: Establishing the number, type and location of dwellings by output area

2001 Census

The 2001 Census provides the most accurate data on the number, type and location of existing dwellings throughout the UK. The Household Spaces and Accommodation Type (KS16), a subset of the 2001 Census defines the type of dwelling (detached, semi-detached, terraced, or flat) and also the total number of dwellings by output area.

2007 council tax data

To establish the total number of dwellings by output area that have been built post the 2001 Census, you should refer to the 2007 Council Tax data 'Dwelling Stock by Council Tax Band, 2007'.

The dwelling stock by council tax band, 2007 unfortunately does not indicate the type of property (as defined in the KS16 dataset). The total number of dwellings per output area reported in the Council Tax Band 2007 dataset includes all residential properties and the total number of caravans. The total number of caravans must be removed from the Council Tax Band, 2007 dataset prior to calculating the number of additional dwellings post 2001 Census by output area.

Removing Caravans from Council Tax Band, 2007 dataset

The total number of caravans by output area is reported in the 2001 Census (KS16) dataset. This should be assumed to reflect the total number of caravans by output area within the Council Tax Band 2007 dataset.

Once the total number of caravans has been removed from the Council Tax Band 2007 dataset the total number of additional dwellings can be established using the method given below:

Total number of dwellings built post 2001 Census by output area	Equals	Total number of dwellings in Council Tax Band 2007 minus total number of Caravans identified in 2001 Census (KS16) dataset	Minus	Total number of dwellings (detached, semi-detached, terraced, flat) in 2001 Census (KS16) dataset

The proportion of dwelling types by output area (detached, semi-detached, terraced, flat) should be assumed to be the same as for the 2001 Census.

Step 2: Establish the energy demand of dwellings in Wales

Once the total number of each dwelling type has been identified the next step in calculating the energy demand of each property is to establish the degree of insulation present within each dwelling, and make an assumption about the average size of each dwelling type.

Step 2.1: Establish the proportion of dwellings with cavity wall insulation

Living in Wales

The 'Living in Wales' survey is an annual statistical survey that reports on information about households and the condition of homes in Wales including information on insulation and energy conservation. The survey reports on statistics at a national level.

The following information has been derived from 'Table 14.4: Household Insulation Summary (Living in Wales 2008)'.

Table 45: Proportion and type of insulation across Wales

Insulation	Percentage
Properties with solid walls	11.6%
Properties with cavity wall insulation	37.3%
Properties without cavity wall insulation	51.1%
Total	**100.0%**

Building Regulations 2002

Dwellings that have been constructed post 2002 have to be built to current building regulations that stipulate minimum levels of insulation within dwellings. It has been assumed that all properties built post 2001 Census have been built in accordance with current building regulations.

Because this split is only for the whole of Wales, if you have more detailed information on housing on your local area, we suggest that you use that instead.

Step 2.2: Modelling the energy demand of dwellings in Wales

SAP Modelling

Standard Assessment Procedure (SAP) models were developed to model the typical energy (space heating and domestic hot water) demand of dwelling types as a function of insulation type. An example of the total space heating and domestic hot water demand (kWh) of each dwelling type as modelled for the Pembrokeshire case study is given in the table below.

Table 46: Space heating and domestic hot water energy demand (kWh) by dwelling type

	Solid Wall	Un-insulated Cavity Wall	Insulated Cavity Wall	Building Regs 2002
Detached	32,328	21,718	16,026	10,702
Semi Detached	22,949	14,379	9,814	7,000
Terraced	13,583	10,253	11,919	6,144
Flat	9,257	6,688	4,973	4,671

Note: Average floor areas for each dwelling type were assumed to be the same as reported within the English Household Condition Survey.

The total existing residential energy demand should then be calculated for each output area.

Step 2.3: Plotting existing residential energy demand by output area

As indicated in Step 2.1 above, existing residential data is reported at output area level. Each output area is unique and represents a standard geographic area. Using a GIS output area data layer for your local authority you should then relate the output area code as given in your modelling dataset to the same output area code as identified in the GIS layer. The two datasets should then seamlessly merge.

The energy units as calculated by the energy model are displayed as kWh. To reflect existing energy demand by output area it is important to also standardise the data by geographic area (km^2). Thus energy demand should be divided by area (km^2) of the respective output area to determine heat density. Heat density should be reported in MW per km^2.

A step by step conversion process from kWh to MW per km^2 is given below:

First step: Convert kWh to MWh

KWh/1,000 = MWh

Second step: Convert MWh to MW. This step is required to convert annual energy demand [MWh] into hourly demand [MW].

MWh/(24 hours x 365 days) = MWh

Both of the above steps can be undertaken using a GIS once the data is merged with the GIS output area data layer.

Using a GIS the area (km^2) of each output area can quickly be calculated.

Third step: Convert MW to MW per km^2

MW/area (km^2) = MW/km^2

It should be noted that research into the viability of DHNs carried out for DECC[90] indicated that residential areas with a heat density of less than 3MW/km^2 were likely to be less viable and therefore our existing heat demand map does not display Output Areas with a heat density below this threshold.

Areas of high fuel poverty

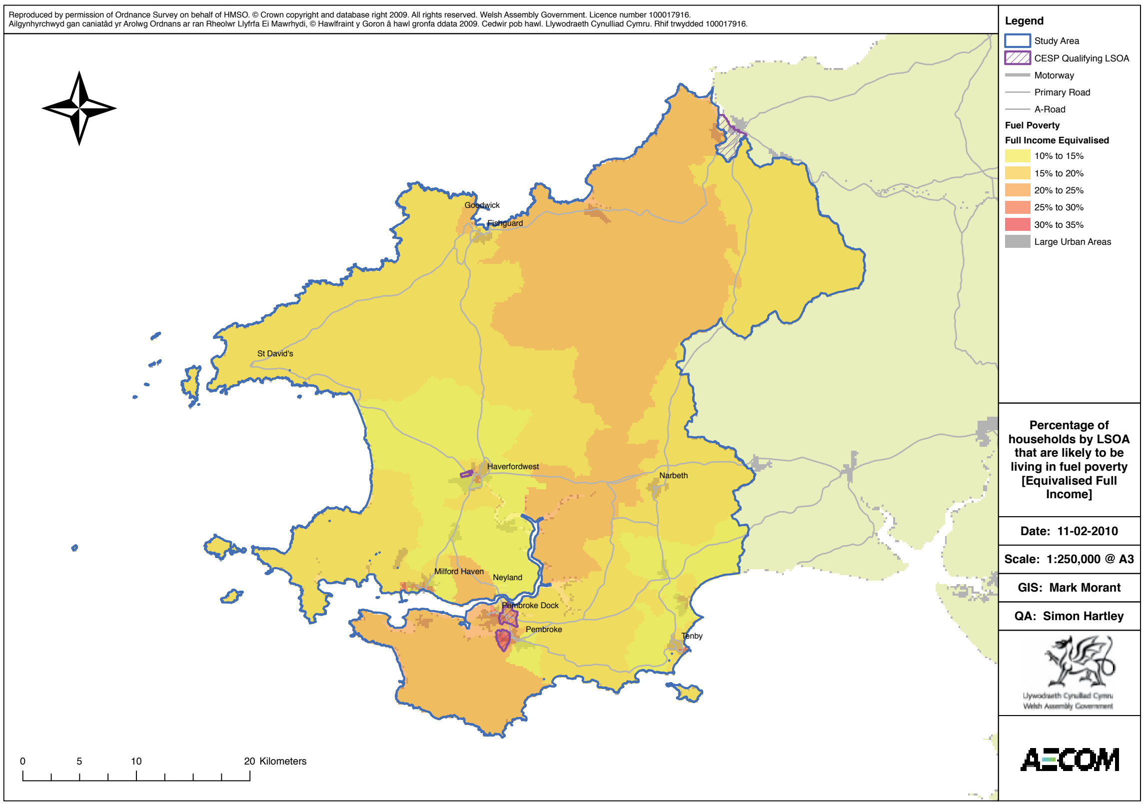
The difficulties of measuring fuel poverty are acknowledged and this is compounded by the use of data to produce the fuel poverty maps originating from the 2001 census and 2004 'Living in Wales' survey. We acknowledge the maps are unlikely to reflect the extent of fuel poverty as it stands today. However, the maps do demonstrate how current data might be used to inform site selection and consideration of LZC technologies.

Step 1: Establish fuel poverty data

You can identify the geographic extent of areas of high fuel poverty by using the Local Fuel Poverty Maps for Wales[91] as indicated in the 'A small area fuel poverty indicator for Wales (Sept 2008)'. You can download the raw data for this from the Welsh Assembly Government website, which gives the number of households in each LSOA in fuel poverty. You can then plot on a map the % of households in each LSOA in fuel poverty. This will enable you to identify if any areas are in areas of opportunity for district heating.

You may also wish to plot on the same map any areas that are eligible for Community Energy Savings Programme[92] [CESP] funding for energy efficiency measures, which can include district heating. The Government proposes that LSOAs eligible for a CESP scheme must be within the 15% most income deprived areas in Wales, based on comparable level of income deprivation. The map below shows an example, for Pembrokeshire, of how you can map the spatial location of both fuel poverty and potential eligibility for CESP funding.

Figure 20: Fuel poverty for Pembrokeshire



Existing DH & CHP schemes and sources of waste heat

Step 1: Establish location of existing DH & CHP schemes

The geographic location, size and type of existing and approved low and zero carbon energy technologies, including district heating and CHP schemes are reported on behalf of BERR at the Renewable Energy Statistics Database for the UK (www.retats.org.uk). The database reports on all planning applications and currently installed LZC technologies and is updated monthly. At the time of writing the latest available version of the data was November 2008.

Eastings and Northings are given for each LZC planning application allowing the dataset to be geo referenced using a GIS.

Existing and approved LZC energy technologies are assumed to be all records that are defined under the category 'pre consent' as 'application approved' or 'no application required', and have 'post consent' that is either 'awaiting construction', 'operational' or 'under construction.'

This information should then be confirmed and/or updated through consultation with the local authority planning department.

Step 2: Establish location of sources of waste heat

The LLPG can be used to identify the location and type of properties that could potentially be sources of waste heat. These include: landfill, quarries, power stations, recycling sites and water treatment works.

The local authority energy manager should also be able to provide information on individual properties that could potentially be identified as sources of waste heat. The geographic location of such properties can be established using the LLPG.

Reference should also be made to the Ofgem ROC database, UK Emissions Trading Scheme and Defra Industrial Heat Maps to establish existing energy from waste facilities and potential sources of waste heat.

All datasets should be checked with the relevant local authority planning department to establish status of existing and proposed schemes.

You can identify any existing CHP schemes that may be in your area by referring to the DECC CHP database website[93]. You should select "Wales" in the region box, and then click on "Run Report". This then generates a list of all CHP schemes in Wales that you can then download to a spreadsheet. This dataset gives the postcode for each generating station which enables you to map its location.

References

[89] See http://www.industrialheatmap.com/

[90] The Potential and Costs of District Heating Networks, by Poyry and Faber Maunsell, A report to the Department of Energy and Climate Change (DECC), April, 2009 See http://www.ilexenergy.com/pages/documents/reports/electricity/District_heating_exec_summary.pdf

[91] You can download the raw data at http://cymru.gov.uk/topics/environmentcountryside/energy/fuelpoverty/fuelpovertymaps/midwales/;jsessionid=9xs2L0wTpKS48SDb2JJLDTYWgnhJcVblvNxW8Gpb7SvyPnP0ByLf!-1041720684?lang=en

[92] On 11 September 2008 the Government announced the launch of the £1bn Home Energy Saving Programme aimed at helping families to permanently cut their energy bills. A key part of the announcement was the creation of a new £350m Community Energy Saving Programme (CESP). This Programme will target households, across Great Britain, in given geographical areas to improve energy efficiency standards, and permanently reduce fuel bills

[93] See http://chp.decc.gov.uk/app/reporting/index/viewtable/token/2

Project Sheet H: Building integrated renewables (BIR)

Overview

Section E2 of the toolkit sets out a simplified method for roughly estimating the level of uptake of BIR in your local authority by 2020, based on modelling carried out for Pembrokeshire. However, this section sets out a method for more accurately predicting the level of BIR uptake in your area. To carry out the actual uptake modelling you would need to engage specialist expertise, therefore this Project Sheet does not set out all that you would need to do to carry out the modelling. However, what this Project Sheet aims to do is:

- Enable you to prepare the base information that you would be likely to need to feed into an uptake model.
- Give you an indication of the outputs that you would want to see from the uptake modelling to enable you to prepare a consultant's brief.

Method

The approach to assessing the microgeneration potential for a local authority area consists of the following steps:

Step 1: Quantify existing dwellings market segment

Step 2: Quantify future new build dwellings segment

Step 3: Quantify existing non-residential market segment

Step 4: Quantify future new non-residential development market segment

Step 5: Predict microgeneration uptake for new residential and non-residential development

Step 6: Predict microgeneration uptake for existing residential and non-residential development

Each of these steps is described in more detail below.

Step 1: Quantify existing dwellings market segment

The sub-categories of existing dwellings that need to be identified and quantified, and the process for doing this, are as follows:

Dwelling type: house or flat. This will affect the size of energy demand for the dwelling, as well as roof area, and hence size of microgeneration system that could be installed.

This information can be collated from the 2001 census data, and Council tax band data to assess the number of new dwellings built since 2001. A method for doing this is set out in Project Sheet G.

Type of tenure: owner occupier, private landlord or Council/social rented. This will affect the likelihood of installing any given microgeneration system and the nature of the consumer group. Groups who are likely to see a benefit from installing microgeneration, such as owner occupiers, will be more likely to proceed with an installation than a private landlord.

Local authorities in Wales should have access to data on this for their own area. If not, you can find data on tenure, at the level of Wales, at http://wales.gov.uk/topics/statistics/theme/housing/stock/?lang=en

This shows that the majority of dwelling stock, 73%, was owner occupied as of 31 March 2008. A further 10% was rented from local authorities, 10% was privately rented and 7% was rented from RSLs.

Location: urban, suburban or rural. This will affect the extent to which wind power technologies will be viable.

A local authority may have information on the proportion of households that are in rural or urban areas. If not, data on the rural/urban split is available from National Statistics at http://www.statistics.gov.uk/geography/rudn.asp[94]

Utilities: on or off gas. Off gas sites will not be suitable for gas micro-CHP. Conversely, heating from renewable energy fuels will be more attractive in these areas as oil and LPG fuels are more expensive than mains gas.

A local authority may have information on the proportion of households that are off gas, as part of fuel poverty monitoring. An alternative is to use the DECC data on final energy consumption for each local authority area available at http://www.decc.gov.uk/en/content/cms/statistics/regional/gas/gas.aspx

This shows the number of domestic consumers that are purchasing gas. You can compare this with the total number of households in your local authority area to give a rough estimate of how many are off gas.

Dwelling age. This is really a proxy for the level of thermal performance of a dwelling, i.e. its annual heating demand. A key break point in time is between those dwellings built prior to 1919, and those after. This is because the majority of dwellings built prior to 1919 have solid walls, and therefore cannot be fitted with cavity wall insulation. Your local authority officer responsible for housing may have data on the age composition of housing stock in your area. Alternatively, information on the age breakdown of the stock for Wales as a whole is available from the Welsh House Condition Survey 1998[95].

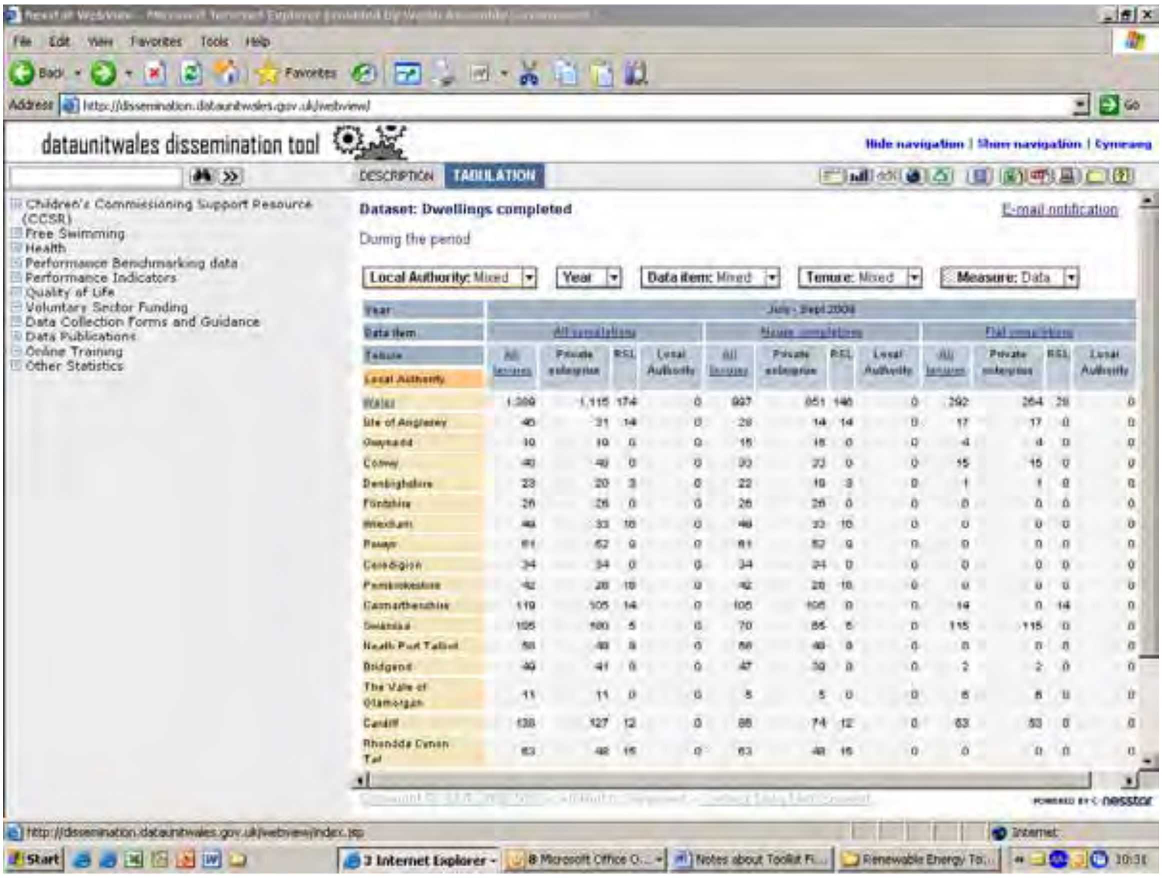
Step 2: Quantify future new build dwellings segment

The first figure to establish is the number of dwellings to be build out in each year. The method for this is described in step 1 of chapter E2 in the main body of the toolkit.

As with existing dwellings, there are a number of similar factors which come into play in determining which technologies will be suitable for a particular dwelling. The sub-categories that need to be identified are the same as step 1, without the need to assess the type of tenure. This is because future Building Regulations will apply to all new dwellings equally, regardless of tenure.

The split between houses and flats can be based on recent data on new housing completions which your local authority should hold. If not, this data can be obtained on-line for each local authority from the Wales Data Unit (see example below). We would suggest taking an average over the last three years to estimate the split going forwards.

Figure 21: Screen print of new housing completions from Wales Data Unit



Data unit Wales http://dissemination.dataunitwales.gov.uk/webview/97

The split for urban/rural can be based on the strategy being proposed in the LDP for how much development should be occurring in rural areas. If there is no suggested split in the LDP, the same split as used in step 1 can be applied.

In terms of identifying the proportion of new dwellings to be on or off gas, this can be assumed to be the same as for step 1.

As an output from steps 1 and 2, you should produce a table similar to the one below, which would provide data to feed into an uptake model.

Table 47: Outputs from LA Toolkit steps 1 & 2, Project Sheet H to feed into renewable energy technologies uptake model

Viable	Category	Existing dwellings	Future dwellings
Tenure	LA/RSL	Insert % here	n/a
	Owner Occupier	Insert % here	n/a
	Private Landlord	Insert % here	n/a
Location	Suburban	Insert % here	Insert % here
	Rural	Insert % here	Insert % here
	Urban	Insert % here	Insert % here
Type	House	Insert % here	Insert % here
	Flat	Insert % here	Insert % here
Gas Supply	Yes	Insert % here	Insert % here
	No	Insert % here	Insert % here
Age/thermal performance of existing stock	e.g. % pre-1919, 19-1919-1945, 1945-1965, 1965+	Insert % breakdown here	n/a
Total number		Insert number here	Insert number here (average per annum)

Avoiding double counting

Note - if you are also assessing the potential for district heating and CHP at strategic sites (see chapter E4), and including the output from CHP at those sites as part of area wide installed capacity targets, then the new buildings included in these sites should not be included in the BIR uptake assessment. Otherwise, the strategic sites will be assumed to have both district heating/CHP and microgeneration, which would overstate the potential. This caution does not apply to existing buildings, as any supply of renewable heat to them via heat networks is likely to be additional to any BIR uptake.

Step 3: Quantify existing non-residential market segment

In order to estimate the potential uptake in non-residential buildings, the modelling approach generally used is to break the buildings down into different broad categories, and then estimate the number of buildings in that category and the typical annual energy demands, for gas, oil and electricity. We suggest that typical categories would be as follows:

- Public sector
  - Schools
  - Leisure centres
  - Offices
  - Health facilities
- Private sector
  - Retail
  - Warehouses
  - Offices
  - Factories
  - Hospitality/hotels

The officer responsible for energy management or facilities for your local authority should be able to provide data on the number of buildings, floor area and the energy use for schools, leisure centres and Council offices. This officer should also be able to give you a contact for Welsh Health Estates in order to obtain data on the number and floor areas of health facilities in your area. If you are also doing heat opportunities mapping, then much of this data will have been collected as set out in Project Sheet G.

For non-public buildings, data for a local authority on floor areas for non-residential buildings can be obtained from the Valuations Office Authority (VOA) who administer business rates. The VOA breaks down non-residential buildings into five "bulk class" sectors, covering: retail, factory, warehouses, commercial offices, and other offices (which includes local authority offices). This data can be downloaded at a local authority level from the neighbourhood statistics website. http://www.neighbourhood.statistics.gov.uk/dissemination/Download1.do.

At the bottom of this webpage it says 'I Want To:' and below that click on 'view or download data by topic'. When the list of topics appears, click on the '+' sign of the Physical Environment topic to show the list of datasets available under this topic. The Commercial and Industrial Floorspace and Rateable Value Statistics datasets can be accessed by clicking on the associated button to the right of the screen and then 'Next' in the bottom right corner. This links to a page where the datasets can be viewed online for specific geographies for specific years, or the full set of data for each year can be downloaded in a .csv format.

This dataset will tell you the total number of businesses in a particular bulk class, and also the total rateable floor area for the bulk class. From that information, you can calculate, for each bulk class, an average floor area for each business.

For hospitality businesses, which are not included in the VOA dataset, we suggest that you use the LLPG dataset to identify the number of hotels in your authority. You could then talk to an officer in your authority who deals with tourism to gain an idea of the typical floor area or number of beds for the hotels in your area.

As well as knowing the number of buildings, as with the residential sector, it is also useful to know whether the buildings are located in urban or rural areas, and also whether they are on or off the mains gas network. For public buildings, the relevant officer should be able to provide you with this information. For non-public buildings, this information is unlikely to be readily available. Therefore, we suggest that you assume the same proportional split between on and off gas, and rural and urban as you have used for dwellings.

In order to provide input data for an uptake model, we suggest that you should prepare a table similar to the one overleaf:

Consumer groups	Sub-sectors	No. of businesses/ units	Typical floor areas (m^2)
Private ownership buildng types	Retail		
	Office		
	Warehouse		
	Factory		
	Hospitality		
Public ownership building types	Health		
	School		
	Leisure centre without pool		
	Leisure centre with pool		

Step 4: Quantify future new non-residential development market segment

As for the existing non-residential segment, there are two key sectors in this segment, namely the public sector and commercial development.

For the public sector, you should talk to the officer in your authority responsible for procuring new buildings, to identify the pipeline of planned new schools, leisure centres, and any other new Council buildings (if any). You will require information on the estimated proposed floor area of each, as well as a description of the building type, e.g. whether a primary or secondary school and the anticipated year of completion. For other public sector buildings, again we suggest to talk to Welsh Health Estates to identify the pipeline of proposed new health buildings in your area.

For commercial development, you should estimate expected floor areas for each type of development, at least in terms of use class (e.g B1, B2, B8, etc.) for non-residential development to be provided over the Plan period. This should be broken down into each year.

In practice, you may only know the potential hectares for each use class. Information on this would be informed by any employment land studies or retail studies that you may have had carried out for your area. These may provide historical data that you could project forward, or they may provide future projections and requirements.

If the areas in hectares of sites with the potential to be developed are known, but floor areas are not, ratios between site area and floor space for various building types can be used to estimate potential floor space developed. The ratios used to calculate floor area from the projection of annual development in hectares are given in Table 48.

Table 48: Plot ratios for employment use (gross floor space to site area)[97]

	Roger Tym (1997)[98]	Other Studies	Suggested value to use[99]
Business Park	0.25 to 0.30	0.25 to 0.40	0.275
Industrial	0.42	0.35 to 0.45	0.4
Warehouse	-	0.40 to 0.60	0.5
Town Centre Office	0.41	0.75 to 2.00	1.05

Step 5: Predict microgeneration uptake for new residential and non-residential development

As mentioned above, this task would need to be carried out by a specialist expert or consultant. Essentially, it involves building a model that assesses the least (capital) cost technology option for any given building type in any given year to comply with regulatory carbon reduction requirements.

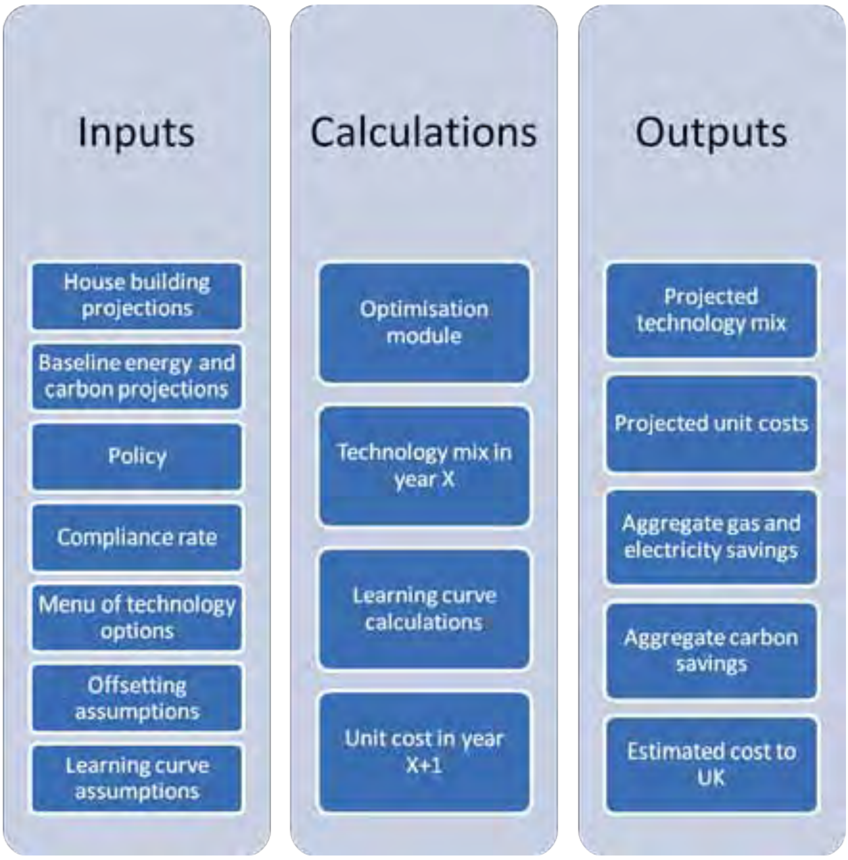
Examples of the sort of models and the outputs that can be produced are:

- The modelling carried out by Element Energy for the Renewables Advisory Board[100] to inform the Government's consultation on zero carbon new homes.
- Modelling carried out by Cyril Sweett, Faber Maunsell (now AECOM) and Europe Economics for the Government's regulatory impact assessment for the zero carbon homes policy[101].

The key outputs that the consultant should produce are as follows:

- Two or three scenarios to account for uncertainty over level of uptake due to uncertainty over future regulatory requirements and technology costs.
- For each scenario, a breakdown of the cumulative number of installations for each technology type, the total installed kW for each technology and the kWh of energy generated from each technology for key years, e.g. 2015, 2020 and 2025.
- For each scenario, a breakdown of the cumulative installed capacity (in kW) and energy output (kWh) in terms of renewable heat, and renewable electricity, not including low carbon (but not renewable) energy technologies, as these will not contribute to the Wales or UK renewable energy targets.

Figure 22: Schematic of cost model used for UK Government's zero carbon homes policy research



Step 6: Predict microgeneration uptake for existing residential and non-residential development

This section addresses the projected uptake of microgeneration in existing buildings. Microgeneration uptake in existing buildings is not currently driven by policy, unlike uptake in new buildings. Instead uptake is driven by consumer choice, incentivised by:

- Energy cost savings and maintenance
- Grants
- Revenue incentives - i.e. Feed in Tariff
- Versus: unfamiliarity, capital costs, inconvenience

Two modelling approaches have been used by national studies:

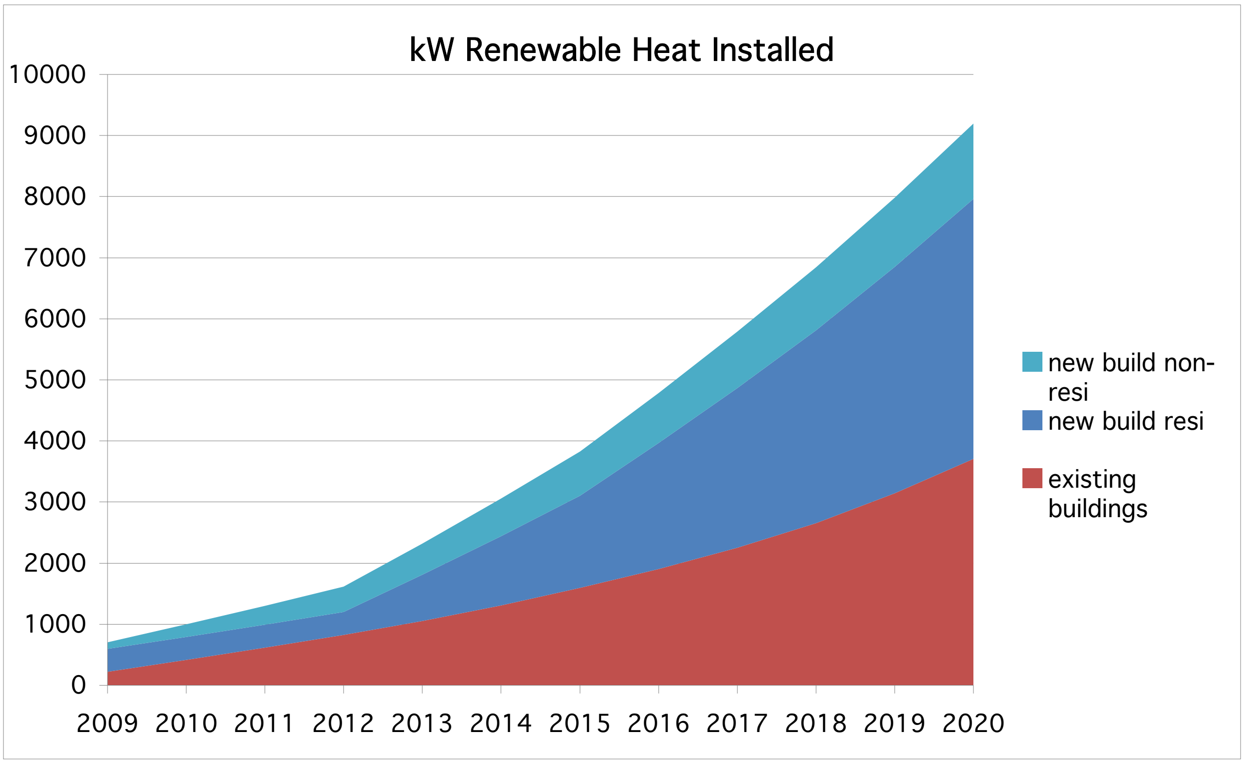
1. Determine the potential capacity for each technology based on estimated uptake rate, growing to an estimated limiting capacity.
2. Discrete consumer choice model as used by Element Energy in their 2008 report.[102]

The first method is useful to determine the maximum uptake of a given technology, but the technology totals cannot be added together to find a total installed capacity (as householders would be double counted). This limitation led Element Energy to develop a discrete choice model for their 2008 report. A discrete choice model attempts to simulate uptake based on consumer's values versus technology attributes. The consumer's values are represented by coefficients based on extensive survey results.

For the Pembrokeshire pilot study AECOM developed its own discrete choice model based on the survey coefficients from Element Energy's 2008 report.

The final outputs should be as for step 5 and should give the cumulative total installed renewable power (kWe) and heat (kWh) each year and the cumulative number of installations. An example of the output that might be produced by a consultant, covering the combined output from steps 5 and 6 is given below[103].

Figure 23: Example output (from Pembrokeshire case study) from BIR uptake model



References

94 We suggest you use the ward level data, and assume that our category of "suburban" equates to the ONS category of "town and fringe"

95 See http://wales.gov.uk/topics/statistics/publications/whcs98/?lang=en

96 See http://dissemination.dataunitwales.gov.uk/webview/97

97 Employment Land Reviews: Guidance Note, CLG, December 2004

98 Roger Tym & Partners, 1997 and ERM Review

99 These values are averages of the previous two columns. If you have access to data on historical plot ratios specifically for your area, then you should use that data in preference to the values in the table

100 Available from the Renewables Advisory Board website at http://www.renewables-advisory-board.org.uk/vBulletin/attachment.php?attachmentid=324&d=1195637587

101 See the final technical report at http://www.communities.gov.uk/documents/planningandbuilding/pdf/1158782.pdf

102 The growth potential for Microgeneration in England, Wales and Scotland, Element Energy, June 2008, available at http://www.berr.gov.uk/files/file46003.pdf

103 As mentioned above, for informing area wide renewable energy targets, it is only the uptake of renewable energy BIR that you are interested in, therefore the uptake of non-renewable BIR (i.e. micro-CHP) needs to be netted off

Project Sheet I: Energy baseline/future target guidelines

Existing energy baseline

This section delineates the method employed for base-lining area wide energy consumption. The method relies upon:

- Predicted future energy demand as indicated in the UK Renewable Energy Strategy.
- WAG derived data and statistics currently published by DECC.

Step 1: Establish future energy consumption

The UK Renewable Energy Strategy reports the current [2008] and future [2020] energy consumption across the UK for the three main energy sectors: electricity, heating and transport. It also reports and the proportion that is met, and that will need to be met in the future, by renewable energy sources.

Table 49: Final UK energy consumption in 2008 and projected for 2020

	2008		2020	
	All Energy (TWh)	Renewable Energy (TWh)	All Energy (TWh)	Renewable Energy (TWh)
Electricity	387	22	386	117
Heat	711	7	599	72
Transport	598	9	605	49
Total Final Energy Consumption	1,695	39	1,590	239

The above table indicates that total final energy consumption will contract by circa 6.6% between 2008 and 2020, with electricity consumption reducing by 0.3%, heat consumption reducing by 18.7%, and transport consumption increasing by 1.2%.

The total proportion of renewable energy generated by each key energy sector is anticipated to increase by a total of 612.8%, with renewable electricity generation increasing by 531.8%, renewable heat generation increasing by 1,028.6%, and renewable energy from transport increasing by 612.8%.

Step 2: Establishing existing energy consumption

Total annual energy consumption data is currently reported at a national, regional and local authority level by DECC[104]. An example of energy data from DECC is given below.

Table 50: Total energy 2006 (GWh) by DECC energy sector for the UK, Wales and for Pembrokeshire

	Total Energy 2006 (GWh)		
Sector	**UK**	**Wales**	**Pembrokehsire**
Coal (Industrial/Commercial)	26,754	1,454	72
Coal (Domestic)	4,838	632	42
Manufactured fuels (Industrial/Commercial)	6,720	1,586	0
Manufactured fuels (Domestic)	2,585	155	2
Petroleum products (Industrial/Commercial)	189,176	16,555	8,726
Petroleum products (Domestic)	39,481	2,707	220
Petroleum products (Road Transport)	496,244	24,757	907
Petroleum products (Rail)	8,628	562	13
Natural gas (Industrial/Commercial)	229,555	12,803	128
Natural gas (Domestic)	399,179	19,599	543
Electricity (Industrial/Commercial)	203,346	11,794	782
Electricity (Domestic)	125,048	5,600	260
Renewables & Waste	6,939	609	25

Note: Natural gas (industrial/commercial) and natural gas (domestic) figures are reported on a Great Britain level only and do not include Northern Ireland.

Additional datasets are available from 2002 to 2007. However, currently only the 2005 and 2006 datasets report on energy derived from renewable energy sources and waste.

As recommended in the UK RES, energy consumption data should be split into the following energy sectors: Electricity, Heating, and Transport. The energy sectors as identified within the DECC 2005 and 2006 total final energy consumption datasets should be classified as follows:

Table 51: Classification of DECC Energy Sector to UK RES Sector

DECC Energy Sector	UK RES Sector
Coal (Industrial/Commercial)	Heat
Coal (Domestic)	Heat
Manufactured fuels (Industrial/Commercial)	Heat
Manufactured fuels (Domestic)	Heat
Petroleum products (Industria /Commercial)	Heat
Petroleum products (Domestic)	Heat
Petroleum products (Road Transport)	Transport
Petroleum products (Rail)	Transport
Natural gas (Industrial/Commercial)	Heat
Natural gas (Domestic)	Heat
Electricity (Industrial/Commercial)	Electricity
Electricity (Domestic)	Electricity
Renewables & Waste	n/a
Coal (Industrial/Commercial)	Heat

Note: Natural gas (industrial/commercial) and natural gas (domestic) figures are reported on a Great Britain level only and do not include Northern Ireland.

Once the key energy sectors have been collated, the total energy for the reported period can be calculated. The table below provides an example of the split between electricity, heat and transport for the UK, Wales and for Pembrokeshire.

Table 52: Total DECC Energy 2006 (GWh) data reported by UK RES energy sector for the UK, Wales and for Pembrokeshire

	Total Energy 2006 (GWh)		
Sector	**UK**	**Wales**	**Pembrokehsire**
Electricity	328,393	17,394	1,042
Heat	898,287	55,489	9,735
Transport	504,871	25,319	919

Step 3: Monitoring Progress

As indicated by the UK RES, energy consumption for electricity, heat and transport can be predicted up to 2020 for both total energy consumed and for the proportion met by renewables. Using the same growth predictions, local authorities can establish their predicted 2020 energy consumption and proportion that should be met by renewables. Annual monitoring using the DECC data provides a robust framework in which to assess overall energy consumption.

References

[104] http://www.decc.gov.uk/en/content/cms/statistics/regional/total_final/total_final.aspx

Project Sheet J: Calculating Annual Energy Output using Capacity Factors

The results of the area wide resource assessments, for different technologies, as described in section E1 will give an indication of the potential installed capacity (in terms of MW of power output) that can be supported by the available resource. However, the UK renewable energy target for 2020 is expressed in terms of a % of energy demand. Therefore, in order to be compatible with this target, as well as knowing the potential installed renewable energy capacity in an area, you also need to be able to estimate how much energy this capacity could generate.

A simple and well established way of doing this is to use capacity factors[105]. These factors, which vary by technology, are a measure of how much energy a generating station will typically produce in a year for any given installed capacity. This reflects the fact that the installed capacity is a measure of the maximum amount of power that a generating station can produce at any given moment. However, for reasons to do with either fuel availability[106], the need for maintenance downtime, or, for heat generating plant, a lack of heat demand at certain times of day or year, the capacity factor is always less than 1.

For any particular technology, the capacity factor (CF) is defined as follows:

CF = (typical annual energy output)/(annual energy output if plant generated at full capacity for the entire year)

Therefore, for any given generating station, its annual energy output can be calculated by multiplying its installed capacity by its capacity factor and the number of hours in a year.

For example, a biomass power station with an installed capacity of 5MWe, and a CF of 0.9. the annual energy output would be:

$$5 \times 0.9 \times 365 \times 24 = 39{,}420 \text{ MWh}_e$$

Those forms of renewable electricity generation that rely on intermittent natural flows of energy (such as wind, photovoltaics and hydropower) inevitably have lower capacity factors than those that are fuelled by biomass (or waste), in its various forms, as the biomass can be stored to ensure a continuity of supply. A summary of different capacity factors for different technologies is given below:

Table 53: Renewable electricity generation capacity factors

Technology	Capacity factor	Comments and source
Onshore wind	0.27	DUKES 2009, figure for 2008[107]
Biomass (animal and plant matter)[108]	0.9	typical for gas and coal fired power stations[109]
Hydropower	0.37	DUKES 2009, figure for 2008
Energy from Waste	0.9	typical for gas and coal fired power stations
Landfill gas	0.60	DUKES 2009, figure for 2008,
Sewage gas	0.42	DUKES 2009, figure for 2008
BIR electricity	0.1	this is an average for PV and micro and small wind

Table 54: Renewable heat generation capacity factors

Technology	Capacity factor	Comments and source
Heat from CHP (from biomass or energy from waste, or from large scale heat only biomass or energy from waste)	0.5	This allows for the fact that not all of the waste heat can be usefully used 100% of the time
BIR heat (solar water heating, heat pumps, biomass boilers)	0.2	This is an average across a range of technologies, covering heat pumps, wood chip and pellet boilers and solar water heating

References

105 These are also sometimes referred to as load factors

106 Which, in the case of renewable energy, includes natural energy flows such as the wind, sun and water, as well as solid fuels such as biomass

107 Digest of UK energy statistics, 2009, table 7.4 http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

108 i.e. this should be applied to both generation from energy crops, as well as generation from AD of animal slurry and/or food waste

109 Markal energy model, 2007, chapter 5 Project Sheet of model documentation, http://www.ukerc.ac.uk/support/tikiindex.php?page=ESMMARKALDocs08&highlight=Chapter%205:%20Electricity%20and%20Heat%20v1
The Markal energy model was used for the projections in the 2007 UK Energy White Paper