Research

Sustainable Development Commission

Low Carbon Wales

Resource Bank

November 2009

The Built Environment and Energy

This document provides background information on a wealth of low carbon solutions for the built environment and energy sectors alongside case studies, tips for replication and recommendations for delivery through the Wales Spatial Plan Groups. It was constructed through a significant desk based study as part of the *Low Carbon Wales: Regional Priorities for Action* project between January and April/May 2009. Given the dynamic nature and massive scope of the subject area it is recognised that this document cannot cover all potential carbon reduction solutions and that relevant policy and regulation may have progressed or changed since the time of writing. This is however a useful reference guide for Spatial Plan Regional Groups and wider stakeholders in the transition to low carbon.

Contents

1. Summary

The built environment, in construction and in use, is a significant contributor to UK CO_2 emissions. Domestic energy use alone contributes 27% to UK CO_2 emissions, whilst the Carbon Trust attributes almost another 1/5th of UK carbon emissions to non domestic buildings. Housing is responsible for 1.3 gha per capita of the 5.1 gha per capita average eco footprint across the Spatial Plan Regions of Wales.

Opportunities for emission reductions at a Regional level are addressed in this chapter looking at new build, the existing stock and energy generation in turn. Increasing the energy efficiency of the existing housing stock is seen a priority which can be broken down into to discreet phases. Phase 1 is a preparation phase which involves mapping the Region's housing stock (including energy efficiency, fuel poor and building types), engagement with the local construction sector to ensure that the skills and training needs are addressed, engagement with the Existing Homes Alliance Wales to explore how its work can be implemented at a Regional level and communication to householders to stimulate demand. Phase 2 is about identifying ways to implement large scale housing refurbishment. The opportunities for new build are addressed by looking at ways to decrease the embedded energy of new buildings and minimising the energy needed to use them. District heating, Energy Service Companies, energy partnerships and community energy are all discussed as potential mechanisms to increase the proportion of renewable energy generated in the Regions.

As set out in section 3.3 of this report, SDC solutions for early consideration for reducing emissions from the built environment and energy at a Regional level are:

(1) Develop and implement a programme of action for the refurbishment of <u>all</u> existing housing stock within the Region

(2) Significantly increase the Region's energy generation capacity from community and large scale renewables

Rationale for prioritisation:

1) The existing stock will continue to make up approximately 80% of the built environment in 2050. Of the 1.3 million homes in Wales only a small percentage are fully fitted with energy efficiency measures.
2) Domestic energy use alone contributes 27% to UK CO_2 emissions. The Energy Saving Trust's Power in Numbers report demonstrated that distributed energy on a community scale reduces costs and increases CO_2 savings, compared to individual microgeneration installation.

2. Policy Overview

2.1. EU Policy

The EU adopted an integrated energy and climate change policy in December 2008, under which: cutting greenhouse gases by 20%; reducing energy consumption by 20% through increased energy efficiency; and meeting 20% of energy need through renewable sources are key targets. A new renewables directive will lay down mandatory national targets for Member States, through promoting the use of renewable energy in the electricity, heating and cooling, and transport sectors in order to ensure that **by 2020 renewable energy makes up at least 20% of the EU's total energy consumption**.

Currently, at a European level key policy instruments for emissions reductions from energy and the built environment sector are the existing Renewables Directive (2001/77/EC) and the Energy Performance of Buildings Directive (EPBD) (2002/91/EC). The current Renewables Directive sets a target for 22% of EU electricity to be derived from renewables by 2020 to be delivered through specified, corresponding targets for member states.

Energy Performance of Buildings Directive

The Directive on Energy Performance of Buildings aims to improve the energy efficiency of public, commercial and private buildings through setting four requirements for member states:

- Producing a method of calculating the integrated energy performance of buildings covering all aspects of energy efficiency including insulations, heating and cooling systems, lighting etc.
- Producing minimum standards for the energy performance of new builds and the refurbishment of existing buildings which should be derived from the above methodology.
- Certifying the energy performance of new and existing buildings, with certificates to be made available when buildings are constructed, sold or rented and displayed in public buildings
- Ensuring regular inspection of heating and cooling installations

This directive builds upon / supplements previous directives on the energy efficiency of hot water boilers (92/42/EEC), the quality of construction materials including heat retention and energy efficiency (89/106/EEC) and the energy labeling of appliances (92/75/EEC)[1,2]. The Directive on the Energy Performance of Buildings is currently being 'recast' and has been the subject of a recent consultation. More information on the progress with the re-casting and on the implementation of this Directive in the UK is available on http://www.diag.org.uk/key-information/key-documents-.aspx

Because transposition of the EPBD poses significant challenges for Member States, the European Commission has taken some **initiatives to support implementation.** These include principally:

- **EPBD Concerted Action,** funded by the Intelligent Energy Europe Programme it enables representatives from Member States to exchange experience and best practice http://www.epbd-ca.org/;
- Establishment and financing of a package of 31 **European Committee for Standardisation (CEN) standards** for calculation and rating methodologies for the energy performance of buildings http://www.cen.eu/cenorm/sectors/sectors/construction/index.asp
- The **EPBD Buildings Platform** – an information service for practitioners, consultants, energy agencies, interest groups and national policy makers. http://www.buildingsplatform.org/cms/

The following policies and resources are also of interest:

- The Energy end-use efficiency and energy services Directive (2006/32/EC) http://europa.eu/scadplus/leg/en/lvb/l27057.htm
- The web-based **ManagEnergy** network hosted by DG TREN is a resource for those working on energy efficiency and renewable energies at the local and Regional level http://www.managenergy.net/ Many Welsh organisations are currently registered.
- Attracting much interest currently is the **Covenant of Mayors on Energy**, an initiative of the European Commission launched in January 2008. Local authorities signing the Covenant make a formal commitment to go beyond the EU objectives on the reduction of CO_2 emissions, i.e. they will commit to reduce their CO_2 emissions by more than 20% by 2020. To achieve this they will establish **Sustainable Energy Action Plans** within one year of signing up to the Covenant, see http://www.eumayors.eu. The Commission is planning to support the signatories' take-up of the best sustainable energy practices through a 'benchmarks for excellence' mechanism and is seeking to involve other major stakeholders in the Covenant. A Covenant secretariat, funded through the Intelligent Energy Europe programme, facilitates monitoring and networking. To date there have been no expressions of interest from Welsh local authorities.

2.2. UK Policy

On a UK stage the current EU Renewables Directive equates to a 15% target for energy from renewables by 2020. Mechanisms for delivery include the Renewables Obligation, requiring all electricity suppliers in England and Wales to source increasing percentages of their supplies from renewable energy sources. No equivalent Renewable Heat Obligation

currently exists but a Renewable Energy Strategy detailing UK government plans for renewable electricity, heat and transport fuels is expected to be published this year. The consultation strategy set out proposals including new incentives for large renewable heat schemes, the expansion of micro-renewables in homes and businesses and improvements to the planning system, including requirements for renewable energy targets in local and Regional plans. The consultation Heat and Energy Saving Strategy sets out government intentions to consult on the full details of a renewable heat incentive later this year.

Heat and Energy Saving Strategy

In early February, 2009, the UK Government released a Heat and Energy Saving Strategy consultation document, announcing plans to refurbish all UK homes by 2030 to cut household carbon emissions (see Figure 1 for indicative pathway). Recognised as an opportunity to make a large contribution to the UK carbon emissions reduction target of 80% by 2050 and simultaneously as an opportunity to provide jobs and ease the burden of high fuel prices, the scheme will involve energy auditing every home. Following this, where necessary, homes will be insulated and loans offered for the uptake of microgeneration technologies. Key proposals include:

- Finance packages to install energy efficiency measures and low-carbon heat and power sources would be offered to householders. **Repayment from part of the savings on energy bills would be linked to the property, rather than residents.**
- Combined with guaranteed cash payments by way of a Renewable Heat Incentive and a Feed-in Tariff for small scale electricity generation, the payback for homeowners who switch to low-carbon technologies and save energy would start from day one.
- Options for improving the delivery of energy efficiency advice and measures, including establishing a central coordinating body funded by energy companies and working to Government-set targets.
- Rolling out low-cost home energy audits, developing a qualification for energy advisers, and establishing an accreditation scheme for installers.

For full details see:
http://www.communities.gov.uk/publications/planningandbuilding/heatenergysavingstrategy.

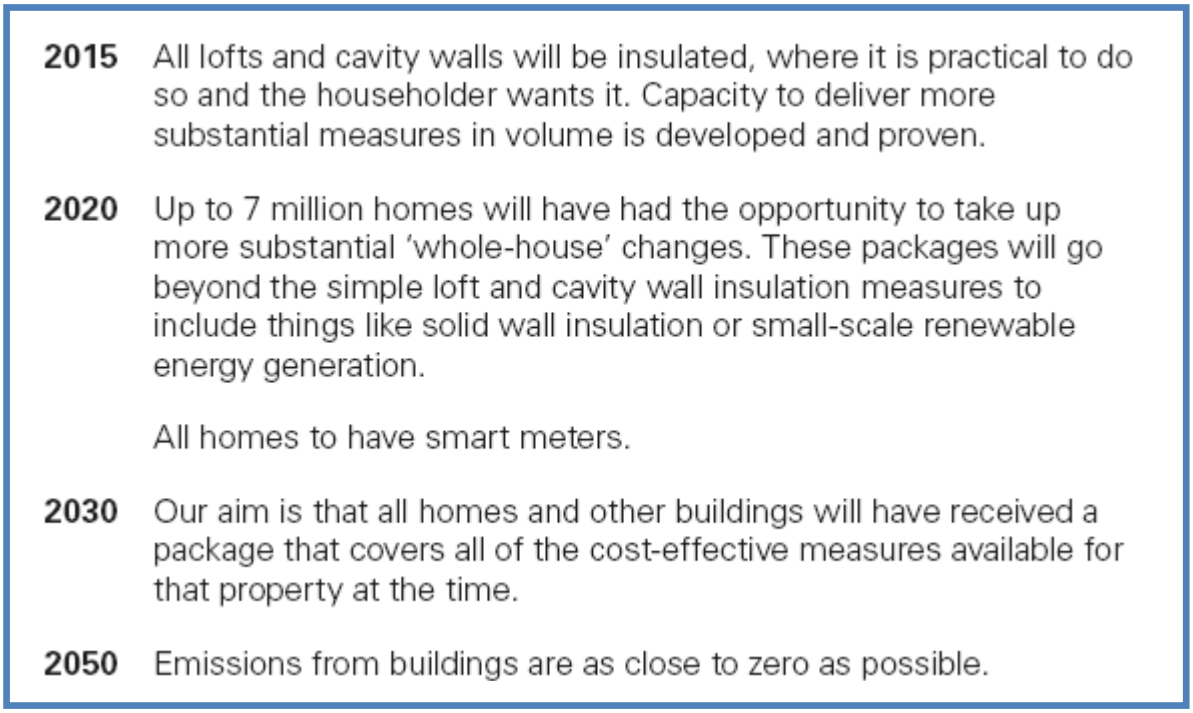

Figure 1. Pathway to 2050 as set out in the UK Heat and Energy Saving consultation document. Source: Department of Energy and Climate Change (2009)[3].
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Community Energy Saving Programme

One delivery mechanism towards achieving the refurbishment targets outlined above will be the Community Energy Saving Programme (CESP), which is expected to operate from 2009-2012. The programme will target households in deprived areas to improve energy efficiency standards through a whole house approach. Delivery will be through a partnership between energy companies and community groups. The current consultation CESP document sets out that this will be funded by a new, additional obligation on energy suppliers and electricity generators. Companies under obligation to contribute towards an overall carbon emissions target will do so by providing carbon reduction measures for domestic energy users.

See http://www.decc.gov.uk/en/content/cms/consultations/open/cesp/cesp.aspx

Carbon Emissions Reduction Target (CERT)

This is the key tool for delivering energy efficiency measures to households to 2012. It requires energy suppliers to deliver overall lifetime carbon dioxide savings through funding household energy efficiency measures, renewable energy and behaviour change. In total £3.9 billion of investment has been secured from suppliers to deliver 154 $MtCO_2$ by 2011 (although this is under revision for potential extension to 2012. See

http://www.energysavingtrust.org.uk/business/Global-Data/Publications/Carbon-Emissions-Reduction-Target-Funding2 for full details of CERT as written by the Energy Saving Trust.

Salix Fund

Finance for energy efficiency improvements to public sector buildings is available from the Salix fund. Salix is an independent, publicly funded company set up to accelerate public sector investment in energy efficiency technologies through invest to save schemes. See http://www.salixfinance.co.uk/home.html

UK Implementation of the Energy Performance of Buildings Directive

In relation to the EU Directive on Energy Performance of Buildings, the Code for Sustainable Homes was introduced as a means of rating the environmental performance of homes in the UK, with six specified levels of performance (with 6 being the highest). The level a house achieves relates to the percentage reduction in carbon emissions from the building by comparison to a building compliant with Building Regulations Part L1.

Also stemming from the EU Directive on Energy Performance of Buildings, Energy Performance Certificates (EPCs) were introduced which rate a building's energy efficiency on a scale from A to G. When buying, selling, renting or building, an EPC is now required by law. Certificates must be displayed in all public buildings with a floor space over 1000m^2.

See the Sustainable Construction Standards Section (4.2.1) for more details on the Code for Sustainable Homes and the Mapping the Regions' Housing Stock Section (5.2.) for more details on EPC's.

Planning

The Planning Act 2008 makes provision for an independent Infrastructure Planning Commission (IPC) to determine nationally significant infrastructure projects in the UK. The new system will cover certain types of energy, transport, water, waste water and waste projects including power stations. In Wales the IPC will have power to consider consents in Wales in non-devolved areas, including the construction or extension of energy generating stations over 50 mega watts onshore or over 100 mega watts offshore.

The Planning and Energy Act, passed in 2008, is an element of UK policy which is of particular relevance to the Regions of Wales. The act details that:

".....a local planning authority in Wales may in their local development plan, include policies imposing reasonable requirements for –

(a) a proportion of energy used in development in their area to be energy from renewable sources in the locality of the development;

(b) a proportion of energy used in development in their area to be low carbon energy from sources in the locality of the development;

(c) development in their area to comply with energy efficiency standards that exceed the energy requirements of building regulations."[4]

The act empowers local authorities to expect high energy efficiency standards or / and the use of renewable energy in new developments, above those required by building regulations, in line with national policies or guidance.

This is somewhat superseded by the final planning for sustainable buildings amendments to planning policy Wales (PPW), see Welsh Policy Section 2.3. However, the act sets a precedent for local planning authorities to feel empowered to require higher standards locally than those expected at a national level. See Section 4.2.2. for suggestions on how higher standard requirements can be translated into local planning policy.

Community Infrastructure Levy

The Community Infrastructure Levy (CIL) proposed by the UK government and now going through Parliament will enable (but not require) local authorities in England and Wales to impose a charge upon most new developments which will be used to invest in the area's infrastructure. The amount charged will be linked to development size and type. Funds raised are intended to be spent on infrastructure needs associated with development as highlighted in the area's development plan such as transport, schools etc. It is proposed that local authorities will be able to pool CIL monies to deliver on infrastructure requirements raised in regional spatial strategies in England / the Wales Spatial Plan in Wales. It is also proposed that public sector bodies could fund infrastructure projects and later be reimbursed by local authority CIL funds. In Wales all authorities that prepare development plans i.e. county councils, county borough councils and the National Park Authorities will be empowered to charge CIL. These authorities will also have the power to decide whether or not to charge developers the CIL. Setting out planning obligations through Section 106 agreements with developers will still be permitted when CIL comes into force. The government is however considering whether the use of section 106 agreements should be restricted when CIL is in place. Details of how CIL will be implemented in Wales are currently under consideration[5]. For full details see:
http://www.communities.gov.uk/publications/planningandbuilding/communityinfrastructurelevy.

Other policies and delivery mechanism of interest are:

- The Low Carbon Buildings Programme provides grants towards the installation of certified micro-renewables by certified installers in a variety of buildings. See

http://www.lowcarbonbuildings.org.uk/home/ for further details. As part of this year's budget a further £45 million was announced for small scale renewable electricity and heat technologies, to be administered primarily through the low carbon buildings programme.

2.3. Welsh Policy

Renewable Energy

The Renewable Energy Route Map for Wales 2008 consultation document[6] details Welsh Assembly Government plans for renewable electricity, heat production and energy efficiency. It also discusses related issues of planning and infrastructure. At a Regional level points of interest include:

- proposed support for community heat and power scheme through a new wood energy business scheme;
- proposals to support community hydro-power schemes through new Convergence funds;
- a proposed bid for funding to support community wind projects;
- issuing planning guidance for the easier installation of micro-generation;
- initiating communications with utilities to secure a higher price for electricity sold to the grid.

Microgeneration Action Plan

The Welsh Assembly Government does not have devolved power over energy installations above 50MW and as such the Welsh Assembly Government and the Regions of Wales can focus on delivering micro renewable and district energy schemes. The Welsh Assembly Government's Microgeneration Action Plan for Wales sets out how the uptake of micro production of renewable heat and / or electricity will be promoted for homes, communities and businesses across Wales. The plan aspires for the Welsh Assembly Government to achieve:

- *"20,000 microgeneration heating units installed by 2012, with of the order of 100,000 by 2020,*
- *10,000 micro-electricity units installed by 2012, with of the order of 200,000 by 2020, and*
- *50 combined heat and power and/or district heating systems in place by 2020."*[8]

The plan identifies opportunities for local authorities in the delivery of microgeneration in Wales including: providing advice and training on microgeneration technologies and policy to planning officers; working with the Welsh Assembly Government, the private sector and

energy suppliers to identify suitable locations for district heating schemes; the introduction of microgeneration technologies to more schools – with opportunities for funding under the Low Carbon Buildings Programme.
http://wales.gov.uk/docrepos/40382/4038231141/40382112413/plane.pdf?lang=en

Bioenergy Action Plan

The consultation draft of the Bioenergy action plan for Wales sets out how the Welsh Assembly Government will support increased bioenergy capacity across Wales, aiming to achieve at least 5 TWh of electricity and 2.5 TWh of usable heat energy from renewable biomass by 2020. The document focuses on support for local biomass heating, CHP systems and energy from biomass waste. It also confirms that a second Wood Energy Business Scheme is under development, with £21 million of EU structural funds hoped to be available to incentivise bioenergy installations up to 3MW across Wales. http://wales.gov.uk/docs/desh/consultation/090224bioenergyconsultationen.pdf

It is expected that the Welsh Assembly Government will release an overarching Wales energy strategy this autumn.

Welsh Assembly Government Standards

For all new buildings promoted or supported by the Welsh Assembly Government or Assembly Sponsored Government Bodies (ASGBs) the Welsh Assembly Government require
* Residential developments to achieve as a minimum Level 3 of the Code for Sustainable Homes;
* Non-residential developments to achieve 'Excellent' under the Building Research Establishment Environmental Assessment Method (BREEAM) or equivalent; and
* A minimum of 10% (by value) of recycled materials to be used in all new buildings.

The Welsh Assembly has also set out an aspiration for all new buildings to be zero carbon in use by 2011, i.e. Code for Sustainable Homes Level 5 for domestic buildings.

The Welsh Assembly Government is also currently seeking the devolution of building regulations to help achieve its aspiration that all new buildings from 2011 onwards are zero carbon.

Planning Policy Wales

Planning Policy Wales (2002) sets out the land use policies for the Welsh Assembly Government which has sustainability at its heart. In 2005 a Ministerial Interim Planning Policy Statement Planning for Renewable Energy made amendments to Planning Policy

Wales and set out some actions for local authorities in Wales on renewable energy in planning including:

a) Facilitating the development of all forms of renewable energy.
b) Undertaking an assessment of the potential of all renewable energy resources, renewable energy technologies, energy efficiency and conservation measures and including appropriate policies in local development plans.
c) Seeking opportunities to integrate energy efficiency into the planning and design of new developments.
Technical Advice Note (TANs) provide technical advice to supplement policies set out in Planning Policy Wales and Ministerial Interim Planning Policy Statements.

Technical Advice Note 8: Planning for Renewable Energy (2005) relates to the land use planning considerations of renewable energy and sets out Welsh Assembly Government renewable energy targets of 4TerraWatt hours (TWhr) of renewable electricity capacity by 2010 and 7 TWhr by 2020.

Once the overarching energy strategy has been published the Assembly Government will revise Technical Advice Note 8 'Renewable Energy, revising upwards the targets for renewable energy supplied by a range of sources.

The One Wales: One Planet Sustainable Development Scheme for Wales builds upon this, with an aim to generate more than 30TWh of renewable electricity annually and 3 TWh of renewable heat by 2025. The overall aim is to produce more electricity from renewables than Wales consumes as a nation within 20 years.

In 2006 the Welsh Assembly released for consultation a draft Ministerial Interim Planning Policy Statement on Climate Change to begin the process of amending Planning Policy Wales to give further emphasis to climate change considerations in planning. There was further consultation on part of this Ministerial Interim Planning Policy Statement in 2008 as it related to the incorporation of renewable energy in new developments.

This consultation resulted in a final Ministerial Interim Planning Policy Statement on Planning for Sustainable Buildings being published in 200948. This introduced new national planning policies on sustainable buildings, which encourages the use of renewable energy as one of the options to reduce the carbon emissions associated with new buildings as part of a sustainable buildings standard (such as The Code for Sustainable Homes). The text from the MIPSS is contained in Box BE1.

The remaining climate change amendments to Planning Policy Wales from the 2006 consultation will be taken forward and incorporated into a consolidated version of Planning Policy Wales later in 2009.

Box BE1. Ministerial Interim Planning Policy Statement 01/2009 Planning for Sustainable Buildings[9], May 2009

2.12.1 Climate responsive developments are those that tackle the causes of climate change and adapt to the current and future effects of climate change through the incorporation of effective mitigation and adaptation measures

2.12.2 Development proposals should **mitigate** the causes of climate change by minimising carbon and other greenhouse gas emissions, associated with their design, construction, use and eventual demolition. The overall aspiration is to secure zero carbon buildings while continuing to promote a range of low and zero carbon (LZC) technologies as a means to achieve this.

2.12.3 Development proposals should also include features that provide effective **adaptation** to and resilience against the current and predicted future effects of climate change, for example by incorporating green space to provide shading, sustainable drainage systems to reduce run-off, and are designed to prevent overheating and to avoid the need for artificial cooling of buildings.

2.12.4 To move towards more sustainable and zero carbon buildings in Wales, the Assembly Government expects that the following standards will be met:

• Applications for 5 or more dwellings received on or after **1 September 2009** to meet Code for Sustainable Homes Level 3 and obtain 6 credits under issue *Ene1 - Dwelling Emission Rate*.

• Applications for 1 or more dwellings received on or after **1 September 2010** to meet Code for Sustainable Homes Level 3 and obtain 6 credits under issue *Ene1 - Dwelling Emission Rate*.

• Applications received on or after **1st September 2009** for non-residential development which will either have a floorspace of 1,000 sqm or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) 'Very Good' standard and achieve the mandatory credits for 'Excellent' under issue *Ene1 - Reduction of CO2 Emissions*.

Local Development Plan

2.12.5 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 local planning authorities should ensure that what is proposed is evidence-based and viable. Such policies should be

progressed through the Local Development Plan process in accordance with relevant requirements of legislation and national policy.

2.12.6 Applications that reflect the key principles of climate responsive developments and meet or exceed the standards set out in para 2.12.4 should be encouraged.

2.12.7 Particular attention should be given to opportunities for minimising carbon emissions associated with the heating, cooling and power systems for new developments. This can include utilising existing or proposed local and low and zero carbon energy supply systems (including district heating systems), encouraging the development of new opportunities to supply proposed and existing development, and maximising opportunities to co-locate potential heat customers and suppliers.

This policy will result in new homes (within the policy threshold) that reduce their carbon emissions by a minimum of 31% above that of current Building Regulations, and non-domestic properties to deliver a carbon index of 40 – both of these are similar to mid-B rating on the Energy Performance Certificates.

The final MIPPS is supplemented by a draft Technical Advice Note 22 'Planning for Sustainable Buildings' for consultation, which gives further advice on how to reduce carbon emissions and consider the feasibility of different low and zero carbon energy sources. Further guidance on the use of the Code for Sustainable Homes and BREEAM standards in land use planning will be available in a Technical Guidance Note to be published this year (TAN 22: Sustainable Buildings).

Technical Advice Note (TAN) 8: Planning for Renewable Energy and TAN 12: Design are currently being revised. A revised Technical Advice Note 12 'Design' was published in June 2009 to give further emphasis on tackling climate change in the design of new developments. Design and Access statements were made mandatory to accompany certain planning applications and listed building consent applications.

Research has been carried out on local authority zero carbon barriers to identify the barriers to, and opportunities arising at the local level to secure low and zero carbon development in Wales. This was published in June 2009. Further research is being carried out to develop a toolkit to enable local planning authorities to carry out an assessment of potential renewable energy resources as set out under national planning policy. When released this tool may be a significant driver at an Area level

The Welsh Assembly Government has been progressing proposals to make certain micro-generation technologies permitted development, thereby removing the need to make a planning application.

The Welsh Assembly Government is also currently seeking the devolution of building regulations to help achieve its aspiration that all new buildings from 2011 onwards are zero carbon.

These are due to be completed in summer 2009.

Energy Efficiency

The National Energy Efficiency and Savings Plan consultation document, March 2009, proposes practical short term actions for reducing energy use and GHG emissions from households, businesses, communities and the public sector in Wales. Proposed actions include revision of support packages for improving household energy efficiency, supporting 22 community distributed energy generation projects, setting up a pilot scheme to help Assembly Government home workers improve the energy efficiency of their work environments and creating a cross public sector invest to save fund.
See http://wales.gov.uk/docs/desh/consultation/090316energysavingplanen.pdf

Some of the key proposals in the strategy are:

- Revision of the of the Home Energy Efficiency Scheme so that Welsh Assembly Government financial support is directed at householders who are in receipt of means tested benefit and live in a property below EPC band E. This support would no longer be limited to loft and cavity insulation and households who have a broken or no heating system. Therefore houses with solid walls or inefficient boilers could be supported. This support would involve a visit form an energy assessor who would identify the most cost effective way to bring the property up to EPC band C.
- Targeting areas which could have a high proportion of householders in fuel poverty, to ensure that those most in need take advantage of CERT and Welsh Assembly Government support.
- Local Authorities to direct those people applying for housing or council tax benefit to energy efficiency programmes.
- Wales Fuel Poverty and Renewable Energy Project. This project will seek to implement a whole house approach to (including microgeneration) to fuel poor communities in Wales. Part of a £26m Welsh Assembly Government funding package will be directed to this.
- Community Scale Renewable Energy Generation Projects. EU Structural Funds Grant Support for community sized wind, biomass and hydroelectric schemes. It is expected this will enable the support for 22 social enterprises and £14m investment. The project will also include a development office service to build capacity and provide local advice.

Current Assembly government measures to drive forward the uptake of energy efficiency and renewable energy measures in Wales include:

- The Home Energy Efficiency Scheme (the Welsh equivalent of England's Warm Front Programme) is a Welsh Assembly fund providing grants for household energy efficiency improvements, for example towards heating system improvements and insulation. The scheme primarily targets families with children under 16 and householders over 60, in receipt of specified benefits. See http://www.heeswales.co.uk/index.htm for further details.
- The Welsh Housing Quality Standard (WHQS) (the Welsh equivalent of England's Decent Homes Standard) addresses the quality of social housing including the provision of adequate heating, good insulation and fuel efficiency. All social housing must meet the WHQS by 2012. For further details see: http://wales.gov.uk/topics/housingandcommunity/housing/social/whqs/?lang=en

See the Welsh Assembly Government's "Sustainable Development and Zero Carbon – General Information, Requirements and Aspirations"[10] for a full account of policies and regulations relating to the built environment at an EU, UK and Wales level.

3. Background

The built environment, in construction and in use, is a significant contributor to UK CO_2 emissions, accounting for approximately 50% of all energy use[11]. Domestic energy use alone contributes 27% to UK CO_2 emissions[12], and is reportedly growing[11].

A key challenge in Wales, as in the rest of the UK, is the reduction of emissions from the existing building stock. It is frequently reported that existing stock will continue to make up approximately 80% of the built environment in 2050. The Stockholm Environmental Institute 2008 report on Wales' Ecological Footprint summarises key challenges in reducing carbon emissions from the existing housing:

- Of the 1.3 million homes in Wales only a small percentage are fully fitted with energy efficiency measures[13], indicating massive potential for energy efficiency refurbishments
- 72% of Welsh homes are privately owned[13], demonstrating the need for mechanisms and incentives to reach ordinary households and move away from a narrow focus on social housing
- 30% of Welsh homes were built pre 1950[13] and are therefore likely to have low energy efficiency
- Much of the Welsh housing stock is deemed hard to treat[13] e.g. with solid walls which cannot be easily insulated. The Centre for Sustainable Energy's targeting energy efficiency in Wales website (http://www.energyefficiencywales.org.uk/) provides useful reference maps and data on the proportion of hard to treat homes in each of the local authorities.

Tackling emissions from the private non-domestic sector presents a less publicised yet significant challenge. This is illustrated by the estimation that there are 171,000 business enterprises active in Wales[14]. The Carbon Trust attributes almost 1/5th of UK carbon emissions to non domestic buildings.

In 2007, 1369.5 Giga Watt hours of electricity were generated from renewable sources in Wales, with the majority from wind and wave power schemes[15]. In 2007 there were an estimated 95 – 98,000 microgeneration units installed in the UK, primarily solar thermal units[16]. Key barriers to uptake are high upfront costs and long payback periods.

Transition to a low carbon built environment will require the construction of new buildings to low carbon specifications and the refurbishment of existing buildings to a high energy efficiency standard. Regional groups and constituent local authorities can help to make available and stimulate key elements essential for delivery including funding, skills and public demand.

Approximately 80% of houses that will be around in 2050 are already built. Whilst it is essential to reduce emissions from new build the focus for the built environment must be on increasing the energy efficiency of the existing stock. These two agendas are mutually supportive as many of the technologies needed to develop low / zero carbon buildings can be applied in the existing housing stock. Also, Government policies to incentivise / mandate increasing levels of energy efficiency in new build provides a clear message to the construction industry that Government wants the UK to move towards an energy efficient housing stock.

Low/ Zero Carbon Hub Wales

The Low/ Zero Carbon Hub Wales was set up to help coordinate progress towards the Assembly Government's zero carbon new build aspiration from 2011 and the delivery of the 3% per annum reduction in carbon emissions from the existing housing stock. The Hub is a private/public/voluntary sector partnership, with a Steering Group, chaired by Chris Jofeh of Arup, directing the activities within the following work streams:

- Existing Homes Alliance Wales
- Skills and training
- Industry engagement
- Supply chain and innovation
- Consumer engagement
- Policy

Integral to this work has been the establishment of the 'Coalition of the Willing', a cross sector network committed to sharing knowledge, removing barriers and collaborating on research and development to take the zero carbon energy efficiency agenda forward within Wales. Over 50 organisations have now signed up to a **Green Building Charter**, signifying their commitment to support progress towards a built environment that contributes low or zero net carbon emissions as quickly as practically possible. This Charter is the first of its kind in the UK and is enabling collaborative action to tackle emissions from the built environment. The companies signing the Charter now have the confidence that they will not be acting alone or against the grain.

The WSP Regional Groups should seek to engage with the Low/ Zero Carbon Hub Wales, with a view to (a) ensuring local and Regional issues / views are taken into account within the work of the Low/ Zero Carbon Hub Wales, and (b) exploring how the outcomes from the work of the Low/ Zero Carbon Hub Wales can be implemented at a Regional level.

4. Opportunities for Reducing Emissions within New Build at a Regional Level

Minimising carbon emissions from the construction and use of a building can best be tackled though good building design. Although acting on reducing the carbon emissions of new builds may be seen as a small contribution to a low carbon built environment, creating zero carbon new builds now will put us on a path towards a future low carbon built environment and act as a stimulus for wider low carbon action.

The suite of Welsh Assembly Government drivers for zero / low carbon new builds discussed in section 2.3. will help to create demand for low carbon building products and skills and give the construction industry confidence to invest in product development and training. This top down support should also provide impetus for the Spatial Plan Regions of Wales to develop and act upon their own low carbon buildings strategy.

Carbon emissions from buildings can be categorised as those which are emitted through the construction process i.e. the buildings embodied CO_2 and those which are emitted during the use of the building. Opportunities for reducing carbon emissions from these two areas will be addressed in turn in the following two sections.

4.1. Low Carbon Construction

A 2008 study by the Empty Homes Agency[17] showed that embodied CO_2 accounts for approximately 28% of CO_2 emitted over the first 50 years of the life of a new build. Key carbon emissions contributions from the construction sector include the use of cement, mined and manufactured materials and chemicals and transport of materials.

The use of natural and local materials provides an opportunity to significantly reduce the embodied energy of development. Completed projects such as the WISE conference and training facility in Machynlleth demonstrate that the use of prefabricated structures (in this case a glue laminated timber frame) and natural materials such as hemp and lime can produce low embodied energy buildings[18]. The use of recycled materials, minimisation of waste through site waste management plans (see Waste Chapter, Section 1.2.) and reducing transport through revised logistics (see Transport Chapter, Section 4.2.) provide further opportunities for reducing the carbon impacts of construction. **BRE's Green Guide to Specification**[19] enables the construction industry to select materials and components according to their environmental impacts, as assessed through life cycle analyses. The BRE's Green guide to Specification is incorporated under the 'materials' credits provided in the sustainable construction standard – the Code for Sustainable Homes and BREEAM. Organisations such as Rounded Developments Enterprises Ltd and Ty Mawr Lime are sources of sustainable building materials and related advice in Wales.

Through seeking to influence the construction related procurement policy of all bodies represented within the WSP Regional Group and through assisting Local Service Boards in influencing public sector construction related procurement, Regions can impact the embodied emissions of new developments. As part of the delivery of their low carbon strategies **WSP Regional Groups could co-ordinate the creation of a standard for materials to be used in new builds**, based upon BRE's Green Guide to Specification. **Organisations represented within the Regional group, particularly local authorities, can adopt these standards and lead by example**. With first-hand experience of the adoption and use of these standards, Regional groups will be well placed to communicate opportunities for standardising the use of low carbon materials in construction to targeted organisations or SME construction firms within the Region.

Case Study BE1. The "Cardiff Standard"

The "Cardiff Standard" was devised by Cardiff Council for all council properties developed through the Cardiff Partnering Scheme. The standard requires that all new properties have a timber frame construction from a renewable source and that sustainable building materials should be used where possible such as recycled newspaper cavity wall insulation. The scheme has delivered around 380 sustainable new homes in Cardiff in addition to training and local labour placements[20].

Requirements through planning guidance could be a flexible means to proliferate low carbon construction materials and methods, – with local Regional groups and authorities able to introduce a single requirement or a suite of requirements, as they see fit. A good example of the adoption of this approach is the "Cardiff Standard" as outlined in case study BE1. Examples of low carbon / low environmental impact materials that could be required through planning guidance or incorporated in to standards for local authority and public buildings include:

- Life cycle analyses have demonstrated that **wood** has the lowest energy consumption in manufacture, transport, construction and maintenance of common building materials. Börjesson and Gustavsson[21] estimated that the primary energy input for building materials in a concrete frame building were 60 to 80% higher than for a timber frame building. Similarly, the Edinburgh Centre for Carbon Management demonstrated that replacing building materials with timber where possible in the construction of a typical two bedroom semi detached house could decrease building material CO_2 emissions from 12.2 to 3.1 tonnes of CO_2[22]. Using sustainable timber in construction will also provide a long life carbon reservoir. **There is potential for the WSP Regional Groups to work with relevant partners such as the Forestry**

Commission Wales and relevant construction organisations, to look at what is needed to proliferate timber frame housing within the Region.

- Eco concretes including recycled waste products from industry can include up to 30% pulverised fly ash (PFA) or up to 50% ground granulated blast furnace slag (GGBS), diverting waste from landfill and reducing energy use in concrete production. By specifying that all developments must use concretes with 30% PFA content or 50% GGBS content local authorities can begin to reduce the embodied carbon in all new builds in a relatively easy transition for the construction sector.

Building Materials Reuse Centres (BMRCs)

Building materials reuse centres (BMRCs) are common in the United States, yet their success is largely unreplicated in the UK. The centres act as a consolidation site for waste construction materials which can be purchased at a discount price for reuse in another project. Builders can be encouraged to use such as facility through provision of credit for any items donated. The "RE store" in Seattle and Bellingham is an example of a well established and well used building materials reuse centre, which claims to reuse up to 50% of the material from a demolished house and recycle a further 48%[23].

Although this example includes the employment of staff for removal services, provision of workshops on materials reuse and creation of advisory publications, establishing a BMRC need not be resource intensive. A disused Local Authority owned warehouse, building or room could provide the basis for the establishment of a Regional BMRC. If located alongside existing waste facilities, local authorities could potentially divert waste from normal collections to the centre, reducing their waste to landfill and reducing energy use for recycling. Proactive communication with the construction sector to raise awareness of the facility would be essential for Regional groups to ensure success. Initially local authorities could seek volunteer time through local voluntary councils to oversee the operation of the centre. The US's largest BMRC in Oregon – "The Rebuilding Centre" was founded by volunteers, which could potentially be replicated Regionally in Wales in conjunction with the Wales Council for Voluntary Action or local volunteering initiatives. In 2008 BioRegional and WasteWISE launched a toolkit to help interested groups replicate an American BRCM. Free resources (available to download from http://www.bioregional-reclaimed.com/get_report.php) include a generic business plan with guidance on developing a site specific plan.

Box BE2. Mechanisms to reduce the embodied energy of new build

I. Develop a standard for materials to be used in new builds, based upon BRE's Green Guide to Specification.

II. Work with local authorities in the region to incorporate the above standard into planning guidance.

III. Encourage organisations represented on the area group to lead by example and incorporate the above guidance into developments for which they have influence.

IV. Work with relevant partners such as the Forestry Commission Wales and relevant construction organisations, to look at what is needed to proliferate timber frame housing within the region.

V. Establishment of building materials reuse centres (BMRCs)

Box BE3. Measuring success for the embodied energy of new build

- Percentage of new homes meeting CSH level 3 or above
- Percentage of non residential developments achieving BREEAM Very Good or higher
- A standard is developed for materials to be used in new builds, based upon BRE's Green Guide to Specification.
- How many local authorities in the region to incorporate the above standard into planning guidance?
- How many organisations in the region incorporate the above guidance into their policy?
- Number of timber frame buildings in the region.
- Establishment of a building materials reuse centre (BMRCs)
- Turnover of the BMRC
- Construction material diverted from landfill
- Emissions saved by using materials with low embodied energy

4.2 Low Carbon in Use (New Build)

A familiar energy hierarchy exists for reducing emissions from the use of buildings, which should be followed in the design and construction process for any new build:

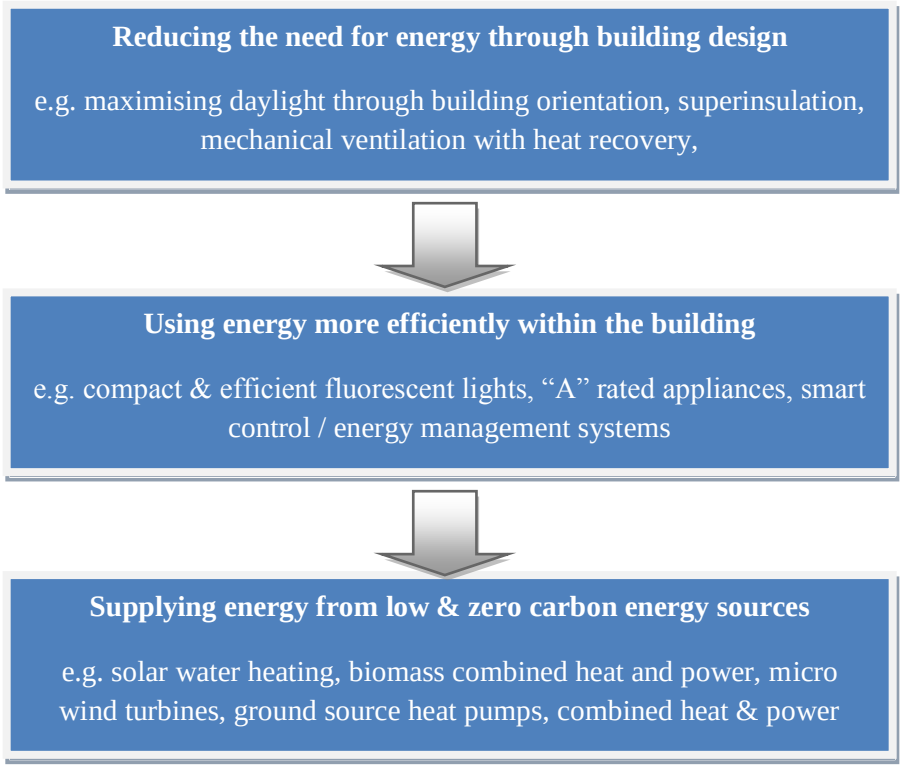

Figure 2. Energy hierarchy for carbon emissions reductions from new buildings and examples.

Much knowledge and literature exists in the UK and worldwide on the building techniques, materials and technologies which can be used in the creation of zero carbon buildings. The NHBC Foundation publication "Zero carbon new homes-an introductory guide for housebuilders"[24] gives a useful introduction to the topic. Publications such as the Carbon Trust's "Building a brighter future"[25] and "Low Carbon Buildings" [18] by the Welsh School of Architecture detail techniques, materials and technologies which can and have been used to deliver the three elements of the energy hierarchy. The Welsh Assembly Government's "Sustainable Buildings in Wales" practical guide gives a summary of common carbon saving measures which can be incorporated into new builds, ordered according to their cost efficiency in reducing emissions:

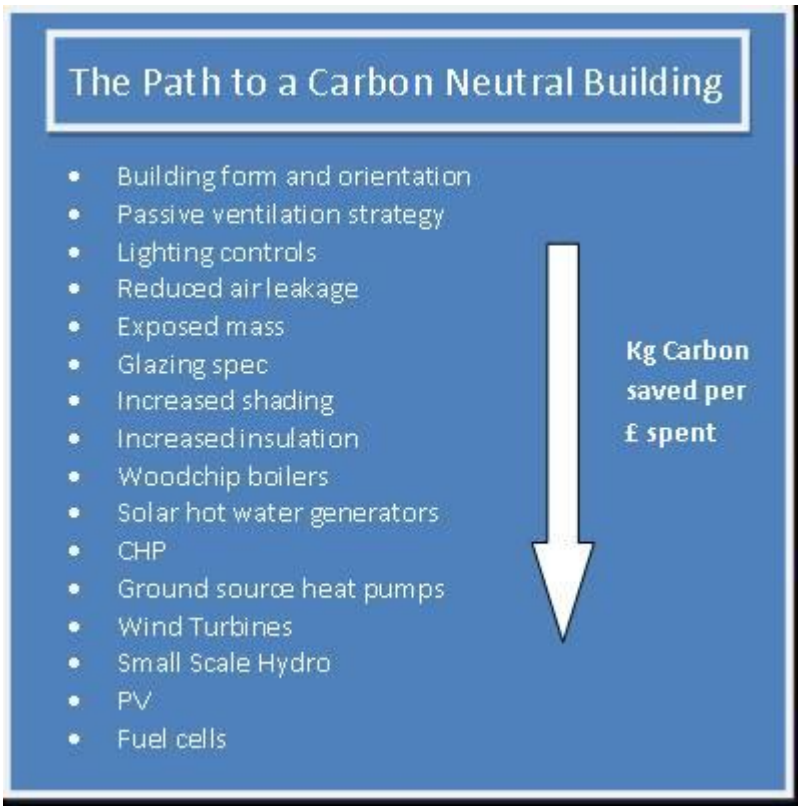

Figure 3. Low carbon construction elements listed by carbon savings per £. Source: Welsh Assembly Government (2008)[26].
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Projects from across the world have demonstrated that every type of building from terraced houses, flats, offices to industrial units and schools can be built to a zero carbon specification. The aforementioned report by the Welsh School of Architecture brings together a portfolio of best practice low carbon buildings in Wales, the UK and Europe and details the main materials and technologies used[18]. The Plas Y Mor care flats and Lindas terraced houses low carbon developments highlighted in the report demonstrate that low carbon homes do not have to exceed the cost of normal homes. The Plas Y Mor flats in Burry Port utilised passive gains, high insulation levels, a shared biomass boiler, PV panels, a heat recovery system and more, at an average cost of approximately £97,400 per flat, with total energy costs for a two bedroom flat approximately £5.75 a week[18].

Box BE4. Sustainable Construction Advice in Wales

- Carbon Trust – Commercial and public sector buildings
- Energy Saving Trust – Domestic, local authorities, housing associations and transport
- Constructing Excellence Wales
- Design Commission for Wales
- BRE Wales

4.2.1. Sustainable Construction Standards

The following standards are a useful tool at the disposal of the Spatial Plan Regions for the promotion and implementation of low carbon solutions in new builds.

BREEAM

The Building Research Establishment Environmental Assessment Method (BREEAM) is an environmental assessment for new and existing buildings applicable to a range of building types including homes, schools, offices and retail. Ratings range from pass to excellent. The Welsh Assembly Government has adopted this assessment method for its own estate and introduced it as part of the new national planning policy (see Section 2.3).

Passive House

The German Passive House (Passiv Haus) standard is a leading world standard for energy efficient buildings. Passive Houses generally save 90% of the energy that an existing house would use through good insulation and minimisation of thermal bridges, careful use of passive solar gains, air tightness, a whole house mechanical ventilation system with heat recovery and energy efficient glazing and appliances[27]. The standard is now dispersing across Europe.

Code for Sustainable Homes

The Code for Sustainable Homes was introduced as a means of rating the environmental performance of new homes in the UK, with six specified levels of performance (6 being the highest). The Welsh Assembly Government has adopted this assessment method for residential buildings and incorporated it in the new national planning policy (see 2.3). The level a house achieves relates targets set out for the following nine categories of sustainable design:

- Energy & CO_2 emissions
- Water
- Materials
- Surface water run-off
- Waste
- Pollution
- Health & well-being
- Management
- Ecology

The percentage reduction in carbon emissions from the building by comparison to a building compliant with Building Regulations Part L1 is highlighted in figure 4 below. A code level 6 home has zero net CO_2 emissions. The Code also lays out minimum water efficiency levels.

Code Level	Minimum percentage reduction in dwelling emission rate over target emission rate
Level 1 (★)	10
Level 2 (★★)	18
Level 3 (★★★)	25
Level 4 (★★★★)	44
Level 5 (★★★★★)	100
Level 6 (★★★★★★)	'Zero Carbon Home'

Figure 4 Code Levels for Mandatory Minimum Standards in CO_2 Emissions. Source: Communities and Local Government (2009)[28].
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4.2.2. Using Planning Requirements

Planning to deliver sustainable developments should be a key consideration in Local Development Plans (LDP). Land allocated for development should be selected to bring existing housing / building densities up to a level which will make combined heat and power systems and/or district heating schemes viable (as emphasised in Planning Policy Wales). This approach should be targeted at areas with potential heat sources such as industrial units, where developing a dense business park adjacent would make use of the waste heat and minimise transmission losses and installation costs.

A number of local councils throughout the UK are utilising their powers in the planning process to call for energy efficiency standards to be compulsory in new builds – i.e. as part of the development plan, through supplementary planning documents or through Section 106 Agreements.

In Wales the new climate change driven amendments to Planning Policy Wales (PPW) as outlined in section 2.3, provide local authorities in Wales with a guidance national control policy on expectations for most new buildings proposed to what they are expected to require to help Wales move towards sustainable and zero carbon buildings. However, there is still scope for Welsh local authorities to require higher sustainable construction standards than will be required by Planning Policy Wales – the national planning policy advises that strategic sites should be considered for opportunities to deliver higher sustainable construction standards than the national minimum expected. The planning processes of Milton Keynes Council, Daventry District Council and Northamptonshire Council offer potentially replicable case studies.

Case Study BE2. Milton Keynes Council[29]

In 2005 Milton Keynes Council adopted a new local plan incorporating a sustainable planning policy conceived by a senior planning officer. As detailed by the Energy Saving Trust, the planning policy required all new developments of over 5 homes or with a floor space over 1000m^2 to include:

- *"Energy efficiency by siting, design, layout and buildings' orientation to maximise sunlight and daylight, avoidance of overshadowing and passive ventilation systems.*
- *Grouped building forms in order to minimise external wall surface extent and exposure.*
- *Landscaping or planting design that optimises screening and improves individual buildings' thermal performance.*
- *Renewable energy technologies.*
- *Sustainable urban drainage systems including rainwater and waste water collection and recycling.*
- *Significant use of building materials that are sustainable or recycled.*
- *Waste reduction and recycling measures.*
- *Carbon neutrality or financial contributions to a carbon offset fund to enable carbon emissions to be offset elsewhere."* [29]

In order to ensure the planning requirements were deliverable, an element of flexibility was built into the policy – allowing developers who put a strong emphasis on delivering one element of the requirements to deliver less on others.

Flexibility was also inbuilt through **allowing developers to contribute to a carbon neutral fund** through a Section 106 agreement where carbon neutrality cannot feasibly be delivered due to financial or site constraints. The fund is targeted at reducing emissions from existing homes, with current focus on the provision of insulation, thus providing **simultaneous emissions reductions from existing housing stock**. Payments to this carbon offsetting fund are calculated based upon the net increase in carbon emissions from the development in a year, with average payments between £300 and £500 per house, payable when building work is completed.

Management of the fund is undertaken by the United Sustainable Energy Agency – an independent company providing sustainable energy services at an individual, business and organisational level.

Key indicators of success include that 94% of planning applications received in 2006 were compliant with the requirements, by 2007 £800,000 of offset funds had been received (with an estimated CO_2 saving of 4000 tonnes) and the policy lead to the construction of the UK's first BREEAM Excellent school.

One of the key objections to the Milton Keynes policy at the time was a feeling that it exceeded local authority planning powers. However, the passing of the Planning and Energy Act (see Section 2.2.) in 2008 gives local authorities permission and encouragement to replicate or request similar efficiency and microgeneration measures in all new developments through Local Development Plans. Other LA's requirements which could be considered by the Welsh authorities as part of their LDPs or supplementary planning documents include:

- Daventry District Council and South Northamptonshire Council's requirements for residential developments of over 10 units to achieve Code for Sustainable Homes Level 3, for residential developments of under 10 units to achieve Code Level 2 and for all non-residential developments over 1000m^2 to incorporate micro-renewables to provide 10% of predicted energy requirements. These requirements were issued as a joint supplementary planning document (SPD) in the Councils after consultation with the Energy Saving Trust. Code levels 2 and 3 were deemed to be easily achievable, without requiring microgeneration. As part of the consultation process the SPD was circulated amongst developers and communities, no responses from developers were received. The Council's development control team oversee the implementation of requirements and energy conservation officers are tasked with directing developers to relevant grant funding. The requirements are enforced through calling for developers to submit an energy statement as part of the planning application, setting out how they will meet the requirements. Developers who cannot meet the requirements are asked to pay for and undertake carbon offsetting measures in existing housing, but must first explain why within the energy statement. Upon completion developers must produce proof of having met the requirements e.g. a Code for Sustainable Homes certificate[30]. **Whilst two of these requirements are now incorporated into PPW, this case study provides a template for setting higher standards.**

- Developed in conjunction with the Energy Saving Trust, it is proposed that new buildings in **Ebbw Vale** will incur **a charge of £1,200 per roof**. In combination with match funding from the EU and the Council, these charges will be used to fund energy efficiency measures in existing Ebbw Vale homes. Linking new developments to delivery of energy efficiency improvements in existing stock in this way holds significant potential for decarbonising the built environment. Other similar options include requiring a % of building costs to be used to improve energy efficiency in existing buildings or a % of building costs to be dedicated to the establishment of a Regional energy partnership or Energy Service Company.

- Southampton City Council requires proposed city centre developments to demonstrate how they have considered linking to district heating and cooling schemes within their planning applications.

In light of potential limitations on the use of S106 agreements when the Community Infrastructure Levy comes into force, local authorities could look to issue these planning requirements within their Local Development Framework supported by supplementary planning documents. The CIL should also be utilised by local authorities to deliver renewable energy infrastructure in line with the energy requirements of new developments.

The website http://www.planningrenewables.org.uk/, launched by the UK Government's Department of Energy and Climate Change, provides information for local authority planners on renewable energy installations. Available resources include information on technologies, policies, case studies and environmental, social and economic considerations.
In addition to incorporating the Code for Sustainable Homes and BREEAM standards into planning policy, local authorities may also / alternatively wish to commit to delivering any new builds on local authorities land or with local authorities funding to a high energy efficiency standard. For example Bath and North East Somerset Council has adopted the BREEAM assessment method for schools and care homes to be built in the area. Local Authorities can also require the Code and or BREEAM standards as a condition of sale when disposing of land (as English Partnerships have done with their quality standards – see http://www.urbandesigncompendium.co.uk/englishpartnershipshousingcorporationdesignqualitystandards).

The previously mentioned Passive House standard is now being adopted for schools in Austria. Building to this standard is rare at present in the UK, with excellent craftsmanship and specific components evolved for Passive House builds required to construct a Passive House building. Building new schools to this standard or equivalent could be piloted in each Regional for the next school build planned, with a view to setting long term targets for all public use new builds to meet these high standards.

To maximise awareness of and engagement with energy efficiency and microgeneration technologies amongst the public any new low or zero carbon build undertaken by local authorities should be used as a tool for communication. **Using exemplar builds to hold public open days** gives an opportunity for communities to experience the technologies and materials and meet suppliers / installers / advisers. This "open house" approach has been utilised successfully elsewhere – see Case Study BE4 of Woking Council's use of an open house as part of a refurbishment drive.

Box BE5. Mechanisms to increase the energy efficiency of new build

I. Local Development Plans to identify how to bring existing housing / building densities up to a level which will make combined heat and power systems and/or district heating schemes viable.

II. Local Authorities to require sustainable construction standards on strategic sites that go beyond the national minimum in line with that go beyond that outlined in Planning Policy Wales.

III. When implementing the above Local Authorities could allow developers to contribute to a carbon neutral fund through a Section 106 agreement where carbon neutrality cannot feasibly be delivered due to financial or site constraints.

IV. Use exemplar sustainable buildings in the region to raise awareness of energy

Box BE6. Measuring success for the energy efficiency of new build

- Percentage of new homes meeting CSH level 3 or above
- Percentage of non residential developments achieving BREEAM Very Good or higher
- Local development plans include land allocated to increase housing densities to make CHP or DH schemes viable
- Local authority sustainable construction requirements are set above those required through Planning Policy Wales
- A carbon neutral fund is established for developments which cannot meet the above
- Number of visitors to sustainable building “open days”

5. Opportunities for Reducing Emissions within the Existing Building Stock at a Regional Level

The existing building stock contributes over 50% to total UK CO2 emissions and will largely still be present in 2050. The Government is starting to realise the scale of refurbishment needed to meet the UK Climate Change Bill's 80% CO_2 reduction target for the same date. Models have shown that a 60-80% reduction in emissions from the existing housing stock is possible, but will require a significant activity in renovating housing to high energy efficiency standards along with the incorporation of low-zero carbon energy generation technologies [31]. The scale of the task is highlighted in figure 5 below.

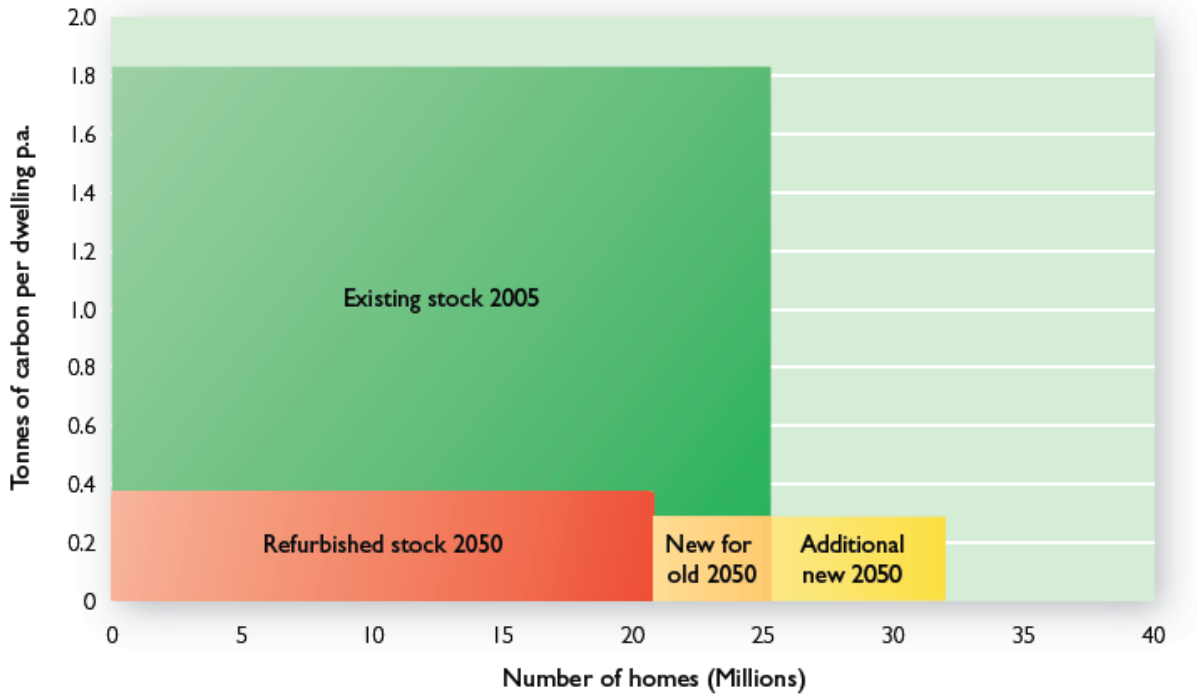

Figure 5. CO_2 emissions from refurbished and new-build housing in a scenario achieving 75% CO_2 reductions by 2050. Source: Killip (2008)[31] reproduced from the original with full text description in Palmer *et al*. (2006)[32].

Box BE7. Government Policy

The Heat and Energy Savings Strategy Consultation (February 2009) set the ambition for all buildings to emit almost zero carbon emission by 2050. There are as yet however few levers and policies in place to improve the energy efficiency of existing buildings. The Consultation stated that they will aim to provide cavity wall and loft insulation for all suitable properties by 2015. Whole house energy makeovers for 400,000 households a year by 2015, with

seven million homes benefiting by 2020, and be on the way to all homes having access to whole house improvements by 2030.

Given the number and dispersed nature of existing buildings in Wales, Regional groups are well placed to tackle the problem on the ground and enable their Region to be prepared for national implementation of the Government Policy highlighted in Section 2.3. Improving the energy efficiency of our existing buildings will also help to tackle fuel poverty and energy security through reduced energy requirements.

In the current economic climate construction has dramatically slowed, providing an opportunity for real focus on the refurbishment of existing buildings. Sustainable building and refurbishment provides an opportunity to improve comfort within and reduce the energy related running costs of our buildings, whilst jointly tackling fuel poverty and providing job opportunities for skilled construction workers.

Emissions reductions from the use of existing stock can be delivered through:

- refurbishment to incorporate energy efficient materials and appliances and microgeneration technologies
- behavioural change to reduce energy use

A suite of cost effective energy efficiency measures are readily available – insulation for lofts, walls, floors, pipes and water tanks; secondary and double glazing; draught proofing; more efficient heating systems and better use of controls; energy efficient lighting and appliances. Despite the long term energy savings possible through adoption of these measures uptake is limited due to the initial capital investment needed and the inconvenience associated with installation. A 2006 behavioural survey on household energy efficiency demonstrated that respondents deemed upfront costs to be a more important consideration than benefits in the decision to invest in domestic insulation[33]. Additional barriers to investment include occupier's uncertainty as to how long they will be at a property, landlords' reluctance to invest when tenants will benefit from the energy savings and an a lack of awareness of potential long term savings.

According to the Foresight report, "Powering Our Lives"[33] most thermal efficiency measures have a relatively quick payback period. Table 1 shows estimated costs, payback times and annual CO_2 savings for a range of energy efficiency measures:

Table 1. Estimated costs and savings of energy efficiency measures for installation in existing homes. Source: Sustainable Development Commission (2008)[34].

	Annual Saving	Installed Cost	Payback (years)	Annual CO_2 saving (tonnes)
Cavity Wall Insulation	£90	£500	5	0.75
Internal Wall Insulation	£300	From £40/m^2		2.4
External wall insulation	£300	From £1,900	From 6	2.5
Double Glazing	£90			0.74
Loft insulation top up	£30	£500	16	0.25
Floor insulation	£45	£90	2	0.37
Draught Proofing	£20	£200	10	0.15
Condensing Boiler	£110			0.88
Heating Controls	£65	£200	3	0.53

Refurbishment can go beyond the installation of energy efficiency measures to include microgeneration to further lower the carbon emissions of our buildings. See the microgeneration Section (6.1.) for further information on microgeneration technologies. Microgeneration technologies typically have higher capital costs and longer payback periods than energy efficiency measures, with less than 1% of the UK population having installed them. For comparison to the data in Table 1, for example, a ground source heat pump typically costs £6,000 to £12,000, would save an estimated £410 a year compared to gas heating, with an implied payback of 14.6 to 29.2 years, and a saving of 1.2 tonnes of CO_2 a year[35]. Typically holistic refurbishments will focus upon reducing energy demand via energy efficiency measures before the installation of microgeneration technologies. This ensures that the renewable energy is used efficiently and its overall contribution to energy used is maximised.

Increasing the uptake of energy efficiency and microgeneration solutions is a challenging task, calling for incentives, awareness raising, education, advice and support to be delivered at a national and Regional level.

5.1 Regional Opportunities

As highlighted earlier, UK and Welsh Assembly Government policies currently out for consultation could potentially provide significant drivers for the refurbishment of the existing housing stock to high energy efficiency standards.

Phase 1 - Preparation

The SDC believes that the WSP Regional groups can play a vital role ensuring that the relevant organisations in the Regions have the relevant information to take advantage of funding stemming from the implementation of new policies and also look at other mechanisms to implement large scale housing refurbishment. From discussions at the Regional workshops, it is considered that the WSP Regional groups should facilitate the following four areas of work:

i. **Mapping the Region's housing stock**, including: thermal mapping, identification of housing types, an Energy Performance Certificate database and identification of fuel poor. Although these activities do not specifically reduce emissions, they provide the information needed to successfully target the resources and technology to areas where they will have the biggest impact. These measures are effectively the preparatory phase needed before a widespread energy efficiency programme is implemented. Some of these mapping exercises are already occurring, either at a national level, or within some local authorities. It is therefore recommended that the **WSP Regional groups collate this evidence** and use it to, identify gaps, guide and co-ordinate projects, and to promote and disseminate relevant information. The detail of the mapping measures are discussed in more detail in Section 5.2. below.
ii. **Engagement with the local construction sector**. This exercise should help raise awareness of the current and potential future market opportunities. This will allow the businesses in this sector to identify and plan their future skills and training needs.
iii. **Engagement with the Existing Homes Alliance Wales (EHAW).** See Box BE8 for more information. It is important that the findings and work from this national initiative are effectively communicated to the WSP Regions, with a view to (a) ensuring local and Regional issues / views are taken into account within the work of the EHAW, and (b) exploring how the outcomes from the EHAW's work can be implemented at a Regional level.
iv. **Communication to Householders**. As mentioned previously, there are a number of barriers such as initial capital investment and the inconvenience associated with installation, which are currently impeding the progress of refurbishing the existing housing stock to high energy efficiency standards. The WSP Regional group's strategic perspective, coupled with local knowledge, could help guide and facilitate initiatives to

address these barriers at a local and Regional level. Some of these initiatives such as open houses and energy saving campaigns are discussed in Section 5.4.

Phase 2 - Implementation

Subsequent to the preparatory phase highlighted above the SDC believes that a zoned approach (see section 5.5 for more information) is the most effective mechanism to implement a large scale refurbishment of the existing housing stock. The WSP are groups are ideally placed to:

i. Maintain a strategic overview of the data gained from phase 1, to identify where the priority areas for refurbishment should be.
ii. Facilitate cross boundary, cross portfolio working.
iii. Identify financing mechanisms, whether it is EU, UK, Welsh Assembly Government, or private sector funding.

Box BE8. Existing Homes Alliance Wales (EHAW)

Chaired and led by the Energy Saving Trust Wales and a key element of the low/zero carbon hub (see Section 3.), the Alliance is seeking to establish how collaborative working amongst key stakeholders in the construction industry, could achieve a 3% pa reduction in greenhouse gases from the existing housing stock in Wales by 2011. The core workstreams for the Alliance over the next year will be: training and skills, EU funding and creating links between social housing projects and private sector housing.

5.2 Mapping the Region's Housing Stock

It should be noted that the UK Government, Department of Energy and Climate Change, is currently developing pilots of a new **National Energy Efficiency Data Framework** to link information from existing databases for the entire building stock. The framework will bring together data from energy suppliers, buildings, installers and other sources. This should provide a comprehensive source of information on building energy use and performance[36] and will include information like EPCs, energy consumption and household characteristics [37].

The WSP Regional Groups should work with the UK Government and the Welsh Assembly Government, to ensure that data collated through mapping of the Region's Housing Stock is complementary, and does not duplicate, the work to establish the National Energy Efficiency Data Framework. The WSP Regional groups are in a unique position to identify where there are gaps in the data needed to effectively identify priority areas for refurbishment.

Thermal mapping

Thermal mapping is used to analyse heat loss from buildings and enables resource to be targeted at buildings most in need of refurbishment. As a preparatory measure and to ensure the efficient use of resources, Local Authorities that have not already done so could be encouraged by WSP Regional groups to undertake thermal mapping of buildings within the authority boundary. Focus could be placed on homes within deprived neighbourhoods, public buildings or local authority schools if funds are limited.

Case Study BE3. Heat Seekers[38]

Heat Seekers is an Energy Saving Partnership working in conjunction with Local Authorities to deliver mass thermal imaging of properties. Vehicles with onboard thermal imaging equipment deployed by Heat Seekers can detect the insulation condition of over 1,000 properties an hour through surveying whilst the vehicles are travelling. This process produces a thermal image of each home requiring insulation, which is then followed up door to door by insulation advisors. Working in partnership with a team of surveyors such as this can allow for a rapid, blanket assessment of the insulation condition of all homes within the Local Authority[38].

Energy Audits

Energy audits determine energy flows and consumption within a specific building and are a tool for identifying potential energy efficiency improvements. Commonly used for domestic, industrial and agricultural buildings, Regional groups could seek to raise awareness of potential energy savings possible through the implementation of measures identified through energy audits e.g. through working with Local Service Boards to consider how this can be delivered across the public sector. As a minimum Regions could seek to ensure energy audits within all local authority buildings are carried out with a view to putting in place a long term strategy for refurbishment delivery.

Identification of Housing Types

There are a large number of energy efficiency products and technologies, which are suited to different types of housing. For example a Victorian solid walled house would need external or internal solid wall insulation instead of cavity wall insulation. Mapping the types of houses within the Region will enable the WSP Regional groups to guide the implementation of energy efficiency refurbishments, so that similar housing types are tackled at the same time. This would allow for the bulk buying of the suitable products and technologies, along with building the expertise of the contractors according to housing type.

Identification of Fuel Poor

As highlighted in section 2.3 many of the proposed initiatives set out in the National Energy Efficiency and Savings Plan are targeted at the fuel poor. **The WSP Regional groups could**

therefore collate the fuel poor data for the Region in order to ascertain where these initiatives should be targeted with their Regions.

Box BE9. Energy Performance Certificates (EPCs)

An Energy performance Certificates is required when a building is constructed, rented or sold. Energy performance Certificates (EPCs) use a methodology called the Standard Assessment Procedure to (SAP) 2005, to provide an estimate of the energy efficiency of a building. Existing properties use a simpler reduced data SAP assessment, rdSAP, which only takes into account the features of the building that are most likely to influence energy use. The SAP and rdSAP ratings use a scale of 1-100, with 100 being the most energy efficient, with a resulting A-G rating given as illustrated in figure 6 below:

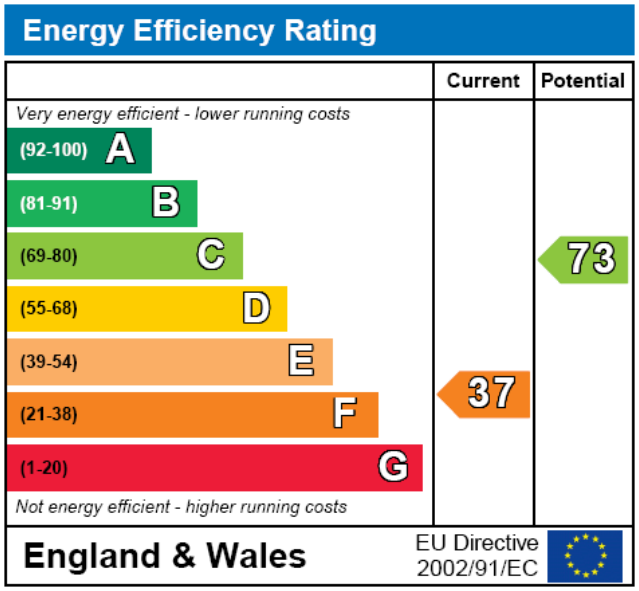

Figure 6. Energy Efficiency Ratings. Source: Communities and Local Government (undated)[39].

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The EPC also gives an indication of the potential running cost of the building, along with suggested cost effective improvements to increase the energy efficiency of the building.

5.3 Engagement with the Local Construction Sector

Refurbishment during Routine Maintenance and Repair

The Environmental Change Institute's report "Transforming the UK's Existing Housing Stock"[31] draws attention to the opportunity to incorporate energy efficiency measures into buildings at the time of building improvements and routine maintenance and repairs. The

report gives examples of incorporating energy efficient appliances into kitchens at the time of refurbishment, solar panels at the time of roof maintenance or replacement, or under floor insulation at the time of rewiring or replumbing.

To enable low carbon considerations to become a routine element of any form of refurbishment, construction firms working in repairs, maintenance and improvement must have the knowledge and skills to recognise opportunities to incorporate low carbon measures and communicate these to the client. However, it will also be important for the owner of the property to know that they can trust the advice being provided to them. The UK Government is therefore considering whether an accreditation scheme to certify trades-people to offer advice on 'whole house' energy efficiency improvements would be beneficial.

Regional groups can work with help to build this skills and knowledge base within their Region's construction firms through direct support for training schemes, through making the industry aware of existing advice and support for sustainable construction and through utilising procurement policies to create demand for such skills.

Box BE10. Sustainable Construction / Refurbishment Training in Wales

- Rounded Developments Enterprises Ltd - offer numerous sustainable building related educational opportunities including sustainable building courses for building professionals with e.g. materials and renewable energy workshops and a tour of an eco-building.
- Centre for Alternative Technology – run accredited training courses e.g. PV installation courses and offer eco building advice.
- Ty Mawr Lime – offer training courses in techniques such as lime plastering, earth construction and ecological building.
- Green Dragon Energy – conduct renewable energy courses.
- Low Impact Living Initiative – hold training courses on topics including building with timber, clay and lime render.

In order to help build a sustainable construction skills base locally, Regional groups must strive to utilise these existing training resources within Wales through communicating their existence to the construction sector. Regions could also seek to source funding for the promotion of sustainable building skills e.g. to enable local training facilities to offer

subsidised courses for local builders. Support for community level / third sector groups and organisations such as those participating in the low carbon communities network (see Section 6.6.) could serve to deliver training courses for the construction sector, as per the Bollington community example given.

In addition to developing a local sustainable building skills base, Regional groups can also influence the demand for such skills through local authority public procurement / refurbishment of social housing and public buildings through encouraging local authorities to set refurbishment / efficiency standards for all buildings which they have responsibility for. Targeting schools as a priority would provide a highly visible example of a low carbon building within a community in addition to incorporating carbon awareness into education. The Existing Homes Alliance Wales and the Zero Carbon Hub Wales are currently looking at the skills and training needs to renovate the existing housing stock to high energy efficiency standards. It is important the Regional groups keep up to date with this study and identify how education providers and the construction industry can deliver the skills.

5.4 Communication to Householders

Properties refurbished to a low or zero carbon standard provide an ideal educational and awareness raising tool to advocate the uptake of energy efficiency measures and microgeneration technologies. Utilising the "open house" approach members of the public have the opportunity to see these technologies in use. The benefits of this approach can be enhanced by having suppliers and contractors working in refurbishment and microgeneration installation present at the open days to put communities in touch with potential supply chains for refurbishment of their own homes.

Case Study BE4. Woking Borough Council

Woking Borough Council has recognised the opportunity for utilising refurbished properties for the wider communication of energy efficiency. The Council has an energy efficient demonstration house open to the public and a programme to work with 1,000 households to help them reduce their carbon emissions, hoping that participants will act as "community champions" and disseminate energy efficiency advice amongst friends and neighbours.

The Welsh Assembly Government publication 'Improving Your Home – A Climate Change Guide' details 10 common projects that a householder may carry out to improve their homes. Alongside these projects are a number of measures that can be undertaken to respond to climate change in the most effective way.

Regional Groups can seek to work with the Energy Saving Trust/ networks such as Old Home SuperHome and/ or local Housing Associations to run energy efficiency open days, showcasing any low or zero carbon refurbished houses. Local Authorities can utilise any low carbon refurbishments within public buildings as an opportunity for low carbon education.

Case Study BE5. Old Home Super Home[40]

Old Home Super Home is a programme run by the Sustainable Energy Academy working with private homeowners to improve the energy efficiency of the existing housing stock. The programme aims to establish a network of energy efficient older homes which are accessible to the public and to Local Authorities, through open home days, to allow them to gain firsthand experience and knowledge of refurbishing for energy efficiency. There is currently one Super Home in Wales, in Llandiloes, with a number accessible just over the border into England.

Energy Efficiency Education

The behaviour of the occupants of any building will be crucial in determining overall energy use. Education on energy efficiency and behavioural change is crucial alongside any energy efficient construction, refurbishment and renewable energy projects. Potential opportunities to raise awareness of energy use and uptake of potential efficiency measures within an area include:

a) **Energy efficiency campaigns** working in conjunction with local authorities and third sector organisations to target chosen audiences such as householder or offices. It has been demonstrated that campaigns for behavioural change alone are not enough unless the measures to adopt are convenient and low cost[33]. Focusing campaigns on simple cost free options such as putting fridges on a timer to switch off for an hour at night or turning down thermostats may, therefore, prove to be most effective. Communicating the potential cost savings associated with energy efficiency measure may also increase uptake. See case studies BE6, BE7 and BE8 for examples.

b) Increasing **smart meter installation** in homes and businesses to increase awareness of energy consumption. Trials have indicated the success of smart metering with 5% carbon emissions savings seen on average in SMEs using advanced metering.
Smart meter role out is on the agenda of the UK Government and numerous pilots are already underway. The government intends to use CERT to provide incentives for energy suppliers to provide real time displays to consumers, with a view to completing a domestic role out by 2020. A Welsh Assembly Government / Carbon Trust smart meter pilot project on gas and electricity meters at Bridgend Industrial Estate saw companies

save up to 30% on heating costs. Regional groups can seek opportunities to partner with energy companies or third sector energy advisory organisations and e.g. large business parks to increase Regional uptake of the technology. See case study BE9.

Case study BE6. Polish Mobile Energy Bus[41]

In Poland, a mobile energy bus equipped with printed materials on energy saving measures and renewable technologies was created and deployed to take energy training into Polish communities. Whilst the initiative required significant funding it demonstrated the efficacy of mobile information compared to static training centres. Within the regions of Wales taking advantage of mobile libraries as a vehicle for taking energy related literature into communities should be considered and further opportunities sought. This mobile educational approach has been successfully replicated in the UK, for example West Sussex local authorities operate a mobile advice and demonstration unit providing demonstrations of renewable energy, free energy efficient light bulbs etc to visited communities.

Case study BE7. The European Energy Trophy[42]

The European Energy Trophy is an energy saving competition for companies and public bodies. It was launched in 2004 to promote the uptake of cost-free energy saving measures in offices. Through the provision of advice on measures that could be implemented and subsequently checking the readings on office's energy meters on competition start and end dates participants' energy saving percentages were calculated and compared. Private companies were approached as potential competition sponsors to provide financial support and prizes. The highest percentage saved was over 30% and most participants planned to extend the measures to their other offices. Due to the success of the 2004 trophy a second was held in 2007/8 which was open to companies in 18 countries, including the UK. This is a multinational competition which was resource intensive due to extensive publicity, literature printing, database creation for information gathering etc. The competition approach to motivating companies to reduce energy demand has been shown to be highly effective and could easily be implemented on a regional or local authority scale for local companies or schools. Existing literature such as The Green Office's "56 simple ways of going green at work" (http://www.thegreenoffice.co.uk/page.asp?id=articles) and Energy Saving Trust advice could be drawn upon to suggest measures to participants. The ARENA network business and sustainability awards which cover resource efficiency in businesses could be more widely promoted within the regions or/and could be replicated at a regional level for regional impact.

Case study BE8. Spanish Domestic Energy Use Campaign[43]

A regional Spanish campaign to promote domestic energy saving involved the creation and dissemination of a leaflet of easily implementable measures to 22,000 homes, delivered to the door in conjunction with the region's leading newspaper. The scheme demonstrated that the cost of energy saving campaigns can be minimised through joint working of local authorities and private sector organisations. As previously recognised regional area groups could play a significant intermediary role between local authorities, the private and third sectors.

Case Study BE9. Smart Meter Library Loans

Libraries in York and Lewisham now loan smart meters to members alongside books. The meters allow lenders to view real time energy use in their homes. York Council libraries offer two types of meter – one which shows whole house electricity consumption allowing users to appreciate the energy consumption of all of their actions, and one which monitors the electricity use of a specific appliance, allowing users to appreciate the energy impact of the use of each appliance.

Similarly, in some South Australian libraries, home energy self audit kits are loaned. These kits include a home energy audit worksheet, a manual, infrared thermometer, stop watch, a compass and a power meter. The Government's Energy Office assembled the kits and sold them at a subsidised rate to council libraries to loan to the public.

Working in conjunction with libraries, community groups or third sector organisations Area groups can explore opportunities to loan smart meters and energy auditing tools to the public.

5.5. Refurbishment of Building Envelope and Zoned Approach

Moving away from a fragmented approach to refurbishment, the SDC along with other organisations such as the Energy Saving Trust, the Climate Change Commission for Wales and the UK Green Building Council advocate a scaled up approach to refurbishment. This involves two complementary mechanisms of refurbishment; i) a whole building envelope approach and ii) a zoned approach. Details of these two mechanisms are given below.

Utilising a **whole building envelope approach** to refurbishment – incorporating all practical energy efficiency measures during one project is a favoured approach. Arguments for this approach include maximising energy and carbon savings and minimising disturbance. This

idea is expanded further, with **whole street, neighbourhood or zone wide refurbishments** recognised as an opportunity for rapid, large scale delivery, which capitalise on savings and advice sharing through bulk buying and shared labour. The low carbon zone approach proposed by Brenda Boardman of Oxford's Environmental Change is increasingly recognised as an opportunity for large scale delivery on the energy efficiency refurbishment agenda[44].

The proposed **low carbon zone approach** is:

- identification of a low carbon zone within each local authority to include around 5000 homes, focusing on fuel poor areas (utilising Sustainable Energy's Fuel Poverty Indicator to identify fuel poor)
- assessment and provision of an energy performance certificate for each of the 5000 homes to determine the extent of the work needed
- focusing on improvements to the external building envelope of the homes i.e. roof, walls and windows, but also installing insulation, solar panels and connection to CHP schemes were possible, at an estimated cost of £7500 per home
- delivery through a team of installers who carry out work a street at a time
- identification and improvement of a succession of low carbon zones to refurbish all homes within an authority[44]

Boardman believes that this must be a government led initiative, with zones tackled in phases across the country. However, she highlights the pivotal role of local authorities in the identification of the zones, co-ordinating delivery of the refurbishments and communication with householders. In London the GLA are currently working with EST, energy suppliers, London Energy Partnership and local authorities to identify 10 flagship Low Carbon Zones. They will provide initial seed funding and support to support development of the zones.

Regional groups and constituent local authorities should be aware of this approach and its potential emergence from a government level in future. **Current opportunities for Regional groups to act on this are:**

- Helping constituent local authorities to identify fuel poor areas (as highlighted in section 5.2) and proposed low carbon zones to put authorities in the best position to apply for funding for delivery, should such government funding become available.
- Adopting the street wide or zoned approach to energy efficient refurbishment to take advantage of economies of scale and minimise disturbance in any future refurbishment of local authority owned social housing.
- Partnering with relevant organisations such as the EST and local construction firms to develop a bid for a pilot low carbon zone scheme within a chosen local authority or a zone within each local authority in the Spatial Plan Region.

- Local authorities are well positioned to co-ordinate zoned low carbon housing refurbishments and the approved proposal for EU funds from the European Cohesion Policy to improve household energy efficiency under local, regional and national schemes could provide a means for Regional delivery. Funding will potentially be available for local authorities to bid to co-finance energy efficiency and renewable energy projects. Again, the **early identification of fuel poor areas and the preparation of potential projects will allow local authorities and Regional groups to capitalise upon this opportunity.**

Case Study BE10. Heads of the Valleys (HoV) Low Carbon Programme.

Europe's first low carbon zone is set to be established under the Heads of the Valleys (HoV) Low Carbon Programme. The HoV programme is a regeneration strategy developed in partnership between the local authorities of Rhondda Cynon Taf, Merthyr Tydfil, Caerphilly, Blaenau-Gwent and Torfaen and local stakeholders. The low carbon zone project has secured multi million pounds worth of funding including £10 million from HoV, £12 million from Welsh Assembly Government's Strategic Capital Investment Fund, £8 million through CERT and £8 to £10 million from registered social landlords. Further funding has been secured through the second phase of the Low Carbon Buildings Programme with match funding hoped for through an EU Convergence bid. Key deliverables of the low carbon zone will be:

- 40,000 microgeneration units or their equivalent installed;
- 65,000 homes assessed for energy efficiency;
- 39,000 energy reduction measures implemented;
- The largest concentration of microgeneration in the EU;
- Reduced domestic energy bills of at least £1.7m;
- Reduced emissions of at least 139,200 tonnes CO_2 a year.

Alongside the low carbon zone a Centre for Regeneration Excellence is to be established in the HoV area. This will provide renewable energy and energy efficiency related training opportunities, support and participate in research and development linked to Universities and link to green jobs and businesses within Wales. It is hoped that the establishment of the Centre for Regeneration Excellence and the development of the low carbon zone will stimulate the creation and growth of an innovation park in its vicinity, attracting businesses and organisations with expertise in renewable energy and energy efficiency. These joint initiatives will create markets for, develop skills in and cluster knowledge and expertise relating to low carbon technologies and initiatives, radiating impetus towards a low carbon economy in Wales.

This low carbon zone will be an exemplar project, showcasing low carbon refurbishment achievements. Regions can seek to make use of project outputs through keeping up to date with progress to learn from best practice, taking advantage of training courses offered and making use of the skills and expertise accumulated in Regional refurbishment projects. Perhaps more importantly, Regional Groups should recognise that the development of an exemplar low carbon zone is an opportunity to cluster low carbon expertise and provide a "seed" for stimulating further low carbon projects within a Region. **Each Region should seek to develop a low carbon zone, with opportunity to incorporate measures suggested under each sector in this report to provide a holistic low carbon zone. Existing low carbon initiatives such as the Cardiff sustainable travel town can be seen as building blocks for the creation of low carbon zone with a wider, cross-sectoral low carbon remit.**

5.6. Potential Delivery Mechanisms

As highlighted earlier, the provision of long term loans by energy companies to cover the upfront cost of household energy improvement to be repaid through household energy bills is currently being researched by the SDC and others. These loans would be linked to the property and not the occupier allowing payback over a longer period and overcoming the issue of occupants moving house. It is hoped that money saved on energy bills through the technologies installed would cover the cost of the technology added to each bill, leading to no extra cost over all for the bill payer. Various permutations of potential financing mechanisms for energy efficiency measures are discussed in the UK government's Heat and Energy Saving Strategy consultation.

This above type of financing mechanism could provide a strong market driver in the future. However, there are still a number of mechanisms that can be used to stimulate progress in refurbishment across all sectors of the built environment, with some of these highlighted below:

- **Tying the refurbishment of existing buildings to the development of new buildings** in planning requirements is a key mechanism for Regional progress. As suggested in the new build planning discussion, local authorities could call for developers to fund energy efficiency measures in existing equivalent stock as a condition of planning permissions.
- Establishing **local authority revolving funds** can provide a potential long term mechanism for financing energy efficiency and microgeneration installations. See revolving funds Section in 6.3 for details.
- **Community Energy projects** provide an opportunity to incorporate renewable energy technologies at a community or neighbourhood level and can be supported and promoted Regionally. See Community Energy section 6.6.

- **Energy Service Company** establishment by local authorities or Regional partnerships is a complex yet promising opportunity for providing capital to meet the large upfront investment of energy efficiency and microgeneration measures. See the Energy Service Company section 6.4.

Social or Private Domestic Properties

- Accessing and taking advantage of **CERT funding** for household energy efficiency improvements. Local Authorities or housing associations can apply to the six major energy suppliers for projects relating to improving household energy efficiency, renewable energy and behaviour change. Funds can be accessed for new projects or can be integrated into existing household energy efficiency improvement schemes e.g. towards meeting the Wales Housing Quality Standard in social housing.
  Requirements for applications include having accurate data on the housing stock and a well prepared proposal, with preference given to areas with homes requiring cavity wall and loft insulation. **Housing stock databases can also be developed in conjunction with energy companies as part of the CERT scheme**.
- **Accessing and taking advantage of CESP funding when it is available.** It is expected that funds will be available from energy suppliers and generators to partnerships of community organisations (including RSLs) and local authorities. These can be used to to deliver a whole house approach for hard to treat homes in deprived areas. Funding for the programme will be limited to £350m across the UK so partnerships with proposals developed ahead of the launch of the fund are most likely to be successful in obtaining funding from this route.
- **Developing cross-sectoral relationships and partnerships to access funding and expertise to co-deliver an enveloping refurbishment programme.** For example, Neath Port Talbot County Borough Council in partnership with **Warm Wales** is offering all households in the borough free or heavily discounted insulation and advice. Between 2004 and 2007, 62,000 homes were contacted and 19,000 were insulated. Wrexham County Borough Council has now also launched a county wide energy efficiency and fuel poverty targeted project in partnership with Warm Wales. RWE Npower fund the scheme and are planning to expand it in Wales over the next 2 years. Local Authorities with a significant proportion of fuel poor households could consider contacting Warm Wales to register an interest in participating although Warm Wales has not appear to have announced any plans for expansion or asked for any applications.

Private Rented Sector

- Influencing the uptake of energy efficiency measures in private rented buildings is a difficult challenge. This is mainly to the **landlord tenant conflict**, where the tenant is the beneficiary of any improvements that the landlord makes to the property.

Impetus has been provided by the legal requirement for an Energy Performance Certificate in all rented properties (see UK Policy Overview Section 2.2.)

- **Options for local authorities** to encourage energy efficiency in privately rented buildings as identified by the Energy Saving Trust[45] include: reducing the cost of energy efficiency measures through bulk buying or through grant schemes, providing low cost loans for capital investment and/or establishing voluntary private rented sector accreditation schemes, with minimum energy efficiency standards to be met in order for a property to be accredited. EST's briefing note on targeting the private rented sector gives numerous local authority lead initiative case studies.

  See the following document for details of the accreditation scheme and landlord grant established by East Riding of Yorkshire Council: http://www.energysavingtrust.org.uk/uploads/documents/housingbuildings/PRS_East_Riding_cs.pdf

  Key to the successful uptake of schemes such as this is active communication with Landlords Associations, such as the National Landlords Association, of which most Local Authorities in Wales are members. EST has now also established a Landlord's Advice Scheme which could be promoted amongst Landlord's Associations.

Non Domestic (Public or Private)

- Phase 2 of the **Low Carbon Buildings Programme** provides grants towards the installation of microgeneration technologies for community groups, public and non-profit sector applicants. Regional groups could take this opportunity to work with constituent local authorities to identify and prepare bids for key local authority and school buildings, for which microgeneration installations would be feasible. A focus on school buildings provides an opportunity to maximise the visibility of renewable energy within communities.

Non Domestic (Private)

- Influencing the uptake of refurbishment measures within the private sector is likely to be difficult for Regional groups. **A key action point for Regional groups is communicating to private and third sector organisations existing initiatives which could help them reduce their building's carbon footprint:**

  On the 5th of February 2009, the **Carbon Trust** launched its **"One Million a Day" campaign** – by encouraging the uptake of cost effective energy efficiency measures, the Trust is aiming to save UK businesses £1 million a day on energy bills. Through offering **interest free energy efficiency loans of £5,000 to £200,000** for upgrading

energy equipment, the Trust aims to impact carbon emissions and jointly help SMEs make direct savings at a time of recession. The Carbon Trust also offers energy saving advice to companies, tailored by sector.

- **Ecotricity's Merchant Wind Power Scheme** (see Table 4) could also be promoted amongst large business parks and industrial estates within the Regions.
- With little influence over energy efficiency in private non-domestic buildings, Regions could consider looking at opportunities for an **EU Convergence funding** bid to tackle this sector of the built environment. Opportunities for a funding bid include employing development officers to approach businesses parks, identify opportunities for energy efficiency measures and part funding installations.

Non Domestic (Public Sector)

Public sector buildings reportedly account for almost 1/3 of the UK's non domestic building stock. Interim results from a current energy audit of public buildings in England and Wales indicate that public buildings are emitting 11 million tonnes of carbon dioxide a year. Options for reducing emissions from public sector buildings include:

- **Refurbishment of local authority estates** represents a key consideration for Regional groups in the energy efficiency of their built environments. Without the availability of upfront funds, long term targets could be set for the installation of specified energy efficiency measures within local authority buildings. The Energy Saving Trust offers advice and support to Local Authorities – their Local Authority web tool is advertised as a "one stop shop" for sustainable energy information and support. EST can deliver free presentations and workshops to LA staff on topics including renewable energy and funding, they can offer assistance in drawing up an energy strategy and up to two years free consultancy. The Carbon Trust offer a carbon management programme for local authorities providing dedicated support to help LA's realise emissions savings from sources under their control.
- Working with Local Service Boards will be a key vehicle for the delivery of refurbishment of public sector buildings. Long term interest free grants available through Salix Finance are a key resource for the refurbishment of public buildings. To date only a handful of Welsh Local Authorities have participated in the programme.

Case Study BE11. Gwynedd Carbon Footprint Reduction Project

Gwynedd LSB is responsible for Gwynedd's "Carbon footprint reduction project", which has an initial focus on reducing the emission of the public bodies which are members of Gwynedd LSB. A key work area within this project is improving the energy efficiency of their buildings through insulation, improving heating systems and awareness raising. The LSB has set long term targets for CO_2 emission reductions from energy use in non-domestic buildings (compared to a 2005/6 baseline), culminating in a 60% reduction by 2020.

- Regional groups working with local authorities or public sector organisations to develop long term refurbishment programmes should seek to ensure that minimum procurement standards for energy efficiency rating are adopted when appliances require replacement.
- It is important that public sector organisations take into account the lifecycle benefits of upgrading their building stock. These lifecycle benefits need to be taken into account when allocating resources within public sector organisations. Although there may be upfront capital costs, a resource efficient public sector presents better value for money for the tax payer.

5.7. Other Elements of the Built Environment

Energy used in street lighting and signage has already been recognised as an opportunity for cost reductions within numerous local authorities. Street lighting is a significant contributor to local authority carbon emissions for example 20% for Cardiff Council. Powys County Council was the first in Wales to switch off street lights to save money. Torfaen County Borough Council are now also planning to do so and estimate potential saving of 1,235 tonnes of carbon equating to around 8 % of the council's annual emissions.

Common strategies are the switch off of lights on minor roads between 12 pm and 5 am in winter and switch off at 12pm in summer; the dimming of lights between 12 pm and 5am as an alternative to complete switch off; the use of reflective signs and bollards as opposed to illuminated and the installation of more energy efficient systems such as low watt white lights; ensuring light timers are fully aligned with changes in natural daylight throughout the year, with regular calibration and ensuring street lighting provision in rural areas is not excessive.

More resource intensive options include the installation of intelligent cats eyes (e.g. solar powered cats eyes which can be seen at a greater distance and do not depend on headlight reflection); installation of intelligent street lighting (e.g. in Oslo, Norway street lighting with

electronic dimming gear informed by traffic sensors and light meters was shown to have energy saving potential of up to 70% when retrofitting an old installation[46]) and the installation of microrenewables to power street lights and signs (e.g. street light columns with solar panels and battery storage for power).

Conflicting evidence exists in relation to the road safety implications of switching off street lights, and as such most local authorities who have implemented such strategies have done so on a trial basis in carefully selected areas with main junctions, known accident hotspots and areas with above average crime rates avoided.

Potential Regional Group actions in conjunction with local authorities on the above are:

- Setting a minimum energy efficiency level for new and replacement street light installations
- Seeking funds for the installation of intelligent energy lighting within a defined zone.

Box BE11. Mechanisms to increase the energy efficiency of the existing stock

Mapping the Regions Housing Stock

I. Thermal mapping of the existing building stock

II. Energy Auditing of the existing building stock

III. Mapping of fuel poor households within the region

IV. Mapping of housing types within the region

V. Identify priority areas for housing refurbishment

Engagement with the Construction Sector

VI. Encourage the construction trade to recommend energy efficiency improvements during routine refurbishments/repairs

VII. Work with the construction sector to identify the skills and training needed to specify and install low carbon measures

Communication to Householders

VIII. Identify ways in which to incentivise energy efficient householders to have an 'open house' for x days per year.

IX. Increase the number of smart meter installations, e.g. loans of smart meters through local libraries

Refurbishment via a Zoned Approach

X. Partner with relevant organisations to develop bids for EU, CERT and CESP funding

XI. Use Section 106 to require developers to fund energy efficiency improvements of the existing stock.

Business and Public Sector Energy Efficiency

XII. Work with the Carbon Trust to promote it energy efficiency loans scheme to SME's in the area.

XIII. Work with the Carbon Trust to upgrade Public Sector buildings in the area

XIV. Switch off street lights during periods of low demand (i.e. 12pm -5am)

XV. Intelligent traffic signals and street lighting

Box BE12. Measuring success for existing stock

- **National Strategic Indicator 18 EEF/02:**
  - **a) Percentage reduction in carbon dioxide emissions in the non domestic public building stock**
  - **bi) Percentage reduction in energy use in the housing stock**
  - **bii) Percentage reduction in carbon dioxide emissions in the housing stock**

- Percentage of housing stock which has been subject to thermal mapping and/or energy auditing
- Fuel poor households and housing types are mapped across the Region
- Priority areas for refurbishment are mapped across the Region
- Percentage of the Region's housing stock refurbished to EPC C or above
- Number of construction firms within the Region with at least one employee who has attended a sustainable construction course
- An analysis of skills and training needed to install low carbon measures is undertaken within the Region
- Number of sustainable construction training course opportunities within the Region
- Number of energy efficient building "open days" held within the Region each year
- Number of smart meters loans through libraries within the Region
- Number of homes targeted via a Regional energy efficiency campaign
- Number of buildings for which funding is secured to refurbish them through a zoned approach
- Percentage of public sector buildings refurbished
- Number of businesses within the Region accessing Carbon Trust energy efficiency loans
- Number of businesses within the Region achieving Green Dragon Environmental Standard Levels 3 to 5
- Number of businesses taking part in a Regional energy saving competition
- Local authority energy and CO_2 savings through street light switch off / dimming

6. Opportunities for Reducing Emissions Utilising Renewable Energy at a Regional Level

Renewable energy generation at a local scale will be central to the development of new low carbon buildings and to the refurbishment of existing stock. In order to maximise the emission reduction benefits of renewable energy generation, the energy efficiency of the buildings to be supplied should be addressed prior to installation.

Local renewable generation will provide the joint benefits of: displacing non renewable fuel sources and associated emissions; providing energy security and increasing user awareness of climate change issues. Both individual microgeneration and community scale decentralised energy are likely to be within the influence of Regional groups. The importance of adopting the technology best suited to the natural resources and building type(s) in an area, in order to maximise emission savings is demonstrated in section 6.1. and 6.2. **A crucial preparatory phase to enable this is the mapping of renewable energy resources within the Region.** See http://www.pcnpa.org.uk/website/default.asp?SID=1317 and http://www.oursouthwest.com/revision2010/resource_mapping.doc for examples of a renewable energy assessment in Pembrokeshire Coast National Park and renewable energy resource mapping in the South West of England. The consultancy Faber Maunsell have been contracted to develop a toolkit to enable local planning authorities to carry out an assessment of potential renewable energy resources. When released this tool may be a significant driver at a Regional level.

Large Scale Renewable Energy

Even though this chapter has a predominant focus on small scale / community scale renewable energy, the SDC does recognise the important role Area Groups can play in facilitating the communication with stakeholders on the development of large scale renewable energy within the regions.

For each region, developing its potential to generate low carbon electricity to feed into the national grid, and contribute to a low carbon UK will be a key element of transition. Decarbonising the electricity supply through large scale renewable energy installations will impact upon the emission reductions possible from all sectors, including maximising emission reduction in the transport sector through the shift to electric and hybrid vehicles. Ensuring public engagement as part of low carbon strategy development could provide an important tool for allaying objections to renewable energy developments within the region. Area Groups should work with renewable energy developers, communities and landowners to ensure renewable energy projects are developed according to sustainable development principles, whilst ensuring community benefit.

SDC has previously produced well regarded reports on large scale renewable energy technologies and some of the issues associated with their implementation. These are highlighted below:

Wind Power in the UK: The report aims to help policy-makers and planners balance genuine local concerns with wider environmental and social needs, so the benefits of renewable energy are realised through careful design and consultation.
http://www.sd-commission.org.uk/publications.php?id=234

Wind Power: Your Questions Answered: 'Wind Power: Yours Questions Answered' is a summary booklet based on our longer report 'Wind Power in the UK'. The booklet is written for householders wishing to get a better idea of how wind power will affect them.
http://www.sd-commission.org.uk/publications.php?id=235

Turning the Tide, Tidal Power in the UK: If fully exploited, tidal power has the potential to generate 10% of the UK's electricity. This report examines in-depth the proposition for a Severn Barrage and also the possible application of tidal range, tidal stream and tidal lagoon technologies at other sites around the UK.
http://www.sd-commission.org.uk/publications.php?id=607

On Stream - creating energy from tidal currents: On Stream aims to break down confusion and increase understanding of tidal stream energy. It draws on the SDC's previous work on Tidal Power in the UK published in Turning the Tide.
http://www.sd-commission.org.uk/publications.php?id=766

Lost in Transmission? - The role of Ofgem in a changing climate: An in-depth review exploring Ofgem's role in meeting the needs of future consumers in a low carbon society. Topics include: options for changes to Ofgem's primary duty, smart metering, transmission arrangements for smaller generators and a greenhouse gas incentive package in Price Control Reviews.
http://www.sd-commission.org.uk/publications.php?id=594

6.1. Microgeneration and Community Scale Generation

Renewable microgeneration technologies are small scale zero or low carbon energy systems used on a single unit or community scale, including:

- Solar photovoltaics
- Solar thermal
- Wind turbines

- Small scale hydro power
- Ground source heat pumps
- Air source heat pumps
- Biomass boilers
- Combined heat and power systems (micro / individual biomass and gas CHP units are not currently commercially available)

Microgeneration provides the distinct advantages of a low carbon, secure energy supply free from the cost increases experienced when purchasing from a central supplier. Additional benefits are minimisation of energy lost in transmission to the end user and the potential to sell surplus electricity produced to the national grid. Decentralised energy production connects individuals and communities to their energy use and may serve as a stimulus for behavioural change in energy use. Individuals with microgeneration installations are likely to serve as awareness raisers amongst their neighbours, friends and family. High upfront costs, long payback times and planning issues are key barriers to be tackled in attempting to promote the uptake of microgeneration technologies. The 2008 Foresight Report – "Powering Our Lives: Sustainable Energy Management and the Built Environment"[32] states that DEFRA research into environmental behaviours has shown that only 30% of the population are willing to install a microgeneration technology and only 7% are able to act on installing.

The Energy Saving Trust's Power in Number report[47,48] explores the barriers to, and potential of, community scale generation. The study found that distributed energy on a community scale reduces costs and increases CO_2 savings compared to individual microgeneration installations. It summarised that the greatest benefits of community scale installation (according to the cost of CO_2 savings) will be achieved for large tower mounted wind turbines (in areas with a good wind resource) and for biomass and CHP technologies in dense urban areas. Table2. gives a full summary of the optimal technology choices for various community types.

Microgeneration technologies become increasingly cost competitive in communities not connected to the gas network, with carbon savings potential simultaneously maximised through displacement of a high carbon intensity fuel.

Table 2. Renewable generation technology best suited to various community types based upon an analysis of the cost of carbon savings and cost of energy delivered for each permutation. Source: Energy Saving Trust (2008)[48].

Community type	Characteristics	Small scale options	Large scale option
Rural 	Dispersed houses, often off the gas grid, typically with relatively high thermal demands. High average wind speeds.	**Heat pumps and biomass boilers** may be attractive. Hydro electric power is attractive where available. Heat pumps are only marginally more expensive than conventional heating.	**Wind power** can provide electricity at prices competitive with the grid in windy locations at a large community scale. Hydro electric power is cost and CO_2 effective where possible. Heat distribution systems are expensive. Heat pumps are the most attractive option in terms of the cost of energy. Biomass boilers are attractive on a 'cost of CO_2 saving' basis.
Suburban 	Medium to low housing density. Houses with gas connection.	**Micro gas CHP** is likely to become a suitable heat technology for individual purchases where gas is available. For groups of 5 households, heat pumps and biomass boilers are the best renewable choice. Electricity from renewables is expensive at this scale, although PV is more CO_2 and cost effective than wind.	**Wind power** is preferred for electricity if wind speeds are sufficiently high and a suitably large turbine can be installed. Heat distribution systems are unlikely to be feasible. As a result, **bulk purchase of heat pumps or individual biomass systems** most likely to be economically viable, with biomass boilers offering cheaper CO_2 benefits.
Urban (houses) 	Medium to high housing density.	**Micro gas CHP** is likely to become a suitable heat technology where gas is available for individual purchases. For groups of 5 households, heat pumps and biomass boilers are the best renewable choice. Electricity from renewables is expensive at this scale, although PV is more CO_2 and cost effective than wind.	**Biomass heating and biomass or gas CHP** solutions are available to meet thermal demands and may provide the lowest cost heating solution. Wind power is unlikely to be available due to space restrictions and lack of suitable resource (poor load factor in urban areas).
Urban (flats) 	High housing density. Restricted space (both internal and external).	**Very limited** access to distributed generation technologies. Micro gas CHP may be the only available option. There is a strong incentive to act as a community to gain access to a wider range of technologies that could provide cheaper energy.	High heat densities make this type of community well suited to a district heating scheme – **either biomass-based or gas CHP**, leading to cost and CO_2 effective solutions. Electricity from wind and PV technologies is very expensive here, (though only available at a community level).
New build (houses) 	Low thermal demands. Opportunity to consider energy solutions in building design phase.	PV technologies are cheaper than in retrofit but still an expensive electricity generation method. There is an opportunity to design in low-temperature heating system which increases heat pump efficiency.	There are strong incentives to access lower cost community energy systems from Code for Sustainable Homes in England and Wales. Solar hot water and large on-site wind are most appropriate.
New build (flats) 	Low thermal demands. Opportunity to consider energy solutions in building design phase.	No renewable electricity option. For heat, only gas CHP is possible, although it is not as CO_2 and cost effective as in other community types.	Relevant solutions include district heating with gas CHP, with solar hot water and heat pumps second best. PV is the most CO_2 and cost effective option for renewable electricity.

6.2. District Heating

The Welsh Assembly Government's Microgeneration Action Plan aims for 50 CHP and/or district heating (DH) systems to be in place in Wales by 2020. District heating schemes comprise of a central boiler connected to a network of insulated distribution pipelines (the heat main), carrying hot water or steam past multiple connected buildings. A heat exchanger within each building takes heat from the main to supply an independent hot water and central heating system. The central boiler may be a heat only boiler or a combined heat and power plant for increased efficiency. District heating is typically gas or biomass fuelled, other potential heat sources are geothermal heat and surplus heat from industry or power stations. The carbon emission mitigation potential of DH schemes is dependent upon fuel type, with biomass CHP district heating having the highest potential for carbon reduction, as demonstrated in Table 3.

Table 3. Carbon Savings associated with district heating schemes – a comparison between fuels and with other technologies. Source: Department for Business, Enterprise and Regulatory Reform (2008)[49], compiled from data in BRE (2007).
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Technology	Carbon saving in a 88.8 m^2 semi detached house compared to:	
	Gas	Electricity
District heating options:		
Biomass CHP district heating	-83%	-90%
Biomass (not CHP) district heating	-71%	-83%
Gas CHP district heating	-6%	-46%
Gas district heating (without CHP)	+10%	-37%
Other technologies (for comparison):		
Wood boiler	-59%	-76%
Gas boiler with PV (2.5 kW)	-47%	-69%
Gas boiler with wind turbine (1 kW)	-22%	-55%
Ground source heat pump.	-14%	-51%
Gas boiler with solar thermal hot water	-9%	-48%
Ground source heat pump, underfloor heating	-5%	-45%

There are numerous financial and technical considerations in siting and investing in a district heating system:

- District heating schemes need to serve a range of building types e.g. homes and offices to create and even heat load over the course of the day[49].
- District heating network establishment involves high capital costs and may make existing gas networks and boilers redundant. Cost effectiveness of a district heating scheme is dependent upon the density of the population, the heat load and the length of the network needed[50]. Costs can be prohibitive on a small scale – the EST found that district heating schemes for between 5 and 100 homes can be more costly than investing in multiple individual microgeneration installations[48]. Clearly this will ultimately depend on the individual site, with small scale community heating schemes more economically competitive in areas not connected to the gas mains.
- Wood fuelled district heating can be competitive in off gas areas and can potentially be linked to forestry enterprises, e.g. Kielder district heating scheme serving local homes and communal buildings set up through a community owned energy services company (ESCO) (see Section 6.4. for further information on ESCOs).
- In dense urban areas the cost of district heating can be similar to or lower than conventional systems such as individual gas central heating boilers[49].
- BERR identified compatibilities between district heating schemes and other low carbon opportunities including: district heating can serve as a reliable load, low temperature heat market for new or existing CHP plants; in other European countries surplus heat from industry is the main source of heat for district heating; heat from biomass CHP and energy from waste plants which are only viable on a large scale can be effectively distributed via a district heating system[49]. The EST states that CHP biomass plants are most cost effective in blocks of flats in dense urban areas where district heating costs can be minimised and most CO_2 effective in off gas communities and those with very high heat loads[48].
- Well designed new developments are unlikely to have large heat demands, and are therefore unlikely to be suited to district heating schemes.
- Whilst initial capital costs are high existing UK district heating schemes in Aberdeen and Southampton have demonstrated that staggered long term installation, expanding the network over time, is viable[49].

Case Study BE12. Llanwddyn Biomass Community Heating

The Energy Saving Trust has documented a successful rural biomass district heating scheme in Llanwddyn. This is a remote forested community where a 600 kW wood chip boiler and heating network was installed to meet the heating needs of a school, community centre and local housing. An initial feasibility study highlighted buildings in need of heating system replacements. Community consultation and awareness raising ensured community buy in. 100% grant funding was obtained from multiple sources including European Regional Development Fund, the Welsh Assembly and the Welsh Development Agency. Initial fuel contracts specified that at least 60% of wood-chip would be sourced from within a 15 mile radius. Over the first five years it was predicted that the heating system would save 1,805 tonnes of CO_2, alongside fuel cost savings for householders and the public buildings. Key lessons for similar schemes include: involving and continually informing the community, having a nearby wood energy scheme as a guide is useful, serving a range of buildings with varying demand profiles is more economically viable, two smaller boilers as opposed to one large may help to better match output to demand throughout the year.

See http://www.energysavingtrust.org.uk/nottingham/Global-Data/Publications/Rural-biomass-Community-Heating-case-study-CE91 for further details.

Regional Delivery of District Heating

With the imminent UK Renewable Energy Strategy expected to propose new incentives for large renewable heat schemes, and the Bioenergy Action Plan for Wales consultation document suggesting that European funding will be sought to support community energy schemes including district heating**; WSP Regional groups should ensure that their local authorities prepare to take advantage of emerging funds through identifying suitable locations for DH schemes.** The above considerations and energy audits/ surveys of potential buildings to be connected will serve as tools for the identification of suitable locations. Energy audits and surveys will help to identify community/ public/ leisure buildings with heating systems in need of replacement and homes with expensive in-efficient heating systems.

A further role for **WSP Regional groups could also be to identify sources of waste heat from industry which could feed district heating networks**. This would require a high heat demand across a range of building types and its feasibility should be carefully considered – for example the high heat load may be better used in a commercial greenhouse to grow

food alongside the heat source. The seasonal variation of heat demand should also be considered when assessing the viability of such initiatives.

Regional opportunities to increase microgeneration uptake (and in some cases installation of district heating schemes) fall primarily into two categories – 1) providing access to advice, support and finance either through guidance to existing sources or through establishment of new finance and advice opportunities; 2) through establishment of, or support for, partnership delivery groups at a Regional or community level. These are discussed in the following two sections.

6.3 Sources of Finance and Advice for Renewable Energy Schemes

Existing sources of advice and finance to be communicated within the Spatial Plan Regions are briefly summarised in Table 4.

Table 4: Potential sources of funding and useful information.

Resource	Description	Further Information
Low Carbon Buildings Programme	Grants for the installation of microgeneration technologies, currently available to households, community groups, public and third sectors	http://www.lowcarbonbuildings.org.uk/home/
Ecotricity Merchant Wind Power Scheme	The scheme provides renewable power for industrial and commercial sites through building a wind turbine on site. Ecotricity pay for feasibility studies, planning, construction and maintenance of the turbine if businesses on site sign up to purchasing their electricity from the turbine long term. Ecotricity claim that this green electricity supply will provide cost reductions. Private sector organisations signed up to the scheme include Ford, B&Q, Sainsburys. The Queen Elizabeth Hospital in King's Lynn, Norfolk is the first public sector organisation to sign up to the scheme – however this may not now go ahead due to refusal of the planning application. Regional groups can seek to communicate the potential of this type of scheme to large public sector buildings and business parks within the Region.	http://www.ecotricity.co.uk/mwp/mwp.html and http://www.ecotricity.co.uk/acrobat/MWP.pdf

Wood Energy Business Scheme 2	Planned grant funding for biomass heat installations and biomass supply chain operations.	http://www.woodenergybusiness.co.uk/en/default.aspx
Carbon Trust on-line Wind Yield Estimator	Allows businesses to calculate, free of charge, the power generation potential, costs and carbon savings of a small wind turbine installation on site. Input data required include postcode and site land use details.	http://www.carbontrust.co.uk/windpowerestimator/
Energy Saving Trust	Information and advice on microgeneration technologies	http://www.energysavingtrust.org.uk/Generate-your-own-energy

In addition to fully exploiting existing sources of funding and advice available at a national level Regional groups have the opportunity to instigate their own support mechanisms or to work with constituent local authorities to instigate these support mechanisms.

Local Authority Revolving Funds

After an initial investment in energy efficiency or microgeneration projects any energy cost savings or revenue raised (e.g. through selling energy) will pay back the initial investment and any net savings or revenue are placed in a revolving fund to pay for new projects. If successful the initial investment will create a long term mechanism for financing the installation of further microgeneration and energy efficiency technologies. Key considerations are that a large initial investment will accelerate savings and revenue building and that ensuring all savings accrue to the fund will maximise its carbon impact.

Woking Borough Council has been a pioneer in adopting this model as a funding mechanism for energy efficiency. From an initial capital investment of £0.25 million in 1990/1991 the council has invested a total of £2.2 million in over 85 projects[50].

Key barriers to be overcome in setting up a revolving fund are: low confidence in potential energy savings, a failure to consider initial investment in technology against long term energy costs and the need to ring-fence money within the local authority. This type of fund could operate at a local authority level to finance energy efficiency improvement within the local authority estate or similarly at a public body level for funding improvements within their own estates. Once sufficient returns are achieved this fund could be used to offer grants or no interest loans to households or businesses for microgeneration technologies, although the former would significantly deplete the fund. The Salix Finance fund for public

sector energy efficiency measures works in this way, see Figure 7, with the beneficiary able to pay back the initial loan through long term energy savings with any further savings accruing to the fund for further investment in new energy efficiency projects.

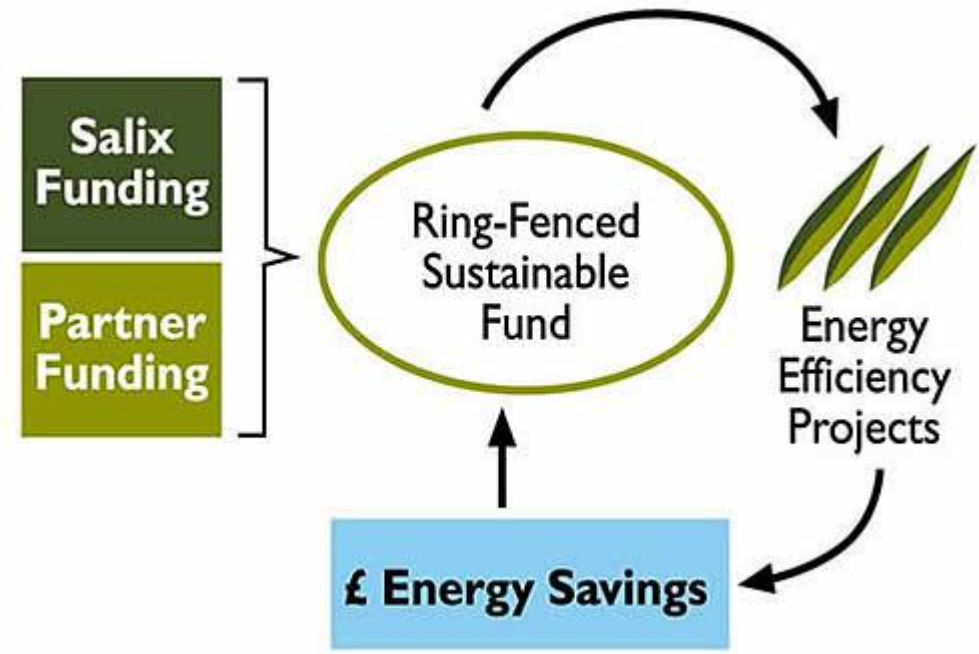

Figure 7. Revolving funds model for microgeneration and energy efficiency installations. Source: Salix (2008)[51].

6.4. Energy Service Companies

At a Regional, local authority or community level Energy Service Company (ESCO) establishment, alone, or in partnership with the private sector is an opportunity to deliver energy efficiency, decentralised energy schemes and / or microgeneration installation. Alternatively partnering with an energy supplier or existing ESCO provides an opportunity to deliver with a lower level of complexity and fewer resources required in establishment.

The traditional ESCO concept is the provision of services derived from energy i.e. heat, light, cooling or motive power. The Energy Saving Trust suggests that a typical energy services package as provided by an ESCO would include[52]:

- The appliance necessary to deliver the service such as a light bulb or heating equipment.
- The financing to purchase it.
- The expertise needed to maintain the equipment.

- Advice to operate it properly.
- The energy required to operate it.

However, there is no strict definition of what an ESCO is or should provide, and several permutations of the original concept have evolved. The London Energy Partnership have produced guidance on making an ESCO work, in which they describe ESCOs as organisations set up to deliver energy efficiency, energy savings and / or sustainable energy.

The EST pins down three broad types of ESCO or energy service schemes[52]:

- **Preferred supplier arrangement/affinity deal** – whereby a local authority, community group or housing association markets a preferred supplier to residents in return for commission from the supplier when a new customer is gained. The revenue is typically used to offer energy efficiency improvements. See http://www.energysavingtrust.org.uk/business/Global-Data/Publications/Affinity-deal-toolkit for the EST's toolkit on setting up this type of deal.
- **Housing energy club** - builds upon the above deal whereby the chosen energy supplier works with the organisation to provide an energy package with advice on energy efficiency given to residents alongside the energy supply. The package may also include the energy supplier providing access to grants for customers who sign up.
- **Energy supply scheme / Direct Supply** – whereby a local authority, community group or housing association supplies heat or power directly to households e.g. through a combined heat and power (CHP) scheme in a block of flats. Local authorities may face legal obstacles in becoming direct energy suppliers – however there are examples where these have been overcome e.g. Woking Borough Council.

EST also discuss renewable energy based ESCOs – identifying them as either generating renewable electricity and selling it to raise funds for energy efficiency measures, or producing an energy service such as heat e.g. from a biomass boiler to supply local demand.

Woking Borough Council is seemingly the first local authority to have participated in ESCO establishment - Thameswey Limited, an Energy and Environmental Services Company (EESCO) wholly owned by the council. It was established in 1999 following discussions with the then Department of the Environment, Transport and the Regions and the Department of Trade and Industry, and through funding from the EST which enabled them to explore what was legally possible in terms of the participation of a local authority in an ESCO.

Thameswey Ltd operates through entering into public private ventures, utilising private finance. In this vain, and to escape the capital controls imposed on a local government company, the EESCO established an unregulated ESCO in partnership with a Danish energy company. This ESCO runs pre existing council schemes such as free energy efficiency advice

for local homes and SMEs, whilst also delivering large energy installation schemes, with a focus on CHP. Projects delivered include a town centre CHP and absorption cooling district heating system to buildings connected with private heat and chilled mains, along with low voltage private electricity wires. Further district heating CHP schemes have and are being rolled out to homes, residential homes and leisure facilities.

The potential to deliver through ESCOs is widely recognised and instigated in Europe. In the UK and in Wales ESCOs are increasingly reported as a replicable mechanism to deliver energy efficiency and decentralised energy schemes[53,54]. EST's Power in Numbers report explores the issues and potential of community level distributed energy, in which it highlights the promotion of ESCOs through national policy as a means of designing, financing and installing community energy projects.

Given the complexities and variations possible in establishing an ESCO or energy services scheme, it is beyond the scope of this report to recommend a formula for success. As such accessing the wealth of information and guidance produced by the EST and London Energy Partnership is recommended as a crucial first step towards establishment:

- EST's Energy Services Review is a useful background / introductory document which includes numerous case studies of each type of ESCO from the UK and further afield in addition to a guide to legal models for running an ESCO. It is available at http://www.energysavingtrust.org.uk/business/Global-Data/Publications/Energy-services-review.

- EST's Energy Services Directory is a guide to establishment including how to chose which type of energy services scheme to develop and how to take it forward. It is available at http://www.energysavingtrust.org.uk/business/Global-Data/Publications/Energy-services-directory.

- The London Energy Partnership's Making ESCO's work report provides guidance and advice on ESCO set up and delivery based upon previous establishment projects. It is available at http://www.lep.org.uk/uploads/lep_making_escos_work.pdf.

Regional Groups should explore the opportunity for energy services schemes and company establishment in conjunction with local authorities – opportunities range from simple partnership with an energy supplier, providing local authority sustainability officer staff time to support community ESCOs to becoming a direct energy supplier in partnership with private sector finance. The EST can help organisations to develop an energy services scheme, offering free consultancy and presentations.

6.5. Energy Partnerships

The need for collaborative working and the establishment of partnerships is echoed by the success of Cornwall's Sustainable Energy Partnership (CSEP).

Case Study BE13. Cornwall's Sustainable Energy Partnership

The partnership was established in 2001 to amalgamate and utilise the knowledge and expertise of individuals and organisations within the regions' public private and third sectors, pertaining to sustainable energy. The partnership is overseen and guided by a strategic steering group of eleven members from different sectors; with business, community, energy efficiency, and education all represented by a member. Each of the 11 members holds a senior role within their sector or organisation, allowing the steering group to function as an executive board. The main delivery mechanism for CSEP projects and initiatives is the 5 delivery groups, working in specific project areas:

- Bio Energy
- Energy in Buildings
- Energy in Transport
- Marine Renewables
- Sustainable Energy Planning

Each delivery group has a set of aims, one of which for each group is the delivery of relevant actions from the Energy Strategy for Cornwall: In 2003 the group employed a consultancy to scope out a project brief for the partnership. After discussion of the document drafted by the consultancy at partnership meetings and the incorporation of received responses, the Energy Strategy for Cornwall was published. 72 partners including local Councils, the NHS Trust, Universities, Housing Associations, renewable energy businesses signed up to working together to deliver on the strategy through a 32 point action plan. The development and launch of the strategy, and securing funding, were fully managed and facilitated by CSEP. Funding was obtained from a number of sources including funds for the consultation process from the Energy Saving Trust; funds from Cornwall County Council; funds through an Energy Deprivation Local Public Services Agreement with the Office of the Deputy Prime Minister; funds from the Local Authority Support Programme and funds, including staff time, provided by CSEP partners. Key deliverables of the strategy are doubling Cornwall's renewable electricity generating capacity, implementing a Region wide household energy efficiency programme and the formation of an ESCo. Four process groups were established to delivery of the Energy Strategy's action points:

- Economy
- Social
- Education
- Local Authorities

These are task driven groups with clear aims and objectives.

Successes of the partnership in delivering the strategy include the installation of community wind turbines, the provision of free insulation and installation of solar energy systems in schools[55].

This approach is currently being replicated elsewhere in recognition that Energy partnerships are potentially a means of large scale delivery on the low carbon built environment agenda. The South East Wales Energy Partnership for example is currently establishing its structure and remit, having recognised the cross sectoral delivery and access to larger funding streams possible through Regional partnership approach. The partnership commissioned AEA to identify the potential remit of the group including what type of projects it should be focusing on and potential funding bids the group could work on.

Regional groups should consider initiating discussions on energy partnership establishment across sectors as a means of delivering multiple energy efficiency and renewable energy projects. Regional groups could play a crucial role in establishment, with individuals sitting on the groups encouraging their own organisations to sign up. Key considerations / ideas for new partnerships include:

- The potential for employing a consultancy to quickly and objectively identify a potential role/ remit and strategy for the partnership
- Utilising the strategy / remit document consultation period to raise awareness amongst potential partners
- The potential to work with other task groups in the Region as a means of delivery, e.g. with housing associations to deliver refurbishments or, for example London Energy Partnership worked closely with a CHP association to deliver renewable energy installations
- The need for a diversity of funding (as achieved by CSEP) to ensure long term sustainability
- The need for an effective partnership structure e.g. a small, expert group to guide and oversee the work of the partnership and small specialised project groups for delivery
- The need for a clear remit and strategy for delivery
- The potential for partnership working to enable access to larger grants e.g. EU Convergence funding for programmes of energy efficiency and/or renewable energy installations
- The potential role of an Energy Partnership as a communication vehicle e.g. to facilitate discussion between industrial units re utilising waste heat from one as an energy source for another

- The potential role of an Energy Partnership as a source of advice and support e.g. for community energy groups, which as identified below, need access to expertise for successful delivery
- The potential for an Energy Partnership to co-ordinate e.g. school bids for renewable energy installations to the Low Carbon Buildings Programme
- The ability for a partnership approach to mobilise others i.e. the "I will if you will" effect
- With cross sectoral representatives partnerships will be well place to identify Regional opportunities e.g. for a district heating system between public school and leisure facilities in an urban area or the establishment of an ESCo
- The valuable guidance and advice available through contacting existing Energy Partnerships for assistance in establishment

6.6. Community Energy

Across the UK, community level low carbon action is taking place. The low carbon communities network provides a stage for the communication of experiences and advice within and between communities striving to become low carbon. Numerous participating communities exist, implementing innovative measures. In Bollington in Cheshire for example, a team of volunteers have, amongst other events, organised "Eco Refurbishment Courses" for householders to enable them to reduce their home energy demands. **Regional groups should actively identify and actively seek to work with existing low carbon communities and encourage the establishment of new low carbon communities in their Regions to assist in the delivery and spread of built environment orientated low carbon initiatives.**

As detailed by Walker[56], community energy projects can involve varying degrees of community ownership e.g. fully owned by a community group or co-owned with a private sector organisation and may provide energy directly to households in the community, to community buildings such as village halls or may be sold to the grid. Clearly community ownership will allow for community engagement and education in renewable energy, is likely to help with minimising objections to planning permission and can provide local income and encourage co-operation. Table 2. is taken from EST's aforementioned Power in Numbers report[47,48] and shows the best microgeneration technology for various community types, based upon an analysis of the cost of carbon savings and cost of energy delivered for each permutation. Community size and natural resource availability (e.g. wind resource) are

demonstrated to be key factors in the possible financial and carbon savings of energy delivered on a community scale.

Walker[56] highlights the different models of legal and financial ownership that have been adopted by existing community energy groups including co-operatives, community charities, development trusts, ownership through share purchase. The EST highlights the difficulties of community energy projects[47]. Critically, establishing a community group in itself is said to be problematic due to lack of resources, trust and the complexity of early stages of the process[47]. Initial stages of community energy installation include assessing feasibility, developing a business case for the installation, raising community awareness, seeking finances, planning applications and liaison with contractors. To overcome these community convening, commitment and technical issues the EST demonstrate through case studies that a "community champion" is essential to drive the project forward, be it a committed individual, group of individuals, established community group or organisation working in the housing or energy field. EST also shows through case studies that access to expert advice is crucial. These community group establishment and operational issues highlight a vacancy for advice and support which EST recommends can be filled through the employment of development officers.

Case Study BE14. Bro Dyfi Community Renewables [57,58,59]

In 2003, the UK's first community delivered and owned wind turbine was installed in the Dulas Valley in Wales. Pantperthog village residents came up with the idea of installing a community owned wind turbine, and subsequent public meetings led to the establishment of Dulas Valley Community Wind Partnership (DVCWP). The partnership generated initial funds for the planning application through charging £10 or £20 membership fees. Advice from individuals at Powys Energy Agency and a local community regeneration organisation enabled the partnership to move forwards. Sub-groups of community members were established to take responsibility for the delivery of specific tasks e.g. the environmental impact assessment. Bro Dyfi Community Renewables Ltd (BDCR) was established by the partnership for legal ownership and responsibility over the turbine and to manage landowner agreements. BDCR was established as a consumer cooperative in which community members bought shares. All work involved in the environmental assessment and planning process was undertaken by members, rewarded through shares. The organisation was successful in securing funds and support from the EcoDyfi organisation which has assisted in the delivery of numerous community based renewable energy schemes in the Dyfi Valley through EC Community Renewable Energy Project funding. Additional funding was secured from EST, Scottish Power's Green Energy Trust and from shares sold to the local community. The Centre for Alternative Technology agreed to purchase the electricity produced at a higher price than available through selling directly to the national grid. The scheme provides ongoing and expanding benefits through the return of a third of the project profit annually into a community energy fund for further energy efficiency measures[57,58,59].

This case study demonstrates the need to engage with organisations from the private and third sector locally with an interest in renewable energy or community involvement. It also echoes the importance of expert advice and support e.g. in accessing finance and electricity markets. The consultation National Energy Efficiency and Savings Plan[37] proposes a number of actions which will help to deliver community level energy projects including support for 22 community distributed energy generation projects in Wales; providing a development fund for communities wishing to act on climate change and providing local development officers. In order to make full use of these resources when they become available Regional groups can seek to identify potential locations / communities and existing community groups which may wish to take forward a community energy project with support. In the intermediary period before the actions of the National Energy Efficiency and Savings Plan consultation are delivered, energy partnerships and local authority energy departments

could be potential means of supporting and advising community groups. Regional groups have the opportunity to facilitate discussion between these parties, identifying what contribution each can make and how they can co-ordinate even an informal or pilot service to advise and assist community energy projects.

Existing community energy groups and the EST are valuable resources for guidance in the establishment of any community energy scheme. A database of community energy projects exists, http://geography.lancs.ac.uk/cei/CommunityEnergyUKProjects.htm, although not all projects listed involve community ownership. Walker[56] discusses the potential for existing community energy projects to be replicated and draws attention to the Baywind cooperative's Energy4All, which is dedicated to helping communities form cooperatives for ownership or co-ownership of renewable energy schemes. Energy4All's Energy Steps Wind Project Generator (see http://www.energysteps.coop/) gives introductory step by step instructions on how to take community wind projects forward. Further support for establishment exists in the form of the Renewable Energy Investment Club (REIC) which was set up to minimise the financial and legal complexities and costs of offering shares in community renewable energy projects[59], see http://www.reic.co.uk/menu.htm. Argyll and Bute Council in Scotland has set up strategic partnerships with renewable developers to offer opportunities for community co-ownership[56] which presents a potentially replicable idea for the local authorities in Wales to drive forward renewable energy provision.

Box BE13. Mechanisms to promote renewable energy

I. Undertake mapping of renewable energy resources at a Regional level to guide and co-ordinate renewable energy generation installation

II. Work with local authorities to streamline the planning process for renewable energy planning applications

III. Identify suitable locations for district heating schemes, e.g. range of building types to create an even heat load, linking forestry resource to fuel for biomass district heating

IV. Wind Turbines for large businesses / business parks – Ecotricity Merchant wind power scheme

V. Explore the possibilities of establishing Energy Service Companies

VI. Establishing an Energy Partnership to explore ways in which organisations within the region can work together to drive forward energy projects.

VII. Provide advice /support to community energy projects

VIII. Facilitate impartial communication on the pros and cons of renewable energy developments in the area

Box BE14. Measuring success for renewable energy

- Regional renewable generation capacity
- Renewable energy resources are mapped across the Region
- The renewable energy resource map is used to guide installation
- Percentage of renewable energy generation planning applications approved within a year
- Suitable locations for district heating schemes are identified across the Region
- Number of large businesses and business parks powered by wind turbines
- Establishment of an ESCO
- Establishment of an energy partnership
- Number of community energy projects within the Region
- Number of DH / CHP schemes within the Region
- Number of homes powered by renewable energy within the Region
- Number of schools with a microgeneration technology installed within the Region

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Rural Land Use and Food

This document provides background information on a wealth of low carbon solutions for the rural land use and food sectors alongside case studies, tips for replication and recommendations for delivery through the Wales Spatial Plan Groups. It was constructed through a significant desk based study as part of the *Low Carbon Wales: Regional Priorities for Action* project between January and April/May 2009. Given the dynamic nature and massive scope of the subject area it is recognised that this document cannot cover all potential carbon reduction solutions and that relevant policy and regulation may have progressed or changed since the time of writing. This is however a useful reference guide for Spatial Plan Regional Groups and wider stakeholders in the transition to low carbon.

Contents

1. Summary

In 2005 agriculture accounted for 11% of total green house gas emissions in Wales. Through sequestration land use, land use change and forestry were found to be a net sink of greenhouse gases in 2005. Soil and plant stores in Wales are estimated to hold 547 million tonnes of carbon, with over 80 % stored in upland soils and grassland.

Opportunities for emission reductions and carbon sequestration at a Regional level are addressed in this chapter under the headings of land use mapping, agriculture, food and carbon sequestration. Land use mapping of soil carbon stores is identified as an essential preparatory measure to guide expenditure on soil carbon protection and restoration, inform local development plans and guide food growing and woodland planting locations. Amongst the opportunities identified for emission reductions are: clustering farm waste to feed local authority anaerobic digestion plants; provision of local authority land for communities to grow their own food and increasing the use of local sustainable timber in long life items to store carbon. Suggested mechanisms for progressing or delivering solutions at a Regional level include partnering with farming bodies such as NFU to engage landowners, influencing local authority planning and community land provision; facilitating communication between landowners to progress e.g. landscape scale woodland planting; and awareness raising campaigns to influence consumer behaviour to food.

As set out in section 3.3 of this report, SDC solutions for early consideration for reducing emissions from rural land use and food at a Regional level are to:

(1) Identify and implement a programme of action to protect <u>all</u> significant soil carbon stores

(2) Implement a comprehensive programme of measures to enable and significantly increase community and individual food growing

Rationale for prioritisation:

1) Soil and plant stores in Wales are estimated to hold 547 million tonnes of carbon, with over 80 % stored in upland soils and grassland.

2) Food accounts for almost $1/10^{th}$ of the carbon footprint of each of the Spatial Plan Regions of Wales (see Stockholm Environment Institute Carbon Footprint for each Region in Chapter 4 of the main report *Low Carbon Wales: Regional Priorities for Action*). Agriculture, transport and food manufacturing are the key emission contributors from food consumed in the UK – all of which can be reduced by individual and community food production and consumption. Re-connecting individuals and communities with the land is also believed to help to deliver progress on wider behavioural change for carbon reduction.

2. Policy Overview

2.1. EU Policy

Whilst policy for land use rests primarily with member states there is a comprehensive suite of EU policies relevant to rural land use and food.

Under the EU's climate and energy package, as a sector not covered by the EU Emissions Trading System, farming is directly targeted as a sector from which greenhouse gas emissions must be cut to 10% below 2005 levels by 2020. The climate and energy package's target to meet 20% of energy needs through renewable sources, and within this the target for at least 10% of transport fuel to be renewable, will put demands on land use for energy crop growth.

Common Agricultural Policy (CAP)

In its current form the CAP is focussed upon supporting farmers' incomes, whilst promoting the delivery of high quality produce to market and ensuring environmentally minded farming practice. This is the single most influential EU policy relating to rural land use and food. Over the 2007 to 2013 period, 34% of the EU's budget is dedicated to the CAP. The primary subsidy to farmers is made through the Single Payment Scheme. In order to receive direct payments under CAP farmers must meet a range of specified standards including environmental standards. One element of this is that the area of permanent pasture in member states is not reduced, which although not directly aimed at conservation of soil carbon stores will limit losses through conversion to arable land.

Rural Development Policy 2007-2013

Whilst land use policy is primarily controlled by individual EU member states or regions within member states, the EU has a common rural development policy. It specifies three themes which member states must fund equally:

- Improving the competitiveness of agriculture and forestry sectors
- Improving the environment and the countryside
- Encouraging diversity in the rural economy to improve the quality of life in rural areas

Each member state must have its own Rural Development programme. CAP funds for rural development are allocated through the RDP.

Forestry

The EU Forestry Strategy identifies the multi functional role of forests and the need for sustainable forestry management but states that forest policy lies with Member States. The EU Forest Action Plan includes improving and protecting and protecting the environment as one of its four main objectives. 18 key actions are detailed within the plan including promoting the use of forest biomass for energy generation. See http://ec.europa.eu/agriculture/fore/action_plan/index_en.htm for further information.

BioEnergy

Through both the EU's climate and energy policy package and CAP subsidies the EU is supporting the growth of bioenergy. Under the rural development policy the EU provides support for both the supply and use of bioenergy through a range of measures implemented by member states. See http://ec.europa.eu/agriculture/bioenergy/index_en.htm for further information.

Soil

EU policy for soil is set out in the **Thematic Strategy for Soil Protection** adopted in 2006. This is one of the seven thematic strategies within the framework of the 6th Environmental Action Programme. http://ec.europa.eu/environment/soil/three_en.htm The need to protect and increase the role of soil as a carbon store features strongly in the Thematic Strategy, in line with the position in the Kyoto Protocol. The Strategy explicitly refers to land management practices to promote carbon sequestration in agricultural soils as a means of mitigating climate change.

2.2 UK Policy

Agriculture, land use and land use planning are competencies devolved to the Welsh Assembly Government. Policies governing agriculture and land use above a Welsh Assembly Government level are primarily EU policies e.g. CAP. Many DEFRA policies and initiatives such as Farming for the Future Programme and the Food Industry Sustainability Strategy are England only initiatives with equivalent strategies and policies developed by the Welsh Assembly Government. The UK Forestry standard addresses sustainability requirements for woodlands – this along with complementary management guidelines is currently being reviewed and refreshed. The new standard and guidelines will cover issues including forests and soils and forests and climate change. The guidelines are expected to be released for consultation this year.

2.3. Welsh Policy

Carbon emissions reduction and sequestration does not appear to have been a focus of Welsh Assembly Government land use policies to date, however, Welsh Assembly Government strategies are increasingly recognising the need to act on these issues.

One Wales

One Wales, the progressive agenda for the Welsh Assembly Government, commits to a number of targets and initiatives which will contribute directly to emissions reduction from land use including agriculture. These are:

- The 3% annual carbon reduction target by 2011 from areas of devolved competence
- Providing support for indigenous woodlands including a new tree for every new baby born in Wales to create a National forest and carbon sink.
- Increased support for farmers' markets.
- Commitment to submit a **Rural Development Plan** (RDP) for 2007-2013 to the European Union. This has now been approved by the EU and sets out how the Welsh Assembly Government intends to support the countryside and rural communities whilst encouraging sustainable agriculture and environmental management. This is set out in four parts (axes). Axis 2 covers improving the environment and countryside. At the end of 2008 the Welsh Assembly Government released for consultation "Sustaining the Land" – reviewing land management actions and the effectiveness of money spent under Axis 2 of the RDP. Amongst the review's remit is exploring altering existing agri-environment schemes to incentivise managing soil carbon. Current Welsh agri-environment schemes such as Tir Gofal and Tir Cynnal do not reward carbon management. On the 5th of May, 2009, following the Axis 2 review, it was announced that all current agri-environment schemes in Wales will be replaced by a single scheme entitled Glastir, to be introduced in 2012. If approved by the European Commission,

Glastir will be a two tier support scheme with the second tier providing targeted support for environmental actions including soil carbon conservation and water management. Additionally, Glastir will provide £5 million of capital grants annually for the installation of renewable energy and efficiency technologies on farms.

- Initiating a new initiative on local food procurement.
- Publishing and implementing a Strategic Action Plan for the Dairy Industry. (This was released for consultation in 2007 and identified reducing the industry's carbon footprint as a key challenge, with energy efficiency and adoption of anaerobic digestion highlighted as opportunities for emissions reduction.)
- Developing a support programme to promote energy efficiency and renewable energy on farm (will be implemented as part of the new Glastir agri-environment scheme).
- Exploring the introduction of a grant scheme to convert to energy crops. (Within the Axis 2 review the economics of energy crops are explored and subsequently the Welsh Assembly Government shows preference for supporting renewable energy based on biomass by stimulating local demand over introducing planting grants for energy crops. The recent announcement on the new comprehensive Glastir agri-environment scheme adheres to this, with no support proposed for energy crop establishment).

Wales Environment Strategy

The Wales Environment Strategy sets out desired environmental outcomes for Wales over the next 20 years. Of direct / specific relevance to emissions reduction and sequestration through land use are:

- outcome 16 - Soil is managed to safeguard its ability to support plants and animals, store carbon and provide other important ecosystem services
- outcome 18 - The use of alternative materials, secondary and recycled aggregates is maximised where possible in the construction industry (relevant to the use of sustainable timber in construction as a carbon reservoir)

Farming, Food and Countryside, Building a Secure Future

"Farming, Food and Countryside, Building a Secure Future", the draft consultation document on a new strategy for farming in Wales was released in 2008. The document's focus is achieving a more profitable and sustainable future for farmers and rural communities. Proposed actions with relevance to reducing emissions through land use include: the development of a "local sourcing strategic action plan" to increase sourcing of Welsh food by the public sector; increased training and support for local farmers' markets; ensuring consideration of soil carbon in revised agri-environment schemes; promoting the sustainable use of woodlands; supporting low input organic farming; using Farming Connect to ensure farmers receive advice on contributing to climate change mitigation and supporting research into anaerobic digestion. See

http://wales.gov.uk/consultation/drah/environmentandcountryside/2008/080616farmingconsultation/consultationdocument/farmingconsultationdoce.pdf?lang=en for the full document.

Woodlands for Wales

A consultation document on proposals to revise Woodlands for Wales was released in 2008, proposed outcomes of the revised strategy include: increasing woodlands within sustainable management; increasing woodland area; using woodlands to reduce Wales' carbon footprint; full utilisation of Welsh woodland timber; increasing markets for wood as a sustainable building material.

The Bioenergy action plan for Wales consultation document was released early in 2009 and sets out how the Welsh Assembly Government will achieve 5 TWh of electricity and 2.5 TWh of heat from renewable biomass by 2020. Proposed actions to increase demand for bioenergy and increase supply of biomass are set out including working with Local Authorities to assess feasibility of biomass in existing and new buildings and encouraging private woodland owners to harvest woodland.

Welsh Soils Action Plan

The Welsh Soils Action Plan consultation reviews the importance of soils in Wales. Actions set out in relation to agriculture and forestry primarily refer back to the Axis 2 review. Other proposed actions include: that the Welsh Assembly Government will ensure Local Development Plans take into account impacts on national soil resources and that the Welsh Assembly Government intends to obtain a better understanding of the location of carbon rich soils across Wales.

The Welsh Assembly Government's newly established Land Use and Climate Change Group, a sub-group of the Climate Change Commission for Wales, will provide direction and drive for the mitigation of GHG emissions from land use and for the conservation of existing carbon stores.

A number of strategies and programmes which may contribute to reducing emissions from land use are due to be launched soon:

- A food and drink strategy for Wales.
- A local food sourcing action plan will be launched by the Welsh Assembly Government this spring.
- A new climate change development programme will be launched by the Welsh Assembly Government as part of Farming Connect this summer.

Bioenergy Action Plan for Wales

The action plan confirms that a second Wood Energy Business Scheme is under development See Built Environment and Energy Welsh Policy Section (8.2.3) for more information.

3. Background

Wales has a total land area of 2,073,000 hectares, 2,100,000 hectares of which is agricultural land. Figure 1 gives a breakdown of land use types by percentage cover in Wales.

Table 1: Land use cover type by percentage cover in Wales. Source: Compiled using data from the Department for Environment, Food and Rural Affairs (2005)[1].

Land Cover Type	% Cover
Agricultural - crops and bare fallow	3.17
Agricultural - grasses and rough grazing	72.29
Other Agricultural (set aside, farm buildings etc)	0.96
Forest and Woodland	13.8
Urban land and unknown land cover	9.79

The land use sector presents dual opportunities for Regions seeking to become low carbon: Firstly, through reducing emissions from land use including agriculture and land use change and secondly, through increasing carbon sequestration in soils and plant biomass.

Reducing carbon dioxide emissions is central to reducing the global warming contribution of the transport, built environment and energy sectors. In the land use sector, and in particular agriculture, methane and nitrous oxide emissions must also be considered alongside carbon emissions. Over a 100 year time horizon methane and nitrous oxides have 21 and 310 times respectively, the global warming potential of the same mass of carbon dioxide. Agriculture accounts for just over 1% of Welsh carbon dioxide emissions but 60% and 82% respectively of Welsh methane and nitrous oxide emissions[2]. In 2005 agriculture accounted for 11% of total green house gas emissions in Wales[2].

Table 2: The ten largest green house gas emissions sources in Wales according to their global warming potential. Source: AEA Energy and Environment (2007)[2].
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Gas	Sector Name	Emission	Percentage of total GWP Weighted Emissions
CO_2	Power Stations	14047	28%
CO_2	Iron and Steel	6332	13%
CO_2	Road Transport	6027	12%
CO_2	Residential Combustion	4488	9%
CO_2	Other Industrial Combustion	3719	7%
CO_2	Refineries	3344	7%
N_2O	Agricultural Soils	2648	5%
CH_4	Enteric Fermentation - Cattle	1468	3%
CO_2	Land Converted to Cropland	1046	2%
CH_4	Landfill	994	2%

Agriculture

A breakdown of agricultural emissions is given in figure 1. Methane emissions from enteric fermentation and nitrous oxide and methane emissions from the waste of grazing animals are dominant.

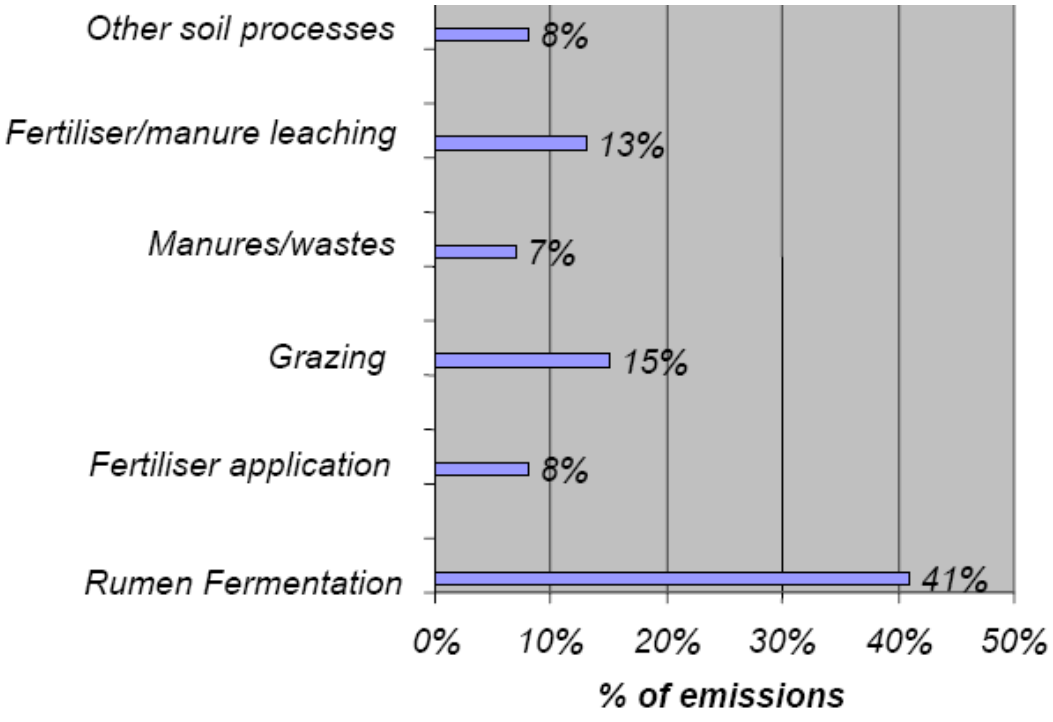

Figure 1: Welsh Agricultural Green House Gas Emission 2005. Source: Welsh Assembly Government (2005)[3].
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Food

Food accounts for almost 1/10th of the carbon footprint of each of the Spatial Plan Regions of Wales (see Stockholm Environment Institute Carbon Footprint for each Region in Chapter 4 of the main report *Low Carbon Wales: Regional Priorities for Action*). Agriculture has been shown to be the largest contributor to greenhouse gas emissions from food consumed in the UK, followed by transport (including overseas), food manufacturing and domestic emissions (for example cooking and refrigeration).

Carbon Sequestration

Through sequestration, land use, land use change and forestry were found to be a net sink of in 2005 (see Figure 2). Emissions from cropland management and from land use change to settlements are shown to be the primary contributors in this sector. Forest land and grassland account for the largest sequestration benefits. As Welsh forests age and carbon sequestration in soils and biomass slow their sequestration contribution will diminish.

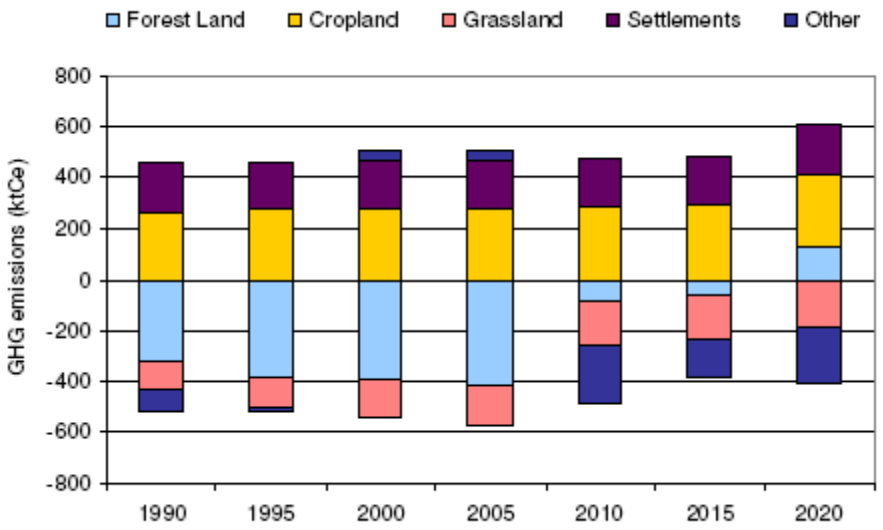

Figure 2: Greenhouse gas emissions and sinks (in carbon equivalent) from land use, land use change and forestry (LULUCF) in Wales, with predictions to 2020. Source: AEA Energy and Environment (2008)[4].
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Soil and plant stores in Wales are estimated to hold 547 million tonnes of carbon, with over 80 % stored in upland soils and grassland. Organic soils cover 20% of Wales and hold an estimated 50% of soil carbon.

Bradley et al.'s article "A Soil Carbon and Land Use Database for the United Kingdom" [5] contains a useful map of soil densities per 1km in Wales.

Woody biomass in Welsh woodlands is estimated to store around 9 million tonnes of carbon. Protecting these existing stores is a key challenge for the land use sector.

Emission reductions and sequestration through agriculture and non-agricultural land uses is complex and opportunities vary on a case by case basis. As highlighted at the beginning of the report Low Carbon Wales: Regional Priorities for Action, using sound science responsibly is one of 5 key elements of sustainable development. **Regional groups must therefore ensure that the potential emission reductions of any land use and agricultural initiatives they instigate have been fully researched.**

4. Opportunities for Reducing Emissions at a Regional Level

4.1. Land Use Mapping

The North West Spatial Plan Regional group is proposing to develop an integrated spatial environmental strategy in conjunction with the Mersey Dee Alliance. The main component of this proposal is to create a zoned map of the Region based on existing characteristics e.g. conservation areas, soil carbon content. Building upon this map the partnership proposes to create zonal narratives identifying opportunities and constraints within each e.g. opportunities to create clusters of green jobs or constraints on land use due to high soil carbon content. Taking this spatial approach will help to inform the geographic implementation of the low carbon land use solutions suggested below. **Having detailed maps of soil carbon content will be crucial for Regional groups in protecting existing carbon stores.** Detailed soil carbon mapping will enable prioritisation of soil carbon restoration projects and soil carbon preservation efforts and should inform the spatial distribution of development in Local Development Plans, in addition to providing a guide for where food growing should be focused and woodlands should be planted to minimise soil carbon losses. The Assembly Government is currently looking into further assessment / mapping of soil carbon.

4.2. Agriculture

Agriculture is a significant contributor to overall greenhouse gas emissions in Wales, and as such opportunities for reducing emissions from all agricultural operations should be sought. Key considerations are emissions reductions from livestock and waste, crops, soils and livestock and avoiding emissions through renewable energy installations on farm. As a starting point for any agricultural operation farm energy auditing or carbon accounting provide opportunities to better understand energy use and the carbon balance and highlight opportunities for improvement.

Box RLU1. Sustainable Agriculture Information and Advice in Wales

- Farming Connect – the Welsh Assembly Government's advisory service for farming businesses
- Soil Association (UK wide)
- Centre for Alternative Land Use
- Farming and Wildlife Advisory Group
- ADAS
- Energy Saving Trust
- Carbon Trust – advice on energy efficiency available for agricultural and horticultural industries

4.2.1. Farm Energy Auditing / Carbon Accounting

Farm energy audits assess total energy use and efficiency on farm including energy used in crop production, meat production, horticulture, dairy farming, heat and lighting, machinery and transport. Farm energy audits will help farmers identify opportunities for energy saving and energy efficiency, reducing emissions from energy use whilst also improving the perceived environmental status of the farm as a supplier. The Centre for Alternative Land Use (CALU) has published a guide to help farmers carry out their own energy audits including with step by step instructions and tables for data recording. As part of the guide the principles of energy auditing are set out, figure 3 CALU state that on the majority of farms a saving of 10 to 29% on energy costs could be made through limited capital investment following a farm energy audit.

1. Review current practice - Collect together any records of fuel and power use, bills, meter readings, deliveries etc for the past 12 months.

2. Rationalise and allocate - Relate records and expenditure to each enterprise on the farm.

3. Inspect all equipment - look in particular at condition, age, methods of control and operation in relation to energy use.

4. Inspect buildings and structures - e.g. lighting, heating systems and control, insulation and heat loss (gain) control.

5. Consider alternative methods of energy production - e.g. renewable energy. There may be opportunities to develop a renewable energy enterprise within the farm business.

Figure 3: The principles of farm energy auditing. Source: Centre for Alternative Land Use (2007)[6].

The Carbon Trust offer energy saving advice tailored to the agricultural and horticultural industries e.g. their agriculture and horticulture fact sheet suggests some introductory ideas for reducing energy use. See http://www.carbontrust.co.uk/publications/publicationdetail?productid=GIL139 ADAS, CALU, EST and Farming Connect can all offer advice on farm energy efficiency.

The Country Land and Business Association have developed a free Carbon Accounting for Land Managers tool (CALM). See http://www.calm.cla.org.uk/. The tool calculates the carbon emission and sequestration balance of land based businesses through the online input of data on energy and fuel use, livestock, cultivation, land use change, fertiliser application, soil types and woodland cover. Once all data is input the calculator produces a report breaking down carbon emitted and sequestered by source, alongside mitigation advice notes relating to each source. Alternative equivalent carbon accounting tools include the CPLAN tool available at http://www.cplan.org.uk with others currently being developed by Bangor University and a farmer at Blaencamel Farm, Aberaeron.

Regional groups wishing to be proactive on agricultural emissions may wish to produce a farm energy and emissions advisory page on constituent local authority websites to communicate the availability of the above resources. Building upon this, as with offering energy audits to homeowners, **Regional groups could seek out partnerships with e.g. the National Farmers Union or the Farming and Wildlife Advisory Group to approach farms within the Region to carry out or provide support and advice relating to the above energy audits and carbon accounting**. **Local Authority owned farms represent an ideal opportunity for piloting such a scheme with tenants, although scope for this may be limited in many areas.** Advice on farm carbon accounting will be provided by the Farming Connect advisory service, therefore engagement with the service will be essential to understand where the Regional Group can add value.

Sources of advice and / or information for farmers on sustainable agricultural practices include Farming Connect, The Centre for Alternative Land Use and The Soil Association.

8.4.2.2. Livestock Management

Emissions from livestock, in particular enteric fermentation and animal wastes are agriculture's most significant contributors to greenhouse gas emissions. In Wales sheep and beef production are the predominant forms of agriculture.

Research into carbon emission reductions possible through livestock often produces conflicting advice. Reducing livestock numbers on farm will reduce overall emissions however, with increased numbers and more intensive farming practices the emissions produced per unit of product may be lower.[7] At a national level this may call for reduced levels of livestock overall with a focus on intensive farming. A recent study by Bangor University demonstrated lower emissions from intensive dairy farms with high yielding cows and low nitrogen inputs than from alternative extensive and organic systems. It must also be considered that the overgrazing of grassland may reduce the amount of stored carbon. Reducing livestock numbers to focus on producing a high quality niche product or, alternatively, farming intensively to benefit from economies of scale both present potential financial opportunities for farmers. An article by RuSource (the Rural Information Network) fully discusses the greenhouse gas emission associated with grazing livestock in intensive and extensive systems, see http://www.arthurrankcentre.org.uk/projects/rusource_briefings/rus08/743.pdf. Similarly, the carbon implications of meat production vs. grain production are uncertain given that grassland emissions are lower than for arable land, but livestock emissions must also be accounted for.[7]

Other opportunities are commonly recognised as having potential for reducing greenhouse gas emissions from livestock and provide a focus for Regional groups wishing to work with farmers to tackle livestock related emissions:

- A move from sheep and beef meat production to pig and poultry production which emit less than half of the CO_2 equivalent per kg of product.[7] This shift may however lead to carbon leakage through dependence upon imported grains as feed, suggesting focus should be on reducing emissions per unit of sheep and beef production.

- DEFRA's milk road map looks at the whole life cycle environmental impacts of milk production and consumption, highlighting opportunities for improvement. Recommendations for emissions reductions include increasing cow longevity to improve the ratio of methane produced per unit of output and increasing milk yields per cow. See http://www.defra.gov.uk/environment/consumerprod/pdf/milk-roadmap.pdf. DairyCo provides advice and business tools for dairy farmers in addition to access to up to date research results with information including information on environmental issues. The

Dairy Development Centre (DCC) is delivering a Dairy Development Programme on behalf of the Welsh Assembly Government's Farming Connect. As part of this the centre has a network of working, commercial demonstration and development farms to help communicate best practice and new technologies to farmers in Wales. The farms hold public open days and owners can be contacted directly. **Awareness of the availability of this resource and DCC factsheets should be raised amongst farmers at a potential source of information and advice for improved efficiency.**

- Preventing overgrazing of grassland will increase vegetation cover thus increasing carbon accumulation in the soil. The timing and intensity of grazing directly impact soil carbon accumulation.

Direct emissions from livestock can be reduced through:

- Dietary change or dietary additives such as adding oil or oil seeds to feed, adding bacterium which breakdown methane to feed and dedicated flatulence vaccines. have all been shown to reduce methane production. Replacing forage with concentrates in the diet may reduce emissions per kg of feed and per kg of product.[7] Grass variety grown may also influence grazing rumen methane emissions – with suggestions that legumes, white clover and birdsfoot trefoil may alter plant breakdown process and reduce methane emitted. Much research into dietary impact on methane emissions is and has been conducted in the UK and worldwide, but there are appears to be no consistent advice to farmers on which method to adopt. The "Ruminant Nutrition Regimes to Reduce Methane and Nitrogen Emissions" research currently being undertaken by Aberystwyth University appears to be at the fore front of current research.

- Similarly, accurately matching feed composition to animal requirements can reduce methane emissions per unit of product. Typically this process requires an animal nutritionist to calculate an optimum diet. Building upon this, ruminants are inefficient users of dietary nitrogen, with much of the nitrogen taken in leading to production of nitrous oxides in waste excretions. Again, research is being undertaken to improve the uptake of nitrogen from feed. Identified solutions include integrating novel crops into the diet and feeding a diet balanced in protein and energy. No guidelines for farmers on best practice are seemingly available.

- Breed selection may influence methane emissions e.g. selecting breeds with a lower feed intake or with a shorter rearing time can contribute to methane emission reductions. Again there appears to be no consistent advice on this available to farmers.

- **Given the need for clarity, in relation to the above research, Regional groups can support and encourage methane livestock emission reduction research through**

Universities within the Region and can also seek to facilitate communication between research institutions and farmers.

Better manure management can reduce or capture emissions from waste:

- Anaerobic digestion is the natural decomposition of organic materials into methane and carbon dioxide – forming a biogas which is captured and can be used in electricity generation. This decomposition also produces a compost / digestate which can be applied in place of fertiliser to land. The process generally occurs in a dedicated sealed vessel which is warmed in the absence of oxygen to allow material decomposition by naturally occurring bacteria. Anaerobic Digestion can be carried out on commercial scale in a centralised location or on a smaller farm scale. Farm feedstocks can include animal manure, agricultural crops, food waste and organic household waste. **Following the allocation of £26 million by the Welsh Assembly Government for investment in anaerobic digestion facilities at a local authority level, Regional groups can seek to facilitate discussion between LAs and the local farming sector to identify opportunities for joint working on this issue.** Developing AD facilities adjacent to farm clusters may boost feedstock availability in return for digestate and/or heat or power provision for contributing farmers. A 2009 DEFRA report states that the National Farmers Union aspires to 1,000 farm based AD units in the UK by 2020 and 100 large waste linked units in which farmers also play a role.[8] **Working with stakeholders such as the NFU provides Regional groups with an opportunity to develop strategies to support and promote the uptake of AD on farm and enable links between LA AD and farmers.**

- Improved storage of manure in lagoons can minimise methane emissions e.g. through cooling the store, covering the lagoon and capturing emitted methane. This is amongst a series of easily implementable solutions which should be communicated to the agricultural industry.

4.2.3. Crop Management

Crop cover plays a key role in soil carbon sequestration as discussed in the sequestration section (4.4). Crop management in terms of efficient application of agrochemicals and manure can play a role in reducing direct and embodied emissions from these sources. More efficient application is particularly important in the reduction of nitrous oxide emissions from wastes and fertilizers.

Opportunities include:

- Precision farming i.e. taking into account in field variations to inform the accurate matching of agrochemical application to crop needs at a spatial level. Through measuring differences in soil type, depth, nutrient levels, topography and weed

cover across a field input levels can be varied across a field to match specific requirements. This is a financially demanding option which is likely to be feasible only for the largest landowners in Wales. A viable alternative for Wales is adopting a low input system such as Linking Environment and Farming, see http://www.leafuk.org/leafuk/organisation/Default.asp?id=4030338.

- Utilising cropping patterns to minimise necessary agrochemical input (i.e. green manures) e.g. through rotating crops with legumes to fix nitrogen within the soil or through utilising winter cover crops as feed for grazing livestock with remaining crop residues to be incorporated into the soil to increase nitrogen content.
- On average crops recover just 50% of fertiliser nitrogen applied. This surplus nitrogen is open to leaching and volatilisation and through microbial activity may be converted to nitrous oxides. Opportunities to minimise losses to the environment are matching fertiliser application more precisely to crop needs; placing fertiliser more accurately; timely application to avoid e.g. periods of heavy rain; maintenance of fertiliser application equipment; switching to lower nitrogen content fertilisers when possible; utilising slow release nitrogen fertilisers to enable crops to recover more nitrogen over a longer period and utilising anaerobic digestion digestate as a fertiliser replacement.
- Making use of crop varieties which require lower agrochemical inputs.

See http://www.hgca.com/cms_publications.output/2/2/Publications/Publication/Arable%20Cropping%20and%20the%20Environment%20Guide.mspx?fn=show&pubcon=893 for a full guide on sustainable arable cropping.

The Welsh Assembly Government's Farming Connect provides advice, support and expertise for farm businesses in Wales. See http://wales.gov.uk/topics/environmentcountryside/farmingconnect/;jsessionid=kjw6JvgVTFFpjHnyyPhYhN2FdQ6kJtKxzMyt2F4rTpv59nh9M6w7!-1868201774?lang=en. Part of the remit of the Farming Connect team is the provision of advice on sustainable farming practices. **Any Regional group wishing to encourage the uptake of emission reducing practices such as the above may wish to look at how to work with or alongside this service in its communication with farmers.** A key issue in managing livestock and crops for reduced emissions appears to be the lack of guidelines communicated to farmers from the research stage. **Dissemination of information and facilitation of communication between research organisations and farming bodies could be an important role for Regional groups.**

Box RLU2. Mechanisms to reduce emissions from agricultural practices

I. Promote the uptake of energy auditing and carbon accounting on farm.

II. Work with relevant partners such as NFU, FUW, CLA and Farming Connect to engage farmers in improved livestock and crop management for green house gas emission reductions.

III. Promote and support research into reducing methane and nitrogen compound emissions from livestock, increasing nitrogen uptake from feed and breed selection for emissions reductions to culminate in best practice guidelines for farmers.

IV. Ensure Local Authorities investing in large anaerobic digestion plants site the facilities to make use of feedstock available through clustering farm waste.

V. Explore opportunities to pilot lower carbon agricultural techniques through working with tenants of Local Authority owned farms.

VI. Support the establishment of environmental farming co-operatives

Box RLU3. Measuring success for emissions from agricultural practices

- Number of farmers within the Region accessing CLA's carbon accounting tool or CALU's energy auditing manual
- Number of farmers engaged in a project to improved livestock and crop management for green house gas emission reductions
- Research is commissioned to look into reducing methane and nitrogen compound emissions from livestock, increasing nitrogen uptake from feed and breed selection
- Quantity of local agricultural waste input to local authority anaerobic digestion facilities
- Percentage of local authority owned farms participating in carbon reduction pilots
- Number of environmental farming co-operatives established

4.2.4. Energy and Fuel Use

Whilst enteric fermentation and animal wastes are the key sources of agricultural emissions, fuel and energy use on farm provide further opportunities to lower total farm emissions. Approximately 36% of direct energy used in agriculture is reportedly fuel used in field operations[9].

As part of the One Wales Progressive Agenda the Welsh Assembly commits to developing a support programme for the promotion of energy efficiency and renewable energy production on farm.

As highlighted previously, undertaking a farm energy audit will help to identify key opportunities for reducing and improving the efficiency of energy use on farm, cutting down on associated CO_2 emissions and maximising the benefit of any renewable energy utilised. Simple measures can be undertaken which will help to reduce fuel and energy use:

- Maintenance of equipment e.g. ensuring thermostats are set at the right temperature
- Correct tractor ballasting and tyre selection
- Matching equipment size and capacity to the requirements of the job

4.2.5. Renewable Energy

Improving energy efficiency and reducing energy use should be tackled prior to the installation of microgeneration technologies to maximise the contribution of renewable energy to overall energy used.

Through the availability of space and natural resources the generation of renewable energy on farm provides an opportunity to reduce energy consumption related emissions. Further benefits include contributing to the security of farm energy supplies, and subsequently domestic food production. Microgeneration may be particularly beneficial for energy intensive farming operation such as specialist horticulture utilising heated glass houses and heating water in dairy farming (see Table 3).

Table 3: Typical annual energy use on farm. Source: Welsh Assembly Government (2008)[9]. *Reproduced under the terms of the Click-Use Licence.*

Typical electricity usage (Enterprise)	**Average Range (kWH)**	**GHG Emission per unit (kg CO_2 e)**
Dairy (per cow)	273 - 434	422 – 672
Beef (per head)	36 - 63	56 – 97
Sheep (per head)	9 - 16	13 – 24
Arable (per ha)	66 - 225	102 – 349
Grain drying (per tonne)	41 - 123	65 – 191
Typical fuel usage	**Average Range (litres)**	**t CO_2 eGWh ha^{-1} [3]**
Glasshouse heating (heating oil/ha)	123,582 - 297858	0.58 – 1.39

[1]0.16 grid primary energy [need to convert by multiply by 0.43, not 0.16]

[2]Arable = root crops, cereals

[3] (litres x 38) x 0.2778

Careful selection of renewable technology, tailored to farm resources and needs, will help to maximise the financial and energy efficiency of the installation. For example a solar hot water system may be particularly applicable to dairy farms which have a high hot water demand. Anaerobic digestion is dependent upon a consistent supply of organic waste and will therefore be well matched to farm with large numbers of cattle or pigs. Farms with waste wood from woodland management, hedge management and with land available to grow dedicated energy crops should look at the opportunity for biomass boiler installation.

Renewable energy generated on farm could alternatively be sold to the grid and act as an offsetting mechanism for farm emission and to generate an alternative income source. As fuel costs rise investing in microgeneration on farm becomes more feasible. Table 4 gives an idea of the costs of a range microgeneration technologies:

Table 4: Capital costs of microgeneration options. Source: Created using data from Department for Business, Enterprise and Regulatory Reform (undated)[10] and Farming and Wildlife Advisory Group (undated)[11].

Technology	Capital Costs (thousand £s)	Installation size - maximum power output (kW)
Solar PV	7.5 to 22.5	1.5 to 3
Biomass boiler	5 to 14	20
Wind turbine	11 to 19	2.5
Anaerobic digestion	50 to 70	10
Small scale hydro	20 to 25	5
Ground source heat pump	6 to 12 plus installation	8 to 12
Air source heat pump	6 to 8	5

Amongst the key results of a recent farm greenhouse gas emissions survey by Natural England – the Carbon Baseline Survey Project – was that "*A combination of increasing the uptake of renewable energy on farms together with woodland planting and management could potentially have a big impact on reducing a farm's net GHG emissions."*[12] Supporting and promoting microgeneration on farm is ultimately a role that the Welsh Assembly Government is intending to play, however **Regional groups have the opportunity to stimulate progress now and bring the microgeneration agenda to the forefront of the farming sector's mind in preparation to make the most of future Welsh Assembly Government support mechanisms**. As part of the new Glastir agri-environment scheme funds are being made available for the support of microgeneration on farm.

To promote the uptake of microgeneration technologies within a Region financial, advice and support provision should all be considered. The formation of an ESCO, an Energy Partnership and the creation of revolving funds, (as discussed in the Built Environment and Energy chapter of this report, sections 3 to 5), all provide potential to deliver financial incentives to and support for landowners to install microgeneration systems (and similarly energy efficiency measures). Partnering or working with farm advisory services in delivery will enable the provision of expert advice. For example, in 2006 the Farming and Wildlife Advisory Group partnered with Nidderdale Are of Outstanding Natural Beauty to provide an Environmental Stewardship advice service dedicated to landowners in the area. Existing sources of information and / or advice on microgeneration to be utilised include the Centre

for Alternative Land Use's energy efficiency and energy generation farm guide, see http://www.calu.bangor.ac.uk/documents/energybk_en.pdf; the Sustainable Energy Network; regional energy agencies; the Energy Saving Trust, the Centre for Alternative Technology and as previously highlighted the Carbon Trust and Farming Connect. As highlighted in the Built Environment and Energy chapter of this report the Carbon Trust's wind yield estimator available at http://www.carbontrust.co.uk/windpowerestimator/ allows businesses to calculate, free of charge, the power generation potential, costs and carbon savings of a small wind turbine installation on site. The Energy4All's Energy Steps Wind Project Generator, see http://www.energysteps.coop/, also previously highlighted is a step by step set of instructions/considerations for community wind projects. Much of this will also be useful in the development of wind power on farm.

Improved management of farm woodland has the potential to produce valuable quantities of feedstock in Wales. Around a quarter of Welsh woodland is within farms and is though to be largely unmanaged. The Welsh Assembly Government estimates that farm woodlands in Wales could potentially produce 0.029 TWh of electricity annually or 0.097 TWh as heat annually if 50% of the wood over 18cm were used, reducing emissions by up to 15631 tonnes of CO_2 equivalent compared to a National Grid supply[9]. **The promotion of the active management of farm woodland to provide a biomass feedstock for use on farm or locally could be part of a farm renewable energy campaign instigated by Regional groups and could be promoted to coincide with the launch of the successor grant to the Wood Energy Business Scheme.** Conversion of biomass to heat is far more efficient than conversion to electricity which should be recognised by Regional groups in any communication with the farming sector. The Farm Woodland Forum (see http://www.agroforestry.ac.uk/index.html) acts as an information exchange for all aspects of farming with trees, facilitating the sharing of best practice. Coed Cymru piloted a First Steps grant scheme for small scale capital works, the outcomes of which may be taken forward in future by the Forestry Commission as a means of encouraging the management of woodland[13]. **Regional groups should be aware of the possibility of the development of a successor scheme which they can help to communicate to farmers.** This is also likely to be a feature of the new Glastir agri-environment scheme.

Growing dedicated energy crops can provide feedstock for a biomass boiler on or off farm i.e. biomass crops such as miscanthus and reed canary grass to produce heat and / or electricity; or alternatively can provide a base material for the production of biofuel i.e. biofuel crops such as oil seed rape for conversion to biodiesel to be used as transport/machinery fuel. In the context of Regional low carbon solutions and reducing on farm emissions this report will mainly focus upon the use of energy crops on farm.

Even on high carbon content soil converted from grassland it is estimated that a 15 year miscanthus rotation can have a net emissions reduction [9]. The production of energy crops

for use in a biomass boiler or fuel production on or off farm should involve careful consideration of the carbon emissions associated with the land use change, the distance the feedstock will be transported to its end use and any agrochemical inputs to the crop. Oil seed rape for example, is a high input crop. **Any support for the growth of energy crops by Regional groups, whether financial or advisory should promote growth on low carbon soils, avoiding conversion of permanent pasture to energy crops and should promote local use of the resource.** The SDC is keen to see the UK government and the Welsh Assembly Government develop sustainability standards for energy crops to ensure overall emission reductions.

It is estimated that approximately 29% of the land area of Wales is suitable for biomass crop growth. Numerous research organisations including Willow for Wales and The Wales Biomass Centre are currently looking at the potential for and the suitability of different crop varieties and breeds in the Welsh Climate. The economics of biomass crops is contentious. Research has demonstrated that biomass crop growth can be economic e.g. SRC can be profitable when wood fuel prices are £40 per oven dried tonne or above, even for low yields given a crop establishment grant of 40%[14]. The consultation review of Axis 2 of the Rural Development Plan for Wales 2007 to 2013 demonstrates that most biomass crops have a negative net margin return and will require significant subsidy and as such the Welsh Assembly Government states that it is minded not to introduce planting grants for energy crops. The Welsh Assembly Government's focus appears to be on increased management of farm woodlands to provide feedstock for small, local heat plants and on stimulating local demand for biomass e.g. through continuing with a scheme similar to the Wood Energy Business Scheme. This stance was reiterated in the recent Welsh Assembly Government announcement on the new Glastir agri-environment scheme.

The Axis 2 review consultation paper does not consider the production of biofuels from arable crops stating that this requires high quality agricultural land which is limited in Wales. The greenhouse gas emissions balance of the growth and use of biofuels varies considerably depending upon crop, growth method, inputs and conversion process. **Again, any support programme initiated by Regional groups should focus upon sustainability considerations.** Biodiesel can be produced on farm through the growth and subsequent crushing of an oil seed crop to extract oil. Waste vegetable oils and animal fats can also be used to produce biodiesel. **Regional groups could seek to co-ordinate the sourcing of suitable local authority wastes collected to provide supplementary feedstock for farmers wishing to enter into biodiesel production, with a view to using the fuel on farm and within local authority waste collection vehicles.** Biodiesel can be used as a blend with mineral diesel or alone and should be promoted as a fossil fuel substitute in farm vehicles and machinery. Bioethanol is produced through the distillation of crops such as wheat and barley. This can be used as a 5% blend in petrol. Conversion to bioethanol is unlikely to be possible on farm and therefore does not provide an opportunity to reduce farm fuel related emissions. Second generation biofuel crops i.e. fuels derived from food crop waste or by-products of other processes are now being developed. It is though that these will be commercially available within 5 to 10 years. **Regional groups can play a role in supporting research in this field.**

Box RLU4. Mechanisms to reduce non-renewable energy and fuel use on farm

I. Work with relevant partners such as NFU and Farming Connect to increase awareness and uptake of simple fuel reduction techniques.

II. Work with relevant partners such as NFU and Farming Connect to support and promote microgeneration uptake on farm, keeping up to progress with potential funding from the Low Carbon Buildings Programme and the second Wood Energy Business Scheme.

III. Utilise part of the resources put into ESCO, energy partnership or revolving fund establishment to target energy efficiency and renewable energy uptake in the agricultural industry.

IV. Work with relevant partners such as NFU and Farming Connect to support and promote the use of existing and purposefully planted biomass crops for conversion to heat, power and fuel.

V. Facilitate communication between groups of famers / co-operatives and local biomass plant developers to co-ordinate biomass supply and demand.

VI. Support the establishment of environmental farming co-operatives

Box RLU5. Measuring success for non-renewable energy and fuel use on farm

- A partnership and subsequent programme of action is developed with NFU or equivalent farm advisory organisation to increase energy / fuel efficiency and promote renewable energy on farm
- Capacity of on farm renewable energy within the region
- Number of farms with community scale renewable generation units
- Number of farmers managing woodlands and growing dedicated biomass crops to provide feedstock for biomass and biofuel plants either on farm or commercially
- Any ESCO, energy partnership or revolving funds established for energy efficiency or decentralised energy, targets the agricultural sector as part of its remit
- Number of environmental co-operatives established

4.2.6. Environmental Cooperatives

The Welsh Assembly Government's Renewable Energy Route Map and Woodlands for Wales consultation paper propose encouraging co-operation between farmers to jointly source and utilise biomass resources. The environmental co-operatives approach as detailed below provides an opportunity for landscape scale management and co-ordination of biomass resources including the management of existing woodlands. Co-operative sourcing of woodfuel could enable farmers to invest jointly in a large biomass boiler unit with a small district heating system to provide heat across a number of farms or to jointly invest in an oil press for the conversion of purposely grown crops to biodiesel for use on the farms.

Environmental cooperatives are voluntary groups of farmers working together at a local or Regional level to protect and enhance the environment and develop their rural economy. Cooperatives allow the development of projects and initiatives which span across farm boundaries allowing landscape scale management.

This co-operative approach is reportedly common in the Netherlands, with groups developing their own remit and agenda, primarily focused on nature and landscape management e.g. landscape scale tree planting. Other reported initiatives include offering advice services to land managers, developing agri-tourism and participating in on farm research. Environmentally concerned and committed founding members appear to have been central to the establishment of Dutch co-operatives. Potential benefits include joint working allowing entry into new activities and providing new revenue opportunities.

Research on Dutch cooperatives[15,16,17] does not highlight low carbon land management initiatives as part of the remit of these groups, however landscape scale management is essential for low carbon land use at a Regional level. The cooperative approach allows the sharing of resources, knowledge and risk to enable the establishment of low carbon land management projects and practices. Environmental cooperatives could make valuable contributions to landscape scale carbon saving and sequestration through implementation of projects such as:

- Cooperative groups could play a key role in researching the feasibility of shared renewable energy installations. Research into cooperative anaerobic digestion for dairy farms in Wisconsin, U.S. highlighted the benefits of shared inputs, responsibilities and costs amongst cooperative members.[18] Key considerations were raised in the aforementioned research report regarding the feasibility of cooperative AD including: total manure (and other feedstock) availability from across the farms; the constancy of the feedstock supply; initial cost and potential long term savings and the level of motivation to participate amongst farmers. Environmental cooperatives could deliver farming community energy projects such as shared wind turbines or biomass fuelled heat and power systems, fed with crop residues and woodland wastes.

- A combined low carbon approach to farming e.g. minimising fertiliser use; reducing livestock levels to focus on production of higher quality, niche products and practicing agroforestry. Cooperative low carbon farming could create a market for these products.

- Landscape scale tree planting on mineral soils carbon sequestration in soils and plant biomass

- Local food initiatives to reduce emissions from the transport, processing and packaging of food.

Reports on Dutch environmental cooperatives highlight a number of common elements of successful establishment and operation[15,16,17]:

- An elected board of officials to steer the work of the group
- Monthly meetings of the above management board in formal meetings
- Sub-committees formed to manage and oversee the delivery of particular projects
- Meetings of the full membership on average twice a year
- Establishment around a common issue which unites farmers within a locality
- The development and adoption of a constitution setting out cooperative rules and procedures
- A locally focused, participatory work programme / agenda developed by members
- Most cooperatives allow members to opt in and out of projects of interest to ensure only project with sufficient support are undertaken

- Undertaking small projects to begin with to achieve rapid successes to maintain enthusiasm of existing members and attract others
- Avoiding reliance on a single source of funding
- Allowing non farmers to join for networking and wider delivery purposes

In the Netherlands government support and incentives for cooperatives has been key to their expansion. Whilst in Wales, these support frameworks are absent the cooperative approach can still be successful as demonstrated by Pontbren Farmers Group:

Case Study RLU1. Pontbren Farmers' Co-operative

Pontbren Farmers Group operating in the north of Powys is the most prominent example of a successful environmental farmer's cooperative in the UK. Ten small neighbouring farms have grouped together to farm in a more traditional way for the benefit of the environment. Together they have identified individual and collective opportunities for improving the future of their farm enterprises. The group has undertaken a number of actions and projects including landscape scale woodland and hedgerow planting, collective sale of products to secure contracts with major retailers, the use of waste wood chipped on farm as animal bedding as a replacement for transported straw. The cooperative is currently developing its own environmental standards and inspection procedures. The group's ability to deliver on a range of environmental agendas at a landscape scale has been acknowledged in funding secured from sources including the Welsh Assembly Government and the Welsh Council for Voluntary Action. Further funding and collaboration has been secured through on farm research projects e.g. in conjunction with the Forestry Commission. See http://www.pontbrenfarmers.co.uk/index.html for further details.

Although not widely adopted, this cooperative approach has the potential to deliver renewable energy projects in addition to carbon sequestration and better management of resources to minimise carbon emissions whilst delivering financial savings, opening up new revenue streams and benefiting biodiversity. **Spatial Plan Regional groups could play a role in raising awareness of this approach and supporting the establishment of such groups through facilitation, funding and support according to the resources available within the group. As a first step groups could look at opportunities for the establishment of a pilot environmental cooperative within the Region, perhaps across local authority boundaries to maximise funding opportunities.**

Support for environmental co-operatives provides an opportunity for Regional groups to deliver on any or all of the low carbon agricultural solutions suggested. Similarly, working with a few selected farms within the Region to instigate a range of low carbon solutions will provide an education / communication tool for promoting low carbon farming. A condition of support or funding for the selected farm(s) could be that they agree to host an open farm day to enable neighboring farmers to view and engage with low carbon practices (e.g. as with the Dairy Development Centre's demonstration farms previously discussed).

4.3. Food

As highlighted in the background information, food is responsible for almost 1/10th of each Spatial Plan Region's carbon footprint. Emissions associated with production have been addressed in the agriculture section above (4.2). Following agriculture, transport and food manufacturing make the next biggest contributions to greenhouse gas emission from the food chain.

Recent research questions the use of food miles and traditional carbon foot printing as proxies for the environmental and carbon impact of food. Carbon emissions from food consumption are far wider including emissions released from soils under crops, emissions from manufacturing and packaging, and emissions from food preparation and storage. The traditional carbon footprint of individual crops does not take into account emissions from the soil (nor carbon returned to the soil by some crops) and as such cannot convey the true carbon impact of a product. Through Ministerial groups, the Spatial Plan should seek to lobby the Welsh and UK governments for the introduction of a comprehensive, comparable single carbon footprinting procedure for food.

Whilst much of this section relates to the promotion of quality local, seasonal food production and consumption to reduce transport and processing emissions, a truly comprehensive approach to promoting low carbon food consumption should be taken by Regional groups. Livestock and crops must be managed to minimise emissions as previously set out, domestic energy use must be tackled through measures put forward in the Built Environment and Energy chapter of this report, packaging must be minimised as set out in the Waste chapter of this report, and individuals should be encouraged to grow their own food to reduce food transport and inputs. The Welsh Assembly Government's Land Use Climate Change Group is looking at whole food chain emission reduction options.

What constitutes a low carbon or sustainable diet is difficult to define given that e.g. on a land area basis greenhouse gas emissions from organic production are typically lower than for an equivalent area of non-organic production, however, per unit of crop yield emissions from organic production may be higher[7]. General principles of a low carbon diet are eating local, seasonal food, wasting less food, minimizing energy use in cooking and storage, taking

fewer trips to the supermarket and cutting down on carbon intensive food such as red meat and dairy products. Within Wales eating local produce and cutting down on red meat and dairy is somewhat contradictory, additionally reduced demand for red meat would impact upon the livelihood of Welsh farmers. **As a consequence Regional groups should prioritize working with Welsh meat farmers and dairy producers to cut down emissions from their operations through the livestock management, energy efficiency and other opportunities discussed above. Alongside this Regional groups should work on the promotion of quality local food to cut down on both transport and manufacturing related emissions. Researching opportunities and providing support for farmers to diversify to fruit and vegetable production will also be an important element of increasing food supplied locally.**

Procurement and choice editing both have key roles in stimulating markets for local food.

4.3.1. Procurement

Regional groups and Local Service Boards can play a key role in supporting the procurement of quality local food by the public sector. With issues such as uncertainty regarding legality of sustainable procurement, a failure to understand whole life costs and lack of drivers for changing suppliers standing in the way of sustainable procurement[19], **Regional groups and Local Service could provide the advice and impetus needed for a shift in public procurement of food to include more local produce where possible**. **Schools and hospitals provide Regional groups with clear targets within which increased procurement of quality local foods would provide maximum societal and health benefit.**

European Public Procurement Legislation (Directives 2004/17/EC and 2004/18/EC) now allows for some consideration of social and economic criteria alongside economic criteria in procurement. However, procurement of local food is seen to discriminate against non local businesses and is therefore not allowed under EU legislation. Research by Cardiff University into the role of public procurement in relocalising the food chain has found that a number of European regions are successfully procuring local produce through using permitted criteria which happen to favour local or at least domestic produce[20,21]:

- Freshness
- Seasonality
- Organic
- Protected Designation of Origin (PDO) and Protected Geographical Indication (PGO) foods such as PGI Welsh Lamb (which are food standards recognised by the EU and can legally be demanded in public procurement)
- “Lots” which allow small producers to bid for part of a contract

Utilising these quality criteria other European countries are stimulating local food chains through public procurement whilst providing high quality food in schools and hospitals. The European Commission has produced a simple guide on the "Legal Framework for Green Public Procurement", available at http://ec.europa.eu/environment/gpp/toolkit_en.htm. This is part of the EC's green public procurement toolkit which provides a full set of resources including legal guidance and examples of environmental criteria to be used including a set for food and catering services.

A wealth of resources exist to assist Regional groups, Local Authorities and public bodies to procure local and sustainable food, including:

- Value Wales' X-Change Wales websites "Buy4Wales" and "Sell2Wales" are national procurement websites established to connect buyers and suppliers in Wales. The Buy4Wales procurement route planner available at https://www.buy4wales.co.uk/PRP/index.html sets out a best practice approach for public procurement, recognizing procurement's role in sustainable development. Welsh producers wishing to sell to the public sector can register at https://www.sell2wales.co.uk/index.html.
- Food Vision has developed a toolkit giving an overview of sustainable food procurement for local authorities, see http://www.foodvision.gov.uk/pages/local-authority-sustainable-food-procurement. The toolkit highlights how sustainable public food procurement can be compatible with the themes of Local Area Agreements, equivalent to Local Delivery Agreements here in Wales.
- DEFRA's Public Sector Food procurement Initiative resources include a catering and food procurement toolkit, available at http://www.defra.gov.uk/farm/policy/sustain/procurement/index.htm.
- Sustain, the alliance for better food and farming, are involved in numerous local food procurement projects in London. The Good Food on the Public Plate project, working with hospitals and care homes provides ideas for working with these organisations to increase sustainable food procurement including providing training on procurement for staff, arranging farmer and supplier visits to hospitals, creating a database of local suppliers. See http://www.sustainweb.org/page.php?id=73.

Influencing the procurement of the private and third sector to favour local food presents an even more difficult challenge for Regional groups. A first step to achieving this will be increasing the visibility of local food supplies and their potential benefits in terms of quality and towards improving the green image of the organisation. Using their procurement of local food and drink can act as a marketing tool for businesses e.g. in the tourist sector.

Case Study RLU2. Local Food Talks

Local Food Talks is a partnership project promoting food and drink from Mid-Wales amongst the tourism, hospitality and retail sectors. Run by the Welsh Assembly Government, Tourism Partnership Mid Wales and the Mid Wales Agri-Food Partnership the project's focus is raising awareness and educating through a programme of events. Events have included using local food in pub menus aimed at chefs, business managers and owners; tasting sessions for tourist and hospitality sector managers and workers; workshops on marketing your business using food and drink; and food expert panel discussions. This active approach to promoting local food has achieved wide reaching success in engaging tourism and hospitality related businesses and provides a model for engagement with the private sector.

To deliver such a programme of events Regional groups could seek to initiate communications between existing food, farming and sustainability partnerships and organisations within the Region.

In support of promoting local sustainable food procurement in the public, private and third sectors Regional groups should look at the possibility of creating a local suppliers database, to be hosted on e.g. Local Authority websites and accessible to all. The voluntary organisation Sustainable Gwynedd has produced an online directory of local food producers in Gwynedd (http://www.gwyneddgynaladwy.org.uk/english/index.htm) providing a valuable resource for individuals and procurement officers wishing to purchase locally.

A Centre of Excellence for Welsh Food is to be established in North West Wales having been successful in a bid for convergence funding. The Centre will promote Welsh food whilst strengthening communication between food producers, processors and customers. In future this may serve as a source of advice and information for use in the promotion of local food amongst businesses and the public sector.

4.3.2. Choice Editing

Choice-editing is the selection of which goods and services to sell to customers by manufacturers, retailers, service-providers and governments. In the case of food sales, choice editing by the retailer could involve selling increased numbers of local, sustainable products to promote the purchase of local food amongst its customers. Possible methods to influence retailers into choice editing for local food could be hosting choice editing events

for food retailers as part of a wider initiative such as the Local Food Talks programme discussed above. **Regional groups could seek work with existing food or/and sustainability partnerships and organisations as a vehicle for delivering such events for the food retail sector.**

4.3.3. Local Seasonal Food / Grow Your Own

In addition to influencing procurement and choice editing Regional groups can work in partnership with public, private and third sector organizations to promote local food production through instigating various local food initiatives to encourage the individual to source more food locally. In isolation these initiatives may have little overall impact on the use of local food, however a comprehensive programme of local food initiatives will maximize awareness and participation:

1) Developing a local diet project such as the Fife Diet Project:

Case Study RLU3. The Fife Diet Project

The Fife Diet Project is a food experiment, initiated to encourage the local sourcing of seasonal food – cutting down on food miles and supporting the local food production sector. Fife diet aims are to:

- "Bring people together to eat good local food"
- "Boost the local community of food producers"
- "Make fresh organic produce more widely available"
- "Help each other re-learn how to eat seasonally"
- "Challenge the insanity of food miles"

The project asks people within Fife to sign up to sourcing their food from the local area for a year. Signatories are asked to share their experiences with others and give feedback on their progress. This is a flexible and interactive diet – participants are encouraged to source what they can from the local area and do not necessarily have to eat only food from Fife. All participants are provided with a list of local suppliers, with recipes using local produce shared on the project website, see http://fifediet.wordpress.com/about/. This local diet has highlighted the quality of Fife's local food supplies including highland cow beef and locally landed sea food. The Fife Diet project is now formalising as a food co-operative. The success of this approach has been recognised by the Scottish Parliament which is planning to create diet hubs based on the Fife diet project model.

Mike Small from the Fife Diet project believes that a number of elements are key to the success of such a project[22]:

- Holding public meetings
- Making it easy for people to participate by providing e.g. childcare for parents alongside meetings
- Creating a positive image and a sense of excitement amongst project participants in helping to tackle climate change

Within Wales the availability of quality local produce provides an ideal opportunity to replicate this local diet initiative within a Spatial Plan Region. **Through creating an online forum, researching and pulling together a list of local suppliers and producing local diet branding and literature, Regional groups in conjunction with constituent local authorities and relevant community groups such as community garden groups e.g. Prestatyn**

Community Garden in North East Wales Region, can establish a local diet encouraging people to sign up to sourcing what food they can locally. The Fife Diet was inspired by Vancouver's 100 mile diet where signatories source all food from within a 100 mile radius. Within Wales limited crop cover will make sourcing all food from within a Region difficult, therefore a more flexible approach – asking people to source locally where possible, and establishment in conjunction with community garden and allotment schemes is likely to be more successful.

2) **Working with Local Councils and Authorities to map out land in their ownership** which could potentially be made available for community food growing, either through leasing to a community group or individual or as a contribution to the community. Small parcels of land or derelict land with little use to the Local Authority could provide suitable sites for a community farm, community garden or new allotments.

3) **Supporting and developing community farms and gardens** provides an opportunity to deliver multiple benefits such as community cohesion, promotion of healthy living, enhancing biodiversity, providing work placements and engaging communities in growing their own food. Community Farms establishment:

Case Study RLU4. Swansea Community Farm

Swansea Community Farm is the only community led farm in Wales. Established by a group of committed individuals on land leased from the City and County of Swansea, volunteer time has been crucial to the establishment and on-going operation of the farm. Volunteer establishment of a management committee, community engagement and farm layout has driven forward organised activities, helping the farm to build a reputation for volunteering opportunities. This in turn has helped the farm to secure funding, and now employs 9 members of staff delivering farm based volunteer projects such as growing organic fruit and vegetables and rearing animals. As with many such initiatives a group of committed individuals was essential in establishing the farm, and replicating such a success will be unlikely without championing individuals to take this forward.

Options for replication of this type of approach are: attempting to source funding to establish a community farm, with managerial members of staff to generate a volunteer base perhaps in conjunction with local voluntary organisations; or working with existing farmers to promote community supported agriculture (CSA). This is the process by which a community will invest in a local farm in return for a share of the produce. A community's investment can be regular labour, sponsoring an apple tree which they harvest themselves, renting an allotment plot for their own use, renting an area of

farmland on which the farmer will grow crops for them. In addition to connecting communities to local produce growth and consumption CSA also provides benefits for farmers including diversifying income and selling direct to the consumer to maximise profit. The Soil Association has produced an action manual for setting up a CSA project aimed at farmers, available at http://www.localfoodworks.org/web/sa/psweb.nsf/cfff6730b881e40e80256a6a002a765c/5ef4ccb3db7864be80257442003226df/$FILE/Action%20Manual%20website%20latest%20version.pdf. Case studies and considerations for CSA are available at: http://www.localfoodworks.org/web/sa/psweb.nsf/cfff6730b881e40e80256a6a002a765c/5ef4ccb3db7864be80257442003226df/$FILE/Cultivating%20Communities%20booklet%20-%20the%20thin%20one.pdf. **A key starting point for Regional groups is to promote and increase awareness of CSA amongst producers and consumers – this could be done through mailing out literature on CSA to farmers and helping interested parties to develop pilot schemes in conjunction with Local authority community and/or environment departments or in conjunction with farming support organisations.** Key to developing community support for and buy into community farms and gardens will be working with local voluntary councils.

4) **Increasing allotment provision** provides a simple, well established option for increasing community involvement in local food production. Preston City Council is now halving allotments plots as they become vacant and re-leasing them as two plots to decrease waiting times which will maximise on the number of people able to grow their own fruit and vegetables in urban areas.

5) **Ensuring garden, roof garden, allotment or/and community garden provision is considered in all new residential developments**, whether in rural or urban areas, will engage individuals in home food production. As previously touched upon, a change of residence or job is the best time to prompt behavioural change. Working with Local Authorities to ensure that this element of building sustainable communities is covered within Local Development plans or is required in Supplementary Planning Documents will enable Regional groups to influence this.

6) **Supporting local farmers markets** (selling local not specialist food) and local box schemes, even through simple measures such as including details within the database of local suppliers to be formed will help to promote local food consumption.

Useful sources of further information on local food and initiatives are www.makinglocalfoodwork.co.uk, www.localfoodworks.org, www.foodvision.gov.uk/ and http://www.farmgarden.org.uk/ .

Box RLU6. Mechanisms to increase local, seasonal food consumption.

I. Lobby the Welsh and UK governments to develop a single comprehensive carbon footprinting procedure for all food produce

II. Work with local authorities and Local Service Boards to increase public sector local food procurement through using criteria such as seasonality and freshness to justify local choice.

III. Work in partnership with specific industry representatives such as the regional Tourism Partnerships, alongside local producers to directly promote procurement of local, sustainably produced food in the private and third sectors. This can be expanded to promote choice editing for local, sustainably produce by food retailers within the region.

IV. Create and make publically accessible a database of local, sustainable food producers.

V. Initiate and promote a regional local diet programme.

VI. Work with local authorities to increase land provision for community food growing, exploring the opportunity for a community farm, community gardens and allotments.

VII. Work with local authorities to ensure land provision for food growing is a requirement in all residential and school developments e.g. roof gardens in blocks of flats, community or individual vegetable gardens.

Box RLU7. Measuring success for local, seasonal food consumption.

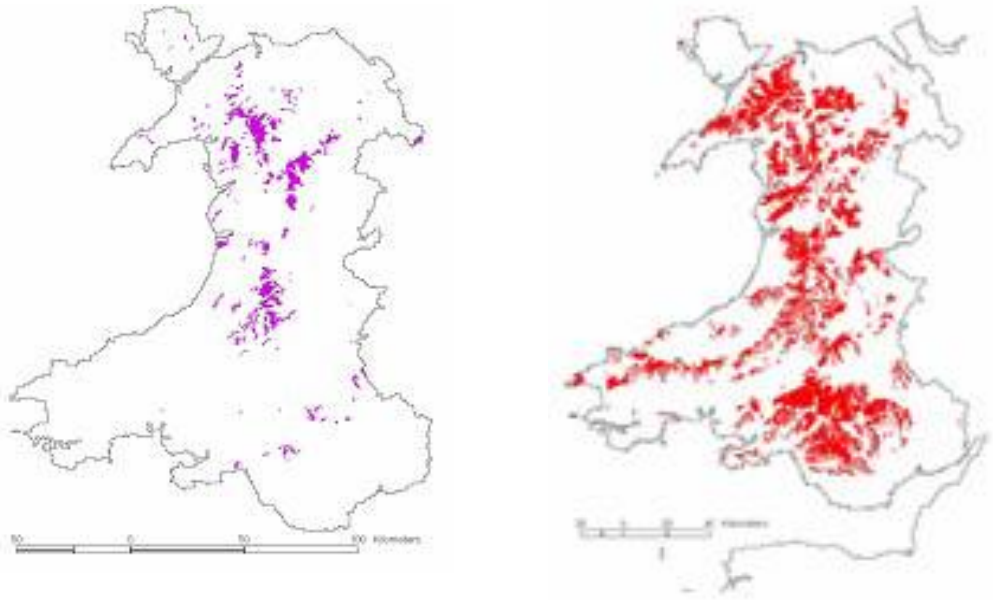
- Percentage of public sector food procured from within the Region
- A partnership or partnerships are established to promote procurement of local, sustainable food in the private and third sectors
- A database of Regional food producers is created and publicised
- A local diet programme is established and publicised
- Number of participants in local diet programme
- Area of land available within the Region for community food growing
- Percentage of schools within the Region with a vegetable garden providing produce for school meals
- Number of farms providing community supported agriculture opportunities
- Number of visitors to local farmers markets
- Percentage of new residential and educational developments with land provided for food growing
- Area of allotment land

4.4. Soil and Biomass Carbon Sequestration

An essential first step to enable Regional groups to work towards the protection of key carbon sinks, and potentially enhance sequestration on suitable land is having access to detailed maps of land use type and soil carbon content. Maps such as those used in the 2007 report "ECOSSE – Estimating Carbon in Organic Soils Sequestration and Emissions" provide a useful basis for understanding the soil types and associated carbon densities within a Region. Maps available from Cranfield University's National Soil Resources Institute are probably the most detailed maps of soil type and soil carbon content available for Wales, see http://www.landis.org.uk/gateway/ooi/welcome.cfm. Within each Region there may limitations to the data available on soil carbon and as such opportunities for further field research may arise. **Engaging Universities with the Region to provide the research resources required will enable Regional groups to construct a useful map of soil carbon.**

4.4.1. Managing existing stores

With an estimated 547 million tonnes of carbon stored in soils and plants in Wales the protection of existing carbon stores should be a priority for Regional groups. Over 80% of this is stored in upland soils and grasslands, providing real focus for the low carbon strategies of Spatial Plan Regions with a significant area of uplands such as the North West. Organic soils cover 20% of Wales and hold an estimated 50% of soil carbon. Figures 4 and 5 illustrate the distribution of high carbon content soils in Wales – peats (figure 4) and organo-mineral soils (figure 5):



Figures 4 and 5: Peat and organo-mineral soils in Wales. Source: Scottish Executive Environment and Rural Affairs Department (2007)[23] after Rudeforth et al., (1984) and Bradley et al., (2005).
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Approximately 76.6% of Wales is primarily low carbon content mineral soil[9].

Land management for the protection of existing soil carbon stores and for enhancing sequestration must take into account all potential greenhouse gas fluxes to ensure positive management. At present all soil GHG fluxes cannot be accurately accounted for[9]. The ECOSSE report prepared by Aberdeen University for the Assembly Government and the Scottish Executive modelled carbon and nitrogen dynamics in organic soils and looked at the potential impact of land use change. Based upon these strands of work the report gives best practice guidelines for the management of organic soils. **This should guide any soil management programmes proposed within the Regional groups**. As highlighted by the Welsh Assembly Government's Technical Services Division the impact of agricultural operations or land use change on emissions from soil will vary according to soil type[9]. Being

aware of soil type and distribution will allow Regional groups to match land management guidance to soil type and ensure continued sequestration.

Priorities in preventing the loss of carbon from existing soil stores are discussed below:

- Avoiding conversion of land on organic soil to lower soil carbon content land use. As a rule, intensively managed land will have lower carbon soil content than natural vegetation cover[7]. When organic soils and peats are converted for agricultural use they tend to be drained which increases aeration and subsequently microbial decomposition of organic matter, emitting CO_2.Figure 6 gives an indication of the change in soil carbon content which occurs with the conversion of land from high carbon content peat land to low carbon content arable land (and also show the potential for sequestration with conversion from arable to grassland). Wet peat lands naturally release CH_4 through anaerobic decomposition of organic materials, but drainage will lead to an increased greenhouse gas contribution through CO_2 emissions. The conversion of unimproved land to improved short term pasture through drainage, vegetation removal, cultivation and agrochemical input is responsible for rapid loss of stored carbon[9]. The conversion of 1 hectare of grassland on organic soil to arable land will release up to 8 tonnes of carbon a year. Land use change to arable is the worst conversion for organic soils due to considerable and ongoing soil disturbance. Any future conversion of land for increased food production must take into account potential effect on soil carbon. Preventing deforestation and identifying and vigorously protecting peat lands should be undertaken to maintain these carbon reservoirs. Confining developments to mineral soils will minimise the loss of soil carbon through conversion to settlements, this should be considered as part of Local Development Plans and could perhaps serve as a tool for helping to prioritise land allocated for development. Again, the spatial land mapping approach could potentially feed into this.

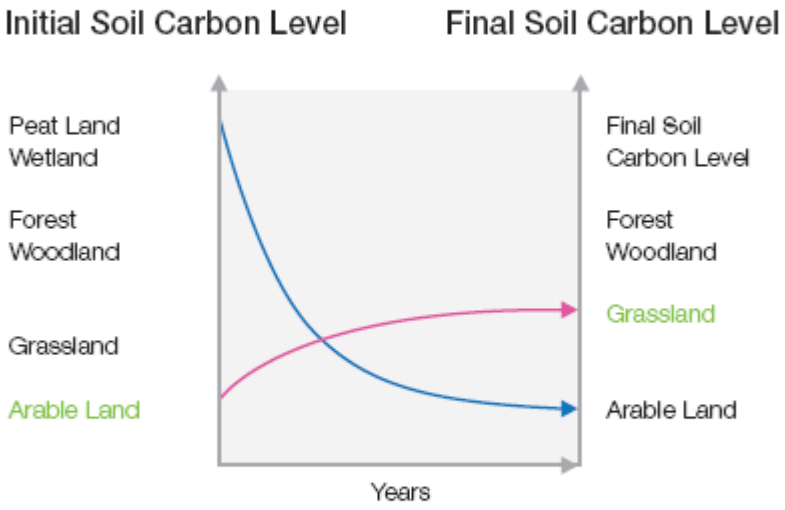

Figure 6. Changes in carbon stock with conversion of peat land to arable land and with conversion of arable to grassland. Peat to arable = red line, arable to grassland = blue line. Source: Greenpeace (2008)[7].

Specific recommendations given as part of the ECOSSE report[23] and the Welsh Assembly Government Technical Services Division Land Use report[9] in relation to preventing emissions from existing organic soil carbon stores through land use change include:

- Discouraging removal of natural vegetation and drainage on high carbon soils for conversion to grassland, or worse, arable land.
- Avoiding drainage of organic soils.
- Blocking existing drains where possible to reduce soil erosion. Where drains cannot be blocked as shallow a water table as possible should be maintained.
- If drainage is essential, areas with a low water table in summer (20 cm or more below the surface) should be drained in preference to permanently waterlogged areas of soil.

- Encouraging carbon aware land management in agricultural and forestry practices.
    - Tillage of agricultural land on organic soil incorporates crop residues, aerates the soil and can subsequently lead to increased microbial decomposition in the surface layers and CO_2 release. The overall impact of soil cultivation / tillage will be dependent upon individual soil conditions including climate and nutrient management practices and the tilling practice undertaken. The ECOSSE report highlights that, as a rule, deeper disturbance will result in greater overall emissions impact therefore deep ploughing on high carbon content soils should be avoided[23]. Whilst there is some debate and conflicting evidence regarding the overall greenhouse gas emissions balance of zero or conservation tilling, there is general agreement[9,23] that overall emissions benefits will be gained through adopting these practices on organic and organo-mineral soils which are currently being tilled conventionally. Zero and conservation tilling practices involve leaving all or a proportion of previous crop residues on the soil surface, amongst which the new crop will be established. In addition to carbon savings, Regional groups should seek to communicate reduced costs for labour, equipment and fuel; improved soil structure and reduced erosion as benefits of zero and conservation tillage, but be aware of potential disadvantages to the farmers including possible reduced yield. Planting a permanent crop will prevent tillage. The ECOSEE report also highlights that winter ploughing should be avoided to prevent erosion and that ploughing should be carried out as close as possible to planting in order to minimise bare soil exposure and possible subsequent erosion of organic matter and loss of soil carbon. The Welsh Assembly Government report stated that work

into the mitigation potential of different tillage options is being commissioned by DEFRA[9].

- In addition to GHG emission contributions from the waste of grazing livestock, over grazing of agricultural land can lead to loss of stored soil carbon and nitrogen. Livestock trampling can contribute to soil disturbance and has been linked to increased N_2O emissions, particularly in wet conditions and also to the loss of organic horizons through erosion and increased aeration in dry conditions leading to carbon emissions[9,23]. To limit losses in this way stocking densities should be carefully managed, including, limiting numbers of heavier animals on vulnerable soils such as waterlogged soils and winter soils which are likely to be wet. The NFU highlighted in a response to the National Assembly for Wales Sustainability Committee inquiry into carbon reduction in Wales that the soil carbon content of optimally grazed pasture maybe greater than on under grazed land[24]. Careful livestock management, considering the time and intensity of grazing, is therefore key in maintaining existing store and may contribute to sequestration.
- Erosion of organic soil layers will contribute to loss of soil carbon. Avoiding bare soil through using cover crops will help to minimise losses from organic arable soils, as will blocking existing drains on organic soils and preventing over trampling by livestock.
- Heather or shrub burning is utilised as a management tool to halt natural succession in upland areas which contributes to CO_2 emissions and exposes soil to erosion. This practice should be avoided on high carbon upland soils where possible and sustainable grazing could be considered as an alternative[23]. Where undertaken burning should be carefully controlled to maintain underground biomass[23].
- Forest soils can reportedly contain more carbon than the trees themselves, especially on peat based upland soils[25]. Where possible forest management should allow litter to return to the soil and enable organic matter build up. Any management operations should be done with minimising soil disturbance to prevent carbon release in mind.

Making land managers aware of these more sustainable practices and land use change issues and helping them to implement the recommendations (beyond the requirements of the Single Payment Scheme) will be the key challenge for Regional groups in maintaining existing soil carbon stores. Previous initiatives working directly with landowners on carbon sequestration include Rhaglen Tir Eryri delivered by Snowdonia National Park Authority and the National Trust's Migneit work as part of their Upper Conwy Project, as detailed in Case Studies RLU5 and RLU6.

Case Study RLU5. Rhaglen Tir Eryri Blanket Bog Restoration

In order to meet targets under Outcome 21 of the Wales Environment Strategy the Snowdonia National Park Authority undertook a programme of blanket bog restoration with landowners in the National Park, known as Rhaglen Tir Eryri. Under the programme landowners were given grant aid to employ contractors to fell and sned conifers on blanket bog, with a view to restoring and improving condition. Contractors on foot were employed as opposed to those using heavy forest harvesting machinery to protect the peat on site. Although monitoring has focussed upon the response of native vegetation as opposed to quantifying sequestered carbon, this approach has been advocated by those involved in the project as one which they would replicate for future projects working directly with landowners to sequester carbon / restore blanket bog or conserve peat.

Key elements of project success identified include:

- Wide pre-implementation consultation with relevant stakeholders including landowners, tenants, Forestry Commission Wales and the Countryside Council for Wales.
- Wide publicity and engagement with landowners at agricultural shows, face to face through project officers and using local contacts.
- Good, reliable contractors.
- Landowners whose land management practices do not conflict with the aims of the project.

Points for consideration in future projects include:

- How much of the sequestration benefit is offset by contractors travelling to and from the site and the use of chainsaws.
- Loss of income for the landowner through premature harvesting of conifers.

Case Study RLU6. National Trust Ditch Blocking on the Migneint.

The Migneint is a significant area of blanket bog acting as a nationally important carbon sink. Over time ditches have been dug into the bog by gamekeepers and farmers to drain the land, which was previously rewarded through agricultural subsidies. The damage to carbon stores caused by drainage and subsequent erosion is now recognised, and as such the National Trust, in conjunction with tenants of Ysbyty Estate – a National Trust property incorporating the Migneint, are undertaking a ditch blocking trail. The project is now in its second of three years. As of yet the effect of blocking the ditches with heather bales on carbon stores is unknown, with further research and surveys needed to gauge success. Emphasising the advantage of eliminating the danger of sheep falling into ditches has been identified as a key tool for encouraging the participation of tenants.

4.4.2. Increasing sequestration

Opportunities for enhancing sequestration exist for mineral and organic soils and also within plant biomass. AEA Energy and Environment reported on policy options for reducing GHG emissions in Wales. If supported by policy they estimated that improving grassland management, preventing urban expansion, increasing forest rotation length and peatland restoration would have the largest sequestration / emissions reduction potential in the LULUCF sector on a pan Wales level. This should be used as a guide for prioritisation only with WSP Regions, given that some of these feature amongst the top options due to the large area over which they could be implemented in Wales and not due to their emissions saving contributions per unit of area. Reducing urban expansion is quoted has having the largest impact per hectare.

Land Use Change

Land use change can have a positive impact on soil carbon and biomass stores when a degraded or low soil carbon land use is converted to natural vegetation. The Welsh Assembly Government's Technical Services Division points out that soil carbon loss through negative land use change can be rapid, whereas sequestration through positive land use change is a slow process[9]. As such emphasis should be on the prevention of loss from existing stores, with any further resources to be allocated to enhancing sequestration.

The Welsh Assembly Government's Technical Services Division report on mitigating greenhouse gas emissions from agriculture states that conversion from arable land to permanent grassland, arable land to woodland and permanent grassland to woodland can contribute significantly to mitigation of GHG emissions[9]. On a farm by farm basis they estimate that on mineral and organic soils afforestation of marginal land has the largest potential for carbon sequestration. They state that the conversion of 10ha arable land to woodland on mineral soils would sequester 164.7 t CO_2 equivalent a year and 178.6 t on organic soils[9]. This is complimentary to the findings of the Natural England Carbon Baseline farm survey previously mentioned which highlights renewable energy and woodland planting on farm as having large potential for the reduction of net emissions[12]. **Support from Regional groups for Environmental co-operatives previously discussed, could help to deliver this on a landscape scale.**

Lowest soil carbon content land uses could be seen as having most potential for sequestration. Reversion of arable land on organic soil to semi natural vegetation or even just to grassland can reduce carbon emission and contribute to sequestration (see Figure 6). The ECOSSE report states that ideally all arable land on organic and organo-mineral soils should be restored to its natural water level and natural vegetation cover[23]. Similarly, the Welsh Assembly Government's Technical Services Division estimates that there are 2500 hectares of temporary grassland on organic and organo-mineral soils in Wales, the

conversion of which to semi-natural habitat would prevent grassland associated CO_2 emissions and additionally contribute to the sequestration of between 11.9 and 45.75 Kt CO_2 equivalent a year[9]. Reversion of land can be encouraged over the whole area or can be localised to field margins or creation of shelter belts of vegetation with the added benefit of shelter for livestock.

Forest expansion at a farm or larger scale provides an opportunity for sequestration in soil and biomass. The Forestry Commission estimates that the maximum potential for carbon accumulation in a UK woodland is approximately 200 tonnes of carbon a hectare over the lifecycle of the stand of trees[25]. **Finding land within Regions for afforestation is likely to be dependent upon joint working and partnering with large landowners such as the MOD and working with groups of land owners to instigate landscape scale planting**. Regional groups should be aware that woodland planting should be conducted on mineral soils or degraded organic soils, some planted woodlands currently act as net carbon emitters due to disturbance to high carbon content soils on which they have been planted. The ECOSSE report looked at soil carbon stocks with land use change from semi-natural extensively grazed upland vegetation on organo-mineral soil to forestry and reached a tentative conclusion that the change had very little effect on soil organic carbon stores[23]. However they highlighted a number of uncertainties for planting on organo-mineral soils including what the net effect on the soil organic carbon store is of disturbance versus carbon captured in tree biomass and soil litter input. To avoid these scientific uncertainties Regional groups could chose to focus upon woodland planting on mineral soils in order to enhance their sequestration contribution.

The GHG emissions implications of peat soils are complicated and not fully understood. Restoration of peatlands through deforestation or conversion of open habitat is recognised as having significant potential for sequestration[4]. Within the Woodlands for Wales consultation document, the Welsh Assembly Government states that "*further guidance is required to help us make better decisions about when and how we go ahead with deforestation and habitat restoration. This is especially complex on highly modified sites where the prospects of successfully restoring habitat are less favourable,"*[13]. As such Regional groups wishing to undertake restoration projects should do so cautiously in conjunction with expert advice, and treat any such undertaking as a pilot project which will enable a more informed approach in future. Under Tir Eryri, Snowdonia National Park Authority worked directly with individual land owners to improve the condition of blanket bog through removing conifer plantations. Also, the National Trust has undertaken ditch blocking to restore the water levels of high carbon soils. See Case Studies RLU 5 and RLU 6.

Farm Management

On a farm basis there are many simple practices which can be undertaken to increase soil carbon sequestration on arable or grazed land:

- Increasing crop yields will increase carbon sequestered and released to the soil during crop growth. Crop yield can be influenced through improved water management, the introduction of legumes to fix soil nitrogen and through selecting for higher yielding crop varieties.

- No or low tillage systems, as previously discussed, retain crop residues and can subsequently increase soil carbon.

- Practicing agroforestry i.e. planting trees and shrubs alongside crops and / or livestock in an integrated approach. Tree planting will sequester carbon in the biomass of the tree whilst also enhancing soil carbon. Agroforestry can be beneficial with trees providing shade and shelter for livestock, helping to prevent soil erosion, retaining soil moisture and providing a resource in terms of woodfuel.

- Carbon storage in degraded cultivated soils can be increased through the incorporation of organic matter such as straw, manure and cover crops. Incorporating green waste diverted from landfill such as compost and paper crumb can provide further benefit through reducing CH_4 emissions from landfill. Over time soils will reach a natural equilibrium in soil carbon content and any further incorporation organic matter may be counterproductive[9]. Similarly sequestration can be maximised in the forestry sector by:

- The pyrolisis (thermal break down) of biomass releases gas for energy generation whilst producing heat and biochar (charcoal) as by products. The application of biochar granules to soil will create a long term carbon reservoir within soils, and early field trials in Germany, Austria and the US are demonstrating biochar application can also improve soil fertility, improve soil structure and water retention. Research undertaken at Cornell University in the US has suggested that biochar burial can double the capacity of soils to store organic carbon, whilst in Germany biochar is being created through the pyrolisys of sewage[26]. Whilst early versions of the required technology are available this process is currently in the research and development phase, and at present the application of biochar in the UK would require licensing as a waste product. Both Bangor and Swansea Universities are already undertaking work in this field. **Regional groups keen to be at the fore-front of R&D in low carbon technologies may wish to look at opportunities to pilot the system through partnering with a research institution.**

Forest Management

Management of existing forests can also contribute to enhanced carbon sequestration. Harvested forests and woodland generally have lower carbon stocks than un-harvested. Management of forest carbon is largely dependent upon individual site conditions, productivity, transport and end use of harvested wood[25]. Management of on site carbon stocks can be approached in one of three broad ways highlighted by the Forestry Commission[25]:

- Carbon reserve management – i.e. minimal intervention, suited to low growth rate forests or those with limited local opportunities for the use of any harvested wood
- Carbon substitution management – woody biomass is harvested for use in wood products and as woodfuel, with careful attention to minimising carbon released through soil disturbance and avoiding harvesting high nutrient material such as foliage
- Selective intervention carbon management – as above but with selective harvesting of certain trees with a defined end use

Whilst the first option will lead to highest sequestration on site, this is not a viable option for commercial forestry. Carbon substitution management is the best suited option for commercial operations. In addition to this AEA Energy and Environment highlight that increasing forest rotation length has the highest potential to sequester carbon from commercial forestry on an all Wales basis. **A Regional group's most promising opportunity to promote these approaches to forestry is likely to be through approaching the Forestry Commission and the Wales Forest Business Partnership to see how the group can add value to and support work already being undertaken on this agenda.**

Timber

Sustainably harvested wood can be used as a woodfuel to displace the consumption of fossil fuel or as a sustainable building material to replace the use of more energy intensive materials. Whilst the Forestry Commission estimates that the maximum accumulation of carbon in a UK woodland would be 200 tC ha^{-1} over the lifecycle of a stand of trees and 100 tC ha^{-1} over a number of rotations in a commercially managed woodland[25], Figure 7 demonstrates the potential for sequestration and avoiding CO_2 emissions through use of harvested wood.

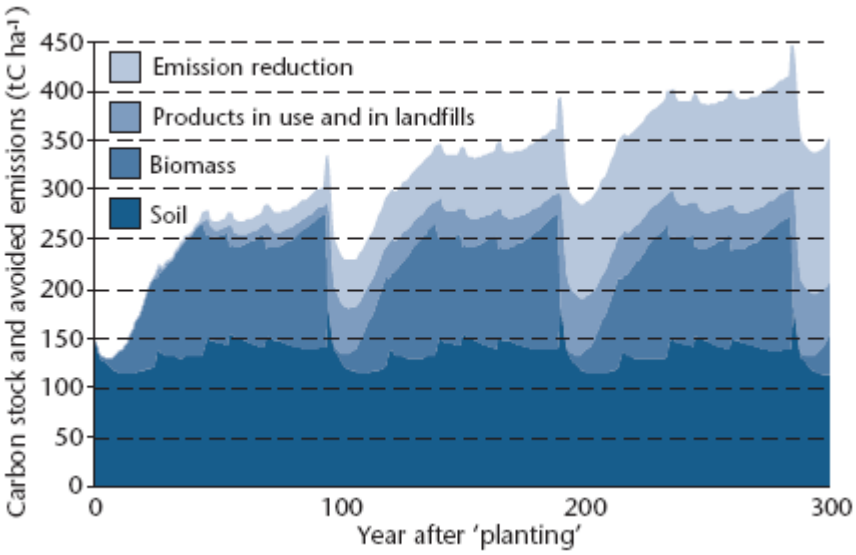

Figure 7. A simulation of carbon stock changes in a forestry system together with carbon emissions avoided through reduced fossil fuel consumption arising from wood utilisation. Source: Forestry Commissions (2003)[25].
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In order to maximise the sequestration potential of harvested woodland, Regional groups should support the use of wood in long life products. Wood products serve as a secondary carbon reservoir. Wood used in the construction industry accounts for the majority of the wood products pool at present[25]. Promoting the use of timber in construction, furniture and fittings will also displace energy intensive material use given that wood has the lowest energy consumption amongst commonly used building materials. This is also currently being promoted by the Wales Forest Business Partnership and Wood Knowledge Wales (WKW). WKW have also been active in promoting the energy efficiency benefits associated with timber framed housing**. Regional groups should work with the public and private sector to promote the adoption building standards for all new developments**. For example, Cardiff Council has produced a standard for all new council buildings which specifies that they must have a timber frame construction from a renewable source. By specifying in local planning guidance that new developments should incorporate low environmental impact materials where possible, including maximising the use of renewable timber Local Authorities can play an instrumental role in stimulating local use of renewable timber.

Box RLU8. Mechanisms to conserve and enhance carbon stores

I. Undertake a mapping exercise (building upon existing soil carbon maps) to identify highest carbon content soils most in need of protection and degraded soils with the most potential for sequestration through restoration to inform e.g. Local Development Plans and conservation expenditure.

II. Work with relevant partners such as NFU, Forestry Commission to explore opportunities to promote soil carbon aware land management in agricultural and forestry practices (beyond what is required as part of the Single Payment Scheme).

III. Explore with organisations such as National Park Associations opportunities for soil carbon restoration projects e.g. a programme of individual or co-operative landowner engagement and delivery for ditch blocking on organic soils or peatland restoration.

IV. Support the establishment of environmental farming co-operatives to deliver landscape scale farm woodland planting for example or bioenergy crop planting.

V. Seek partnerships with large landowners to instigate woodland planting on mineral soils.

VI. Partner with research institutions to pilot soil carbon sequestration schemes such as biochar incorporation or peat bog restoration to culminate in best practice advice for landowners.

VII. Work with relevant partners such as Wood Knowledge Wales to identify opportunities for Regional contributions to promoting the use of local, sustainable timber in construction, furniture and fittings.

VIII. Work with local authorities / local service boards to specify in planning guidance or own estate construction standards the need for utilising renewable timber frames in new developments.

Box RLU9. Measuring success for conserving and enhancing carbon stores

- Soil carbon / land use maps are collated and used to guide projects and development
- A partnership is established to promote soil carbon aware land management in agricultural and forestry practices
- Percentage of all high carbon soils under protection
- Area of soil in carbon restoration projects
- Area of woodland planted on low carbon soils
- Soil carbon sequestration trials e.g. biochar are underway in conjunction with a research institution
- Number of timber frame buildings in the Region
- Number of local authorities utilising local renewable timber frames in new developments on their own estates

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Transport

This document provides background information on a wealth of low carbon solutions for the transport sector alongside case studies, tips for replication and recommendations for delivery through the Wales Spatial Plan Groups. It was constructed through a significant desk based study as part of the *Low Carbon Wales: Regional Priorities for Action* project between January and April/May 2009. Given the dynamic nature and massive scope of the subject area it is recognised that this document cannot cover all potential carbon reduction solutions and that relevant policy and regulation may have progressed or changed since the time of writing. This is however a useful reference guide for Spatial Plan Regional Groups and wider stakeholders in the transition to low carbon.

Contents

1. Summary

Personal mobility and the transport of goods form the basis of everyday life and subsequently produce 16.2% of total CO_2 emissions in Wales. Road transport is the principal contributor to transport emissions, with personal travel by car responsible for 63% of this. Wales' low population density, topographical variations, and isolated rural and coastal communities pose challenges in the provision of viable, frequent and direct public transport services, and subsequently result in car dependency. The transport of goods accounts for 33.4% of Welsh road transport emissions.

Achieving significant emissions reductions from personal mobility and the transport of goods must be tackled through a three tiered approach:

1) Reducing the need to travel.
2) Travelling via more sustainable means, including improving the efficiency of existing modes.
3) Changing travel behaviour which is integral to the delivery of the above but must also be addressed in its own right.

Opportunities for emissions reductions identified under each of these tiers include:
(1) local planning to require a live/work approach to development; use of ICT as a replacement for business related travel. (2) targeted demand responsive transport to key employment sites in rural areas; exploring opportunities for ultra light rail or personal rapid transit in urban centres. (3) a rolling programme of individualised travel marketing; eco-driver training for LGV and HGV drivers. Suggested mechanisms for progressing or delivering solutions at a Regional level include influencing local planning, partnering with Regional Transport Consortia and influencing public procurement.

As set out in Chapter 3.3 of this report, SDC solutions for early consideration for reducing emissions from transport at a Regional level are to:

1) Provide the infrastructure and information needed to enable smarter choices

2) Significantly increase the use of low carbon transport fuels and electric vehicles

Rationale: Whilst reducing the need to travel is at the top of the hierarchy in terms of emission reductions from transport, this must largely be tackled through planning, as addressed by the cross cutting mechanisms for delivery (see chapter 3.5 of the main report on Cross Cutting Mechanisms for Delivery). It is recognised that the distance travelled per person per year is increasing, therefore encouraging more sustainable travel is essential. Experts believe that a complementary programme of both hard and soft measures is needed to change travel behaviour.

2. Policy Overview

2.1. EU Policy

As discussed in the Built Environment and Energy European policy context section, the EU's integrated energy and climate change policy of December 2008, set an overarching target to cut greenhouse gases by at least 20% of 1990 levels. The package also implements the following targets which will impact upon transport emissions:

- In sectors not covered by the EU Emissions Trading System (ETS), including transport (excluding aviation which will become part of the ETS in 2012), emissions will be cut 10% below 2005 levels by 2020.
- As part of the target for renewables to produce 20% of all of the EU's energy by 2020, at least 10% of transport fuel in every country must be renewable, with any biofuels used having to meet specified sustainability criteria.

Other emission reduction orientated transport policies and targets include:

- Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport, which since 2005, has ensured that biofuels account for a minimum proportion of fuel sold in Member States. By 2010 the minimum share of biofuels sold on Member States' markets must be 5% by 2010.
- In December 2008 the European Parliament voted to adopt a regulation on CO_2 emissions from light duty vehicles. As part of this, for all cars registered in the EU, a fleet average of 130 grams/ kilometre must be achieved (averaged over heavier and lighter cars in a fleet). This is to be phased in, with 65% of each manufacturer's newly registered cars to comply with the average in 2012. Manufacturers not meeting targets post 2012 will be required to pay an excess emissions premium. See http://ec.europa.eu/environment/air/transport/co2/co2_home.htm for details.
- The Directive 1999/94/EC on the availability of consumer information in the marketing of new cars is currently under revision to improve the effectiveness of fuel

efficiency labelling on new cars. This revised directive is expected to be adopted later this year.

Since its inception, European transport policy has been focused on eliminating borders between Member States so as to contribute to the free movement of individuals and goods. Its main aims are to complete the internal market, ensure sustainable development, extend transport networks throughout Europe (the TEN-T policy), maximise use of space, enhance safety and promote international cooperation. Additionally, there is an over-arching goal to ensure that all modes of transport are used to best effect. A summary and links to a huge amount of information is available on http://europa.eu/scadplus/leg/en/s13000.htm and on the Commission's transport website http://ec.europa.eu/transport/index_en.htm.

Current transport strategy is based on a White Paper adopted in 2001 (in the light of developing policy for sustainable development); and reviewed in 2006, as reported in the Commission's Communication "*Keep Europe* M*oving - Sustainable mobility for our Continent*"mid-term review of the European Commission's 2001 Transport White Paper (COM(2006) 314 final). This has been followed by the development of significant strategies for freight (for which there is a Freight Logistics Action Plan) in 2007.http://ec.europa.eu/transport/strategies/2007_logistics_en.htm

And most recently Greening Transport.
http://ec.europa.eu/transport/strategies/2008_greening_transport_en.htm

The initiatives set out in the Greening Transport package include principally:

- measures to ensure that transport prices better reflect their real cost to society, so that environmental damage and congestion can gradually be reduced while boosting transport efficiency and benefiting the economy more generally;
- a proposal to enable Member States to help make this happen through more efficient and greener road tolls for goods vehicles, with the revenue to be used to reduce environmental impacts from transport and cut congestion;

- proposals for measures to reduce noise from rail freight;
- an inventory of existing EU measures on greening transport; and
- the preparation of a communication on the additional greening transport initiatives that the Commission will take before the end of 2009.

There has been a long-standing focus on sustainable mobility in urban areas, reflected most recently in the publication of a "Green Paper on Urban Transport" in 2007. The Commission is due to produce an action plan on urban mobility but has not yet done so. Unusually, the European Parliament considers this too important an issue to delay and its Transport Committee is currently working on its own draft plan.
http://ec.europa.eu/transport/urban/urban_mobility/green_paper/green_paper_en.htm
Also see: http://www.euractiv.com/en/transport/parliament-takes-lead-eu-urban-mobility-plan/article-178531

The European Commission has recently launched a debate on the Future of Transport (10 years after the 2001 White Paper); with a view to producing a further communication by June 2009. http://ec.europa.eu/transport/strategies/2009_future_of_transport_en.htm

The European Commission has recently initiated a review of the Trans-European Networks for Transport (TEN-T) policy. The Commission is now seeking to place climate change at the heart of the policy. Attention will be given to the 'climate-proofing' of new infrastructure, for example. Consultation on the *Green Paper - TEN-T: A policy review - Towards a better integrated transeuropean transport network at the service of the common transport policy* (COM/2009/0044 final); has now closed.
http://ec.europa.eu/transport/infrastructure/consultations/2009_04_30_ten_t_green_paper_en.htm. The Sustainable Transport Strategic Framework, guides delivery of the 2007-13 Convergence and Competitiveness ERDF and ESF Programmes in Wales. It provides opportunities for EU funding to support the delivery of a number of integrated transport measures. Additionally, there is a **multi-annual work programme for grants in the field of**

trans-European Transport network (TEN-T) for the period 2007-2013. Initiatives to get freight off the roads and onto more sustainable transport modes (including onto ships – the key aim of the policy for **Motorways of the Sea**); can be co-financed through the **Marco Polo programme**.

2.2. UK Policy

Whilst much of the responsibility for transport is devolved to the Welsh Assembly Government, matters such as ports and shipping, regulation of aviation, aspects of road traffic regulation e.g. road signs; some elements of bus regulation and vehicle construction regulations are reserved to the UK Government.

At a UK level the document "Towards a Sustainable Transport System" sets out the Department for Transport's (DFT) policy and investment plans for UK transport for 2013 to 2014. Amongst the goals set out in the strategy is a goal to address climate change. In transport terms three policy elements are identified for implementation. These are putting a price on carbon – notably emissions trading for aviation; developing and adopting low carbon technologies and removing the barriers which prevent people from making sustainable travel choices.
See:http://www.dft.gov.uk/about/strategy/transportstrategy/tasts/.

Stemming from the above, the document "Delivering a Sustainable Transport System" set out how the specified goals will be actioned. The document states that DFT are developing a strategy for transport towards the delivery of the UK Climate Change Act's 80% greenhouse gas emissions reduction target by 2050. See: http://www.dft.gov.uk/about/strategy/transportstrategy/dasts/ .

Other important UK strategic transport documents are the 2004 "The Future of Transport – White Paper." See: http://www.dft.gov.uk/about/strategy/whitepapers/previous/fot/ and the "Transport Ten Year Plan 2000." See: http://www.dft.gov.uk/about/strategy/whitepapers/previous/fot/.

Notable mechanisms contributing to emissions reduction from transport at UK level are:

- The Renewable Transport Fuels Obligation (RTFO) – an obligation on fuel suppliers to supply a proportion of road fuel from a renewable source, mainly biofuels. By 2013/2014, 5% of all fuel sold on forecourts in the UK (by volume) must be biofuels.
- Reformed Company Car Tax – incentivising employers and drivers to select cars with lower CO_2 emissions.
- Reformed Vehicle Excise Duty (VED) – payments are now linked to the CO_2 emissions of a vehicle and a new much higher first year VED rate is being introduced to encourage purchase of fuel efficient vehicles.

2.3. Welsh Policy

Much of the responsibility for transport is devolved to the Welsh Assembly Government, including roads, some elements of road safety and rail services. The Transport (Wales) Act 2006 and the Railways Act, increased the powers of the Assembly Government to plan and improve transport systems in Wales. The Act also empowered the Assembly Government to produce a national transport strategy.

The Local Transport Act 2008, increases the powers of the Welsh Assembly Government in to improve bus service provision.

The Wales Transport Strategy – "One Wales: Connecting the Nation" is the overarching policy document guiding the development of the nation's transport system. Underlying the strategy is the need to make transport in Wales sustainable through ensuring all transport policy is considered in the context of three key themes: achieving a more efficient and effective transport system, achieving greater use of more sustainable and healthy forms of travel, and minimising demands on the transport system.

The Strategy sets out 17 long term transport outcomes with social, economic and environmental benefits and is closely aligned with the Wales Spatial Plan. In order to deliver on these outcomes the strategy sets out 5 priority areas for progress:

- *" Reducing greenhouse gas emissions and other environmental impacts from transport;*
- *Integrating local transport;*
- *Improving access between key settlements and sites;*
- *Enhancing international connectivity; and*
- *Increasing safety and security."*

The Strategy goes on to identify key actions for delivery of these priorities. Amongst these actions are encouraging modal shift in freight and passenger travel, to lower carbon modes, encouraging uptake of low carbon energy sources and integrating sustainable transport modes. The Welsh Assembly Government also states that it aims to create a series of sustainable travel towns across Wales, one in each of the four transport consortia regions.

The strategy is intended to provide a long term framework for the development of all modes of transport, linking across all policy areas. Figure 1 illustrates how it informs and contributes to other national strategies and plans.

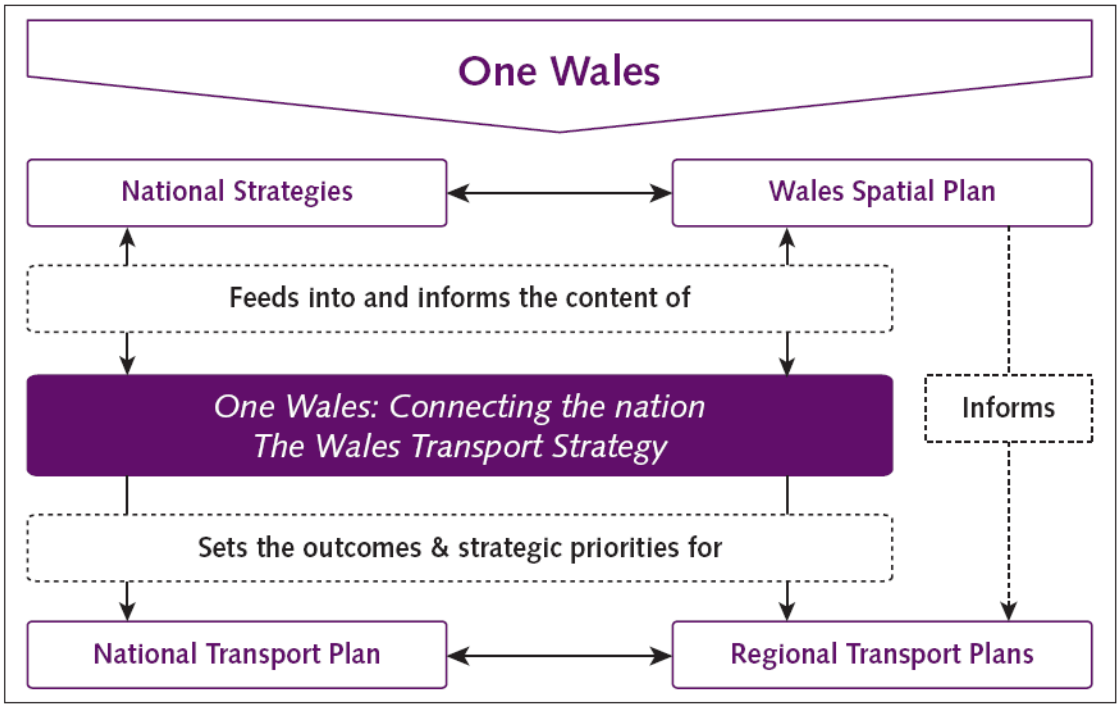

Figure 1: The interactions between the Wales Transport Strategies and other national strategies and plans. Source: Welsh Assembly Government (2008)[1].

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The key policy tool for delivering the outcomes set out in the Strategy will be the National Transport Plan – this was released for consultation in July 2009 and provides detail on delivery at a national level. The four Regional Transport Consortia have responsibility for delivery of the Wales Transport Strategy at a regional level. The four Regional Transport Consortia have responsibility for delivery of the Wales Transport Strategy at a regional level. Draft regional transport plans have been prepared by the consortia, detailing the transport vision for the region and identifying long term capital expenditure programmes on specified priority projects. **Working with the Regional Transport Consortia is, and will continue to be key for Spatial Plan Regional groups to ensure delivery of low carbon transport infrastructure and sustainable travel behaviour.**

Wales Freight Strategy[2]

Building upon the concepts of the Transport Strategy for Wales, the freight strategy outlines strategic aims and policies for freight transport in Wales, whilst feeding into both the national and regional transport plans. Based upon the freight hierarchy given in Figure 2, the strategy sets out 49 steps to delivery under the following headings:

a) Strategic issues e.g. developing intermodal freight interchanges.

b) Road freight e.g. identifying pilot freight consolidation centre locations.

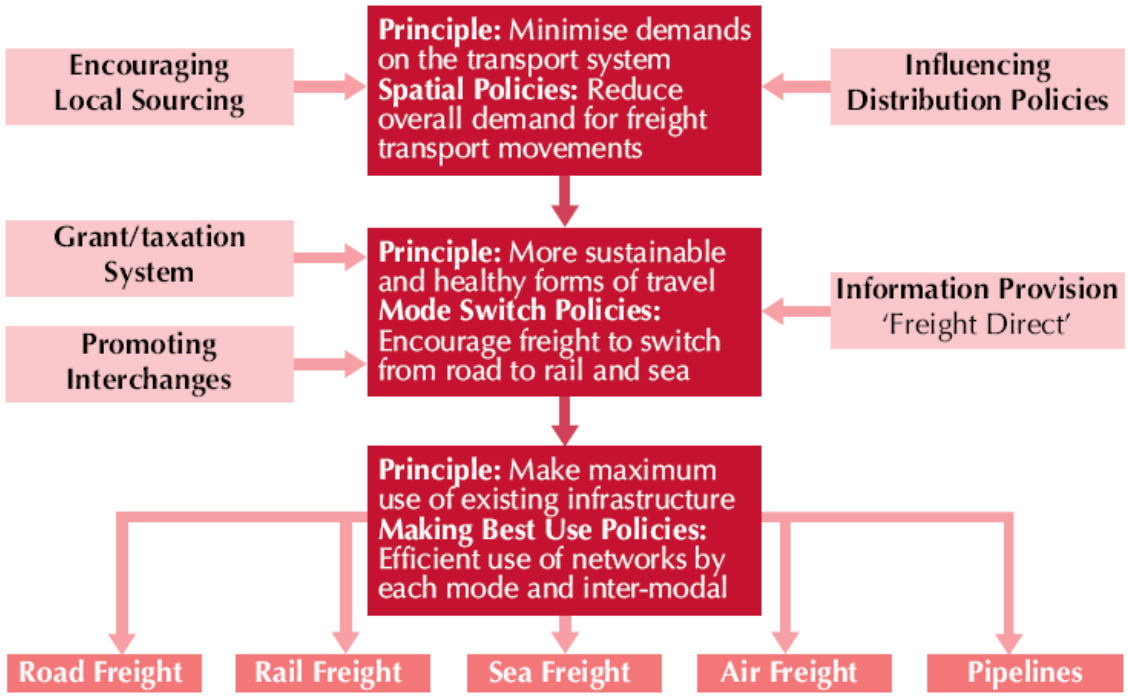
c) Rail freight e.g. increasing the carrying capacity of railways.

d) Ports and shipping e.g. promoting use of inland waterways and coastal shipping.

e) Air freight e.g. considering the need for and efficiency of air freight in the context of CO_2 emissions.

f) Pipeline e.g. promoting the potential role of pipelines.

The Wales Spatial Plan has a key role in facilitating the above headings, especially with regards to identifying the locations for the infrastructure to enable them and how this fits in with the overall spatial planning requirements for the Region.



Hierarchy of Freight Measures

Figure 2: Hierarchy of freight measures underlying the Wales Freight Strategy. Source: Welsh Assembly Government (2008)[2].

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Walking and Cycling Strategy for Wales and the Walking and Cycling Action Plan for Wales 2009-2013

The 2003 Walking and Cycling Strategy for Wales aimed to increase walking and cycling opportunities and improve integration with public transport. A range of actions and lead bodies responsible for delivery were identified. The recent action plan incorporates and builds upon these to create a suite of actions under the themes of changing behaviour, improving infrastructure, incorporating walking and cycling objectives into cross cutting policies, and evaluating progress. Cumulatively these actions are intended to encourage "more people to walk and cycle more safely and more often". Example actions are: local authorities to provide high quality cycle parking and storage facilities in local design and planning; CTC Charitable Trust to take a lead on introducing national standards for cycle training in Wales; Welsh Assembly Government to lead on using / developing safe routes in communities to access public transport interchanges through walking and cycling. See http://wales.gov.uk/topics/transport/publications/walkcycle/?lang=en and http://wales.gov.uk/topics/transport/publications/walkcycleactionplan09/?lang=en.

3. Background

The most recent emissions statistics for Wales attribute 16.2 % of total CO_2 emissions to transport.[3]

Road transport is the principal contributor to transport emissions, with personal travel by car accounting for 63% of all road transport emissions.[1] Wales' low population density, topographical variations, and isolated rural and coastal populations, pose challenges in the provision of viable, direct public transport services and subsequently result in car dependency.

The average distance travelled per person per year is increasing[4]. In 2005/06 the average distance travelled per person in Wales annually was estimated at 7,400 miles compared to 6,600 in 1998/2000[5]. Figure 3 illustrates distance travelled per person per year by purpose, with commuting and business highlighted as the largest contributor. Of the total 7,400 miles travelled per person per year 4,128 miles are identified as journeys travelled as the driver of a car and a further 2,350 miles as a passenger in a car[5]. Over half of respondents in a national travel survey **(53%) said they never use local buses or use them less than once a year[5].** With regards to freight the transport of goods accounts of 33.4% of Welsh road transport emissions.[3]

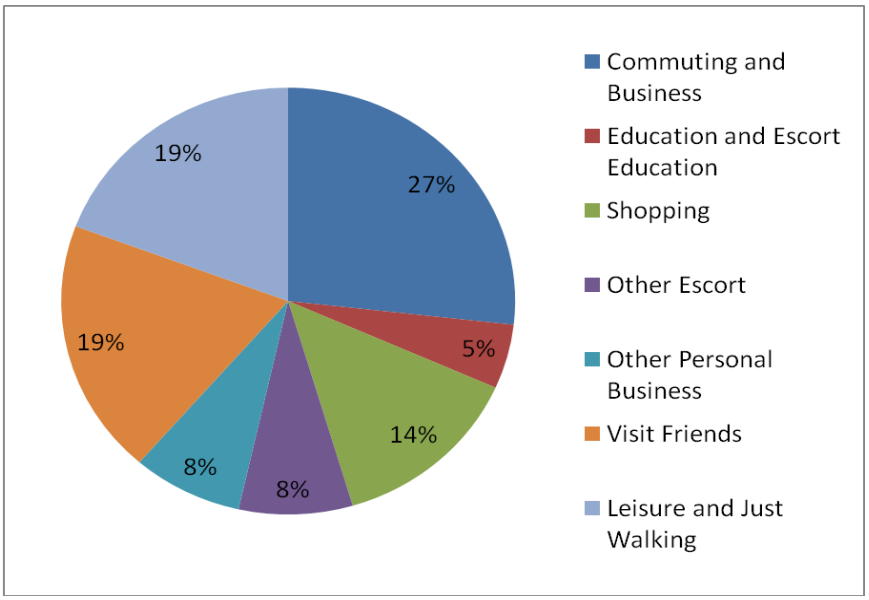

Figure 3: Distance travelled per person per year by journey purpose in Wales. Source: Compiled from data in National Statistics / Welsh Assembly Government (2008)[5].

On a UK level the Metropolitan Transport Research Unit (MTRU) has calculated that a 15% reduction in traffic levels is needed today to catch up with the decline in emissions necessary to meet the Climate Change Act's 80% emissions reduction target, in the transport sector, by 2050[6].

4. Opportunities for Reducing Emissions at a Regional Level

4.1. Reducing the Need to Travel

4.1.1. Land Use Planning

Our current challenge of attempting to "retrofit" Welsh Regions with low carbon transport infrastructures highlights the importance of making sustainability a key consideration in the planning process for any new development. The need to travel can be significantly reduced through integrated and spatially minded community design and land use planning. Opportunities for travel reduction include locating new homes near existing services and employment centres, and locating employment developments close to existing housing and infrastructure. Public services must be located with maximising accessibility in mind. Through infilling existing town and city layouts co-location can be achieved for new and existing homes, jobs and services. Mixed use development can help to deliver co-location for reduced travel need whilst also increasing the viability of CHP plants and district heating.

A dense town or city layout will improve access to services and retail for residents whilst promoting walking and making public transport services more viable and attractive. A report by the Commission for Architecture and the Built Environment (CABE), and Bioregional on the components need to make an eco-town, suggests an average density of no less than 50 dwellings per hectare, but closer to 100 where possible in central built up areas and 50 to 65 dwellings per hectare along transport corridors[7]. Renowned low carbon developments such as the BedZed development in the London Borough of Sutton adhere to this benchmark of 50 dwellings per hectare.

Similarly, ICT connectivity should be a standard consideration in the design and planning of all new builds to reduce the need for residents / workers to travel, enabling teleworking and the development of home businesses. This could mean the provision of shared hot desk office facilities in a new housing development or inclusion of a video conferencing suite in a large business development.

Regions should look to address the co-location of homes, jobs and services, whilst delivering dense town and city layouts through working with local authorities to influence Local Development Plans (LDPs). **The provision of ICT connectivity should be addressed through working with local authorities to look at opportunities for supplementary planning guidance to request connectivity where possible.**

As part of Mid Wales draft Regional Transport Plan the authors - Mid Wales Transportation (TraCC) express their intention to support a "sustainable settlement study" to ensure developments are targeted in locations which have the best opportunities for sustainable travel[8]. This strategic approach must be considered in all Regions to minimise car dependent development.

As highlighted by the Climate Change Commission's Emissions Reduction Sub-Group[9], behavioural change can be best delivered during changes of employment or residence, demonstrating the role that planning could have in altering approaches to travel.

4.1.2. Localism

Building upon the need for local services and workplaces through land use planning, localism can also reduce travel emissions for goods and leisure / recreational activities.

Holidays

Analyses of English data by the Department for Transport indicate that 7% of CO_2 emissions from passenger surface transport modes (cars, buses, coaches, surface rail, underground, light rail and taxis, are from holiday related journeys. In 2006, 85% of tourist traffic on holiday trips in Wales was privately owned cars[5].

Whilst research relating to the potential carbon savings of local holidays is lacking, as a general rule reduced travel distance and reduced reliance on car travel have potential to reduce holiday travel related emissions in Wales. Increasing the take up of local holidays will also ensure that money spent is kept within the local economy.

Potential opportunities for Regional delivery are:

- Working with Visit Wales and the Regional Tourism Partnership to promote local holidays, e.g. targeting individual businesses to offer discounts to local people in return for associated publicity.

- Working with local authority planning departments to ensure new tourist destinations are planned with access by public transport in mind.

- Working with Visit Wales and the Regional Tourism Partnership to pilot car and bike pick up and drop off schemes at public transport interchanges and key tourist destinations to enable visitors to travel to their destination without being dependent upon their own car, but with the freedom of a car availability if needed.

- Working with the Regional Tourism Partnership and Regional Transport Consortium to implement travel planning for key tourist attractions and destinations (see section 4.3.1. for further information on travel planning).

Food

The Stockholm Environmental Institute attributes 1/3 of all energy consumed in the Welsh food chain to transport[3]. Many opportunities for local food production and consumption exist and can easily be promoted within the Wales Spatial Plan Regions as a means of reducing food transport. Local, seasonal food consumption is discussed fully in the Rural Land Use and Food chapter of this report, see 3.3 for further details.

4.1.3. ICT

The potential for Information and Communications Technologies (ICT) to reduce the need for travel is acknowledged in the Wales Spatial Plan. Regions should capitalize on the simultaneous benefits of travel reduction; social inclusion of geographically isolated communities and economic contributions gained through improved ICT connectivity. Wales currently has the lowest broadband penetration in the UK[10]. Increasing broadband access within a Region cannot be achieved without significant investment – low population densities and difficult topography make Welsh broadband deployment problematic. The

dual provision of infrastructure and skills development and support is essential in ensuring broadband uptake.

A number of Welsh Assembly Government initiatives are helping to increase broadband connectivity and speed across Wales:

- Public Sector Broadband Aggregation – providing an ICT network for the public sector in Wales through aggregating demand for high speed connectivity across sectors within a region, reducing costs. Public sector organisations can register an interest in joining at http://psba.pepperio.net/procurement.html.

- Regional Innovative Broadband Support Scheme – providing affordable broadband across Wales, currently researching solutions to bring connectivity to broadband "not-spots". Locations without broadband service can register at http://new.wales.gov.uk/topics/businessandeconomy/broadbandandict/initiatives/ribs/?lang=en

- The Fibre Speed Project – providing high speed connectivity, the first phase has strategically targeted 14 business parks in North Wales.

Regional groups should seek to maximise the benefits of these initiatives in travel reduction through working with local authorities to ensure that: within LDPs land is allocated for business development based upon fibre speed connected locations; that support for home business start up is made available alongside the connection of "not-spot" locations.

Case Study T1. Anglesey Connected[11]

With a view to providing digital inclusion for all, the isle of Anglesey County Council approached PC World Business to help overcome the issues of connecting a sparse, rural population. Working with specialist contractors the island's terrain was mapped and radio masts were erected at optimum locations (from 2004 to 2006). Through installing and registering radio technology the partnership was able to provide island wide wireless broadband access through utilising radio links[11]. Minimal infrastructure requirements enabled fast deployment and the radio links eliminated the need for annual line rentals to be paid for cable or wire solutions. This has been hailed as an innovative and cost effective method of delivering sustainable broadband. The initial phase of the project provided access for all schools, public offices, libraries and learning centres. The second phase will provide more community access points and it is hoped that the business sector and wider public will benefit from future phases.

Known as "Anglesey Connected" the project has won industry awards for innovation. Funding was received from the Welsh European Funding Office, National Grid for Learning, New Opportunities Fund, Objective One ERDF money and money from the Local Regeneration Fund.

Whilst this specific example may now have been superseded in technological advancement terms, the approach demonstrates the success of public / private sector partnership. **Regional groups should explore innovative options for the expansion of broadband connectivity in partnership with the private sector.**

As demonstrated by Figure 3, 27% of the miles travelled per person per year in Wales are spent commuting or on business journeys[5]. The Department for Transport's analysis indicates that commuter journeys of between 10 and 25 miles are the largest contributory category to CO_2 emissions, by journey purpose and length. A further 14% of miles travelled per person per year are attributed to shopping[5]. Utilising ICT to replace travel to work and shops should therefore be exploited at a Regional level to minimise avoidable travel related emissions.

Homeworking and Home Businesses

There is some debate about the potential CO_2 impact of homeworking and home based businesses, with arguments that the relationship between homeworking and travel is not well understood, that energy use in the home can counteract emission saving through travel prevention vs. arguments that case studies have demonstrated real carbon savings. The Smith Institutes' report entitled "Can homeworking save the planet?"[12;] gives a full discussion of the carbon implications of homeworking by a range of contributory expert authors. The report communicates a general consensus that homeworking can provide real carbon benefits alongside benefits such as a less stressful work experience, increased workforce satisfaction and financial savings through reduced office space requirements. There is also consensus that purpose built live/work units alongside hub facilities (meeting space / networking space / hot desk facilities) will provide greater carbon savings than homeworking[12].

Case Study T2. BT Homeworking[12]

16% of BT's UK employees are full time home workers. Amongst the benefits communicated by BT are:

- Commuter CO_2 emissions reduced by 97,000 tonnes
- Staff satisfaction increase of 50%
- Increased staff productivity and retention
- Reduced office property requirements to the value of £500 million[12]

Regional opportunities to utilise ICT as a replacement for commuter travel are:

- **Supporting and promoting the development of home businesses.** In rural Regions the establishment of home businesses can help to tackle car dependency. Small and start up businesses have been recognised as key to reinvigorating the economy. Home businesses are booming despite the economic crisis, with Cardiff, Swansea, Newport, Wrexham, Mold and Caerphilly listed in the UK's top 50 home business hotspots in Enterprise Nations' recent Home Business Report[13]. These hotspots set a precedent for home business establishment, demonstrating its viability in Wales. The report concludes with a checklist of measures to employ to encourage growth in the home business sector. Measures include the creation of written materials and guidelines for home business start up, home business set up information sections on local authority websites and support for new developers to include work spaces into new home builds.

- As part of the Smith Institute's previously mentioned report[12] it was recognised that home based businesses lack access to background resources and assistance. Identified needs include complementary business services such as IT support; meeting spaces; business support facilities including internet access and video conferencing; social spaces for communication with peers. Additionally, it was flagged up that the applicability of tax regimes and regulatory issues to home based businesses is unclear and results in many home businesses being unregistered[12]. **There is a clear role for Regional groups and local authorities in creating and supplying guidelines and resources for home based businesses.**

- **Working with the public, private and third sectors to increase home working**. The public sector is a major employer throughout Wales and should be supported by Regional Groups to provide a lead on home and flexi working. Where possible organisations should be encouraged to promote home working for employees, to cut down on the number of commuter journeys to the workplace. The Climate Change Commission for Wales' Emissions Reductions sub-group suggest that working from home will provide the added benefit of enabling people to walk or cycle their children to school as opposed to driving in as part of their work commute[9]. Regions can draw upon examples of home working support for guidance e.g. Enterprise HQ in Shropshire is amongst the first hubs for homeworkers in the UK. Facilities provided for rural home workers include meeting rooms to hire by the hour, "hot desk" facilities to allow working away from home when necessary and a wireless broadband lounge. Facilities also benefit home businesses, providing networking opportunities and business workshops and seminars[14]. Facilities could also be linked to a video conferencing hub and crèche facilities to maximize use. **Regional groups could seek to pilot the strategic provision of such facilities in conjunction with the private sector. Utilising empty local authority office space may provide an opportunity to deliver a lower cost pilot project.**

- A crucial element of supporting both home businesses and homeworking will be the ability of planning requirements to deliver mixed use developments incorporating facilities for home working including ICT connectivity and work space. Single live/work units mean that new businesses pay for one property only and reduce the carbon impact of construction compared to two separate builds. **Supplementary planning guidance and Section 106 Agreements provide a mechanism to require developers to show consideration to supporting home working.**

The energy efficiency of buildings should be jointly tackled by Regional groups alongside initiatives to promote homeworking and home businesses.

ICT as a Replacement for Business Travel

Regional groups should seek to work with the public, private and third sector to promote and maximise the use of teleconferencing to reduce the need for meeting related travel. Utilising video and telephone conferencing will not only reduce emissions from business meeting travel but will also free up wasted travel time, cut down on travel expenses, improve communication with home workers. In house video conferencing suites are likely to be a worthwhile investment for large private companies with global communication needs. Innovative videoconferencing facilities such as Virtua Live form Telepresence or equivalent technologies provide an immersive interactive video-conferencing experience through installing identical video conferencing suites in communicating offices. Strategically positioned, rentable, video conferencing facilities (hubs) are likely to be a more viable option for many organizations e.g. linked to the new fibre speed network in North Wales could be a valuable resource for public, private and third sector use. Regional groups should explore the feasibility and opportunity to pilot a strategically positioned video conferencing hub alongside widespread promotion of potential benefits amongst public, private and third sectors.

Telehealth

Telehealth is the use of ICT to replace health service related travel, whether it is to allow clinicians to meet without travelling or to provide healthcare directly to patients in their homes. NHS Wales recognises the opportunity for telehealth to maintain a local service in rural areas, whilst making better use of clinicians' time by reducing the need to travel. Opportunities include asking patients to record information on their health / symptoms to be assessed and responded to at a later date, video conferencing between clinicians and possibly patients and utilizing health monitoring technology which can be operated remotely. ICT is used successfully in this way by South West Wales Cancer Network[15].

Case Study T3. South West Wales Cancer Network[15]

In 2005 a project board was established to assess where new ICT equipment was needed and how best ICT could be utilized. They focused upon improving waiting times through the use of video conferencing to enable specialists to come together quickly. This negated the need for lengthy correspondence or distant meetings for specialists which in turn sped up patient referral and treatment times. Staff training and user workshops have been a key element of the successful use of ICT[15].

Opportunities include establishing village telehealth booths with web cams to allow remote patient advice. Some therapy and treatment sessions can be delivered by telephone e.g. some Cognitive Behaviour Therapy sessions. **Regional groups could play a role alongside local service boards in helping to promote and share best practice of the use of ICT in the health service.**

Online Shopping

Online shopping as opposed to individual trips to the supermarket has the potential to reduce transport emissions through shared delivery. The BedZED development includes community facilities for residents to order goods online, with regular co-ordinated deliveries to the site able to cut down on shopping delivery mileage. A 2008 study of food delivery miles showed that where a consumer drives a round-trip distance of over 6.7 km to pick up organic vegetables from a farm shop that the total carbon emissions are likely to exceed emissions from a large scale vegetable box delivery door to door scheme (including emissions from cold storage, packing, transport to a regional distribution point and transport to the door)[16]. **Regional groups can seek to work with local authorities to ensure ICT connectivity to enable consolidated food deliveries is a consideration in new residential developments, particularly in those developments not located near to food retail outlets.**

The role of ICT in reducing emissions from transport is a recurring theme throughout this work. Not only can ICT serve as a substitute for travel but it can also serve as a tool to improve public transport service e.g. though real-time passenger information, can be used to encourage driver behavioural change e.g. Fiat's eco-drive system which shows the user how to drive more efficiently, and can provide online for a for sustainable transport such as lift share and bike buddy websites.

Box T1. Mechanisms to reduce the need to travel

I. Work with local authorities to ensure Local Development Plans or supplementary planning documents require:

- **a)** the co-location of homes, jobs and services through infilling or mixed development
- **b)** dense town and city layouts (aiming for 50 houses per hectare or above)
- **c)** consideration is given to the need for a live/work approach to development
- **d)** ICT connectivity as standard in new developments

II. Work with Visit Wales and the Regional Tourism Partnership to promote local holidays and explore opportunities for sustainable travel to tourist destinations and between attractions.

III. Work with local service boards and local authorities to maximise the benefits of Welsh Assembly Government Broadband initiatives

IV. Explore innovative options for the expansion of broadband connectivity in partnership with the private sector e.g. Anglesey wireless broadband access utilising radio links.

V. Provide support for ICT exploitation in conjunction with local authorities, including producing written materials and guidelines for home business start up; exploring opportunities for establishing strategically positioned home working and video conferencing hubs (in conjunction with the private sector); establishing a promotional programme for the use of ICT for home working, business meetings, telehealth e.g. South West Wales' Cancer Network and co-ordinated online food shopping.

Box T2. Measuring success for reducing the need to travel

- Percentage of new developments designed to deliver co-location
- Percentage of new developments with ICT connectivity
- Establishment of a project addressing sustainable travel to tourist destinations in conjunction with Visit Wales or / and the Regional Tourism Partnership
- Broadband coverage area
- Number of home working and video conferencing hubs
- Creation of written materials and guidelines to support home business start up
- Number of new home businesses established per year
- Number of hospitals / surgeries utilising ICT to reduce travel
- Number of businesses encouraging home working amongst their employees

4.2. Travelling via More Sustainable Means

4.2.1. Land Use Planning

Providing alternatives to car travel should be an early consideration in any planning process. **Opportunities include**: incorporating green pedestrianised corridors into any new development providing pleasant and direct links to the nearby services for walkers and cyclists; capitalising on any existing nearby green spaces to create an extended network; providing facilities for cyclists including plentiful parking spaces and shower and changing facilities in new employment developments, public service buildings and key public transport interchanges; focusing new home building in towns and cities in areas with housing densities below 50 houses per hectare to build towards this critical density and enhance the viability of a frequent bus service; prioritising walkers, cyclists and public transport in the allocation of road space through the provision of fast bus lanes and wide cycle lanes and designing road layouts in urban areas to reduce car speeds; practicing filtered permeability whereby cycling and walking routes are kept short and direct and car travel is limited to key roads; providing good lighting, wide pavements, sloping pavement edges for prams and bicycles and numerous pedestrian crossing points to encourage walking and cycling; and finally creating home zones where road space is not divided between car and pedestrian use to prevent the prioritisation of cars.

The Brighton One Planet Living Community currently under construction incorporates a new "greenway" for walkers and cyclists into its design, providing a new link to Brighton train Station. The design further promotes the use of public transport through the inclusion of only 12 car parking spaces (which are dedicated to disabled and pool car use) and the provision of plentiful secure bicycle parking spaces.

Recent research into addressing transport emissions through policy proposes the introduction of a "public transport accessibility standard" for use in land use planning to ensure that new developments provide an alternative to car travel[6]. Standards could be set based on settlement size and density and should consider all methods of public transport. A baseline of one opportunity to travel via public transport per hour from remote areas and one every 10 to 15 minutes in dense urban areas is recommended. Complementing this idea

are the suggestions of: developing “walkability” standards; minimum bicycle parking standards and ceilings on parking space number in new developments[6].

The South East Wales draft regional transport plan further suggests that new developments without a suite of sustainable transport options should not be allocated. **Spatial Plan groups should seek to implement these standards through influencing local authority Local Development Plans and Supplementary Planning Guidance**. **Mandatory ceilings on car parking spaces and mandatory provision of bicycle parking space linked to development size can be quickly and easily integrated into planning requirements**. The considerations above should also be taken into account for any regeneration projects.

Mid Wales Transportation (TraCC) have allocated a sum of money to the development of smarter choices as part of its first 5 year implementation programme for the draft regional transport plan, this will include funding for a **smarter choices guide aimed at developers** and LDPs. **This is something for all Regions to aim at producing, and could be developed through Regional partnerships**.

Regions should strive for new developments to be pioneers – for example the BedZED development in the London Borough of Sutton was designed with the inclusion solar powered charging points for electric cars – taking the initiative to facilitate the uptake of an innovative solution.

In addition to infrastructure planning, making developer funded travel plans a requirement for all new developments is receiving increasing support. The role of travel plans is discussed in section 4.3.1. South West Wales Integrated Transport Consortium’s (SWWITCH) draft regional transport plan discusses developer funded welcome packs for residents in new developments incorporating money off vouchers for bus journeys or bicycle purchase, a local travel map and travel information.

4.2.2. Technological solutions

The development and uptake of technological advancements for increased fuel efficiency in conventional vehicles and of vehicles powered by no or low carbon fuels are largely beyond

the influence of the Spatial Plan Regions of Wales. A brief overview of low carbon vehicle solutions is given below:

Technological Advancements for Conventional Vehicles

Ongoing work by the SDC in London, entitled Mobility 2020, is looking at opportunities for a rapid shift to low carbon mobility utilising *in reach* technologies. The International Energy Agency estimates that advanced engine technologies, improvements in tyres, aerodynamics, lights and appliances could increase petrol & diesel fuel efficiencies of light duty vehicles by up to 47%.

Electric Vehicles

Full electric vehicles already have overall carbon emissions as low as some of the best internal combustion engine vehicles, and as we decarbonise the electricity supply the potential transport emissions savings through electric vehicles are greatly increased. Electric cars are now commercially available to buy and new models are continually coming to market. Although still more expensive to buy, electric cars can now compete with diesel and petrol cars in terms of speed and acceleration and offer far greater efficiency in the conversion of energy inputs to kinetic energy than internal combustion engines. Electric propulsion is feasible for cars and light goods vehicles however battery limitations mean that periodic recharging is essential, making this technology unsuitable for long distance vehicles such as heavy goods vehicles and possibly buses. The Welsh Transport Statistics 2007 report[5] highlights that of the 7,400 miles travelled per person per year in Wales 4,240 of these miles are travelled on journeys of under 25 miles in length – demonstrating the scope for electric vehicles to meet our travel demands. In rural and peripheral areas of Wales, particularly where public transport provision is challenging, electric or hybrid vehicles hold significant potential to decouple car and carbon dependence.

Investment in recharging infrastructure is essential to enable electric vehicle uptake, including recharge points on street, at offices, in car parks or alternatively / also battery swap over schemes. The Elektromotive company has developed a recharger which is now being installed at on street parking bays and shopping centres in conjunction with local

authorities such as Westminster City Council, and energy suppliers[17]. Similarly, project Better Place is creating a network of battery exchange stations in countries around the world.

Arriva buses are trialling the world's first hybrid double decker bus. Electric trolley buses powered by overhead power lines are common in U.S. cities.

Hydrogen Vehicles

Hydrogen vehicles are not currently commercially available due to hydrogen storage and fuel cell challenges. The carbon benefits of hydrogen propulsion are dependent upon the process through which the hydrogen is produced, for example production via electrolysis requires electricity use which is less efficient overall than an electric vehicle being charged on the same electricity.

Biofuels

The technology exists to produce biodiesel and bio ethanol from a variety of crops and bio wastes. Biogas produced through anaerobic digestion and biome thane are also classed as biofuels. Cars, buses, vans and HGVs can all be powered by biofuels.

Through European CIVITAS project funding a fleet of 150 buses in Toulouse, France, are operating on a fuel blend including 30% biodiesel. In the UK, Arriva is aiming to reduce bus emissions by 14% through using a fatty acid bio fuel as a 20% blend in 75 buses, requiring minimal engineering work to the fleet. See section 7 of this report in the Waste chapter for a detailed case study on the use of biomethane in Camden Town council's refuse collection, recycling and street cleansing vehicles (Case Study W3).

Case Study T4. Biogas buses in Lille[18]

Through European funding as part of project CIVITAS, 128 new biogas buses have been introduced to the Lille public transport fleet. The biogas fuel is produced through the fermentation of sewage sourced from a local sewage treatment plant. Buses are fuelled via a new biomass and natural gas compression unit. A new bus depot with ventilation and detection systems has been constructed to ensure safety. A technical study will be undertaken to evaluate the technical and environmental performance of the fleet[18].

The EU CIVITAS initiative helps cities to achieve more sustainable, clean, energy, efficient urban transport systems.

Regional Opportunities

Opportunities for the Regional groups to influence the uptake of low carbon vehicles include:

- Working with local authorities and local services boards to incorporate procurement of fuel efficient and electric or hybrid vehicles into the forward commitment procurement models (FCP) of the public sector. Recharging infrastructure at public buildings will be required alongside procurement commitments. (FCP is a model which enables the public sector to procure new and innovative environmental goods and services in order to stimulate markets. This is a means of creating demand for an innovative product, to which private sector suppliers respond by investing in and developing the product, bringing it to market at an affordable price. This ensures value for money and access to innovative products for the public sector with reduced risk. See http://www.ogc.gov.uk/documents/FCP.pdf for further information).
- Exploring opportunities to seek European funding and private sector partnerships to pilot low carbon fuels in public transport fleets and local authority fleets.
- Exploring opportunities to seek European funding for an electric transport town or an electric transport rural community.
- Supporting research and development within higher education institutions and the private sector.
- Exploring opportunities for local authority planning officers to work with developers to incorporate recharging infrastructure into new developments to ensure they are future ready.

4.2.3. Public Transport

The 2007 Welsh Transport Statistics report[5] highlights the frequency of use of public transport modes. In 2005, 58% of individuals said they used surface rail less than once a year or never, with similarly high figures of 53% and 80% for local buses and express buses or coaches respectively. There are a multitude of opportunities through which Regional public transport services can be improved to increase use and improve perceptions.

Improving public transport will be dependent upon the policies of commercial transport operators. The North Wales Regional Transport Consortium Taith states that it seeks to address this issue through the creation of partnerships and agreements e.g. "network stability agreements" with bus operators to define levels of relative pricing. **Communication and partnership with private operators and facilitating communication between operators is likely to be an important role for Regional groups to fill or at least to keep an interest in delivery through the Regional Transport Consortia.**

Public Transport Audit

As a starting point, in many cases, more effective use can be made of existing infrastructure. **WSP Regional groups can work with constituent local authorities and Regional Transport Consortia to effectively audit existing public transport services and walking and cycling networks with a view to identifying the following information**: where a new bus service would be of most benefit, where a slight alteration in bus timetable would coincide with the end of a shift on an industrial estate, where pick up and drop off bikes rental facilities could join services or public transport interchanges and where the removal of obstacles [bins and traffic calming measures] could improve cycle lanes. Much of this work will have been carried out as part of the regional transport plans therefore the WSP Regions are likely to have limited additional auditing requirements.

The main function for the Regions would be to ensure effective communication across the organisations represented on the WSP Regional groups. This could help facilitate collaborative working, critical to the success of many low carbon projects.

Case Study T5. Cairngorms National Park Public Transport Audit[19]

In 2006, an audit of public transport services was conducted in the Cairngorms National Park. The audit consisted of: a substantial survey of resident and visitors; an analysis of survey results to highlight access issues; a review of existing services, including detailing and mapping all current services and identifying current limitations; a literature review of sustainable exemplars from other locations; development of a framework to approach public transport providers to adapt routes and frequency; assessing the success of new services; assessing the quality and frequency of services to major transport hubs. The audit uncovered many issues and potential improvements to current services including:

- Identifying local transport gaps
- Identifying routes on which ticket integration is needed
- The need for visitor oriented information on public transport services
- Potential opportunities for demand responsive transport
- A need for cycle carrying facilities of particular buses services

The audit also highlighted potential partnerships and funding streams which would enable the delivery of recommended improvements[19].

Public Transport Integration

The concept of integration encompasses a multitude of improvements to allow for a smoother public transport journey:

- Integrated ticketing across public transport operators and even public transport modes, possibly with a view to creating a Region wide travel card.
- Facilities for buses at train stations including turning circles and lay-bys.
- Integration / synchronisation of timetables across different modes of travel and different operators.
- Provision of transport between public transport interchanges e.g. car pools at train and bus stations or/and bike pick up and drop off points.
- Bicycle storage facilities at train and bus stations.

- Allowing bicycles on trains and on buses e.g. Brecon bike bus which has a specially designed bike trailer attached.
- Integration / consistency of signage throughout public transport interchanges within a Region. SEWTAs regional transport plan for the South East discusses developing quality criteria for public transport interchanges incorporating consistent signage, information provision and waiting facilities.

The Wales transport strategy recognises the need for the integration of public transport in Wales, which involves measures such as: the synchronisation of timetables and allowing bicycles on buses and trains. The strategy also states that the Welsh Assembly Government will work with local authorities to help integrate public transport. Each of the regional transport plans emphasise the need for the integration.

Whilst delivery is covered to a large extent by Regional Transport Consortia and local authorities in conjunction with the Welsh Assembly, **WSP Regional groups can add value through facilitating communication and partnerships between public transport operators.**

Innovative Solutions

Each of the Regional Spatial Plans identifies the need for innovative public transport solutions. Some ideas for effective use are given below:

Demand Responsive Transport - flexible public transport through which individuals book their journey to their chosen destination in advance within a specified operational zone. This has potential for reducing car dependency in low population density areas where frequent, timetabled public transport services are not viable. Demand responsive transport can potentially act as a feeder service from poorly connected areas to transport nodes.

Case Study T6. Deeside Shuttle[20,21]

Flintshire's Shuttle initiative is aimed specifically at improving public transport into employment centres. Aligned with workers' shift times the Deeside Shuttle provides demand responsive transport from multiple towns and villages in the area to Deeside industrial park where over 10,000 people are employed. Prior to the introduction of the shuttle 38% of job vacancies at the park remained due to the inability of those without cars to access the park. There were previously no public transport links to the industrial park. At maximum capacity it is estimated that the service could displace 24,000 car journeys a week, saving 22 tonnes of carbon emissions per year. The success of the scheme has resulted in a cross border expansion, with Cheshire County Council, Flintshire County Council and Lache Neighbourhood Management, planning to jointly fund a service through Saltney and parts of Chester directly to the business park.

Regions should look to assess the current public transport provision and requirements of large employment sites. A demand responsive service should be strategically positioned to ensure widespread use and displacement of single occupancy car travel. With business parks, industrial estates and large public transport interchanges providing potentially high demand destinations.

Central Wales' Bwcabus will provide a feeder to main bus services. The feeder and main services will be linked via telematics which determine vehicle meeting times to ensure passenger connections are made. Carmarthenshire County Council has secured ERDF Convergence funding for the service which aims to provide access for people in rural communities to employment, education and training. If successful it is thought that this could be rolled out as a model across rural Wales. In order to provide Region wide services there is potentially a role for **WSP Regional groups in co-ordinating research and funding into the need for such services with a view to improving access for rural communities whilst decreasing car dependence.**

Community Transport - frequently takes the form of demand responsive minibuses to provide transport for socially isolated groups or those with mobility issues in rural and peripheral areas. Community transport should increasingly be seen as a travel emissions reduction tool – group transport services for the whole social spectrum within a community to a supermarket for example has the potential to greatly reduce emissions from individual car travel. Community minibus hire for groups and organisations provides an opportunity to

reduce mass car travel to a single destination e.g. for a local school run, for team building/staff away days, sports events. The wider use of community transport will require the employment of mechanisms to promote behavioural change and disincentives to the use of cars in addition to the availability of a reliable and affordable service. For example on a Regional level this could mean car parking charges in supermarket car parks coupled with well advertised, frequent free supermarket buses. The supermarket Tesco recently discontinued a free bus service from Shropshire towns to Tesco Shrewsbury due to limited uptake, demonstrating the need for a multi faceted approach to promoting the use of community and public transport.

Park and ride – Creation and expansion of new and existing park and ride facilities is covered within the draft regional transport plans. New bus-based park and ride facilities should be strategically positioned to serve public transport interchanges and key retail and employment hubs as a means of replacing multiple car journeys. Research has demonstrated that whilst park and ride facilities reduce traffic within the urban areas they serve, in most cases this is accompanied by a simultaneous increase in traffic outside the urban area. The final result of which is redistribution as opposed to reduction in traffic[22].

As recognised in the draft regional transport plans, ensuring the provision of adequate car parking spaces at train stations will maximise the use of park and ride by rail.

Real Time Information – Draft regional transport plans recognise the need for passengers to have access to real time information on public transport services.

Case Study T7. The Cardiff Real Time Passenger Information System

The Cardiff Real Time Passenger Information System involves the transmission of information on travel progress from buses tracked via GPS to a central computer. Real time information is relayed from the central computer to LED displays which have been installed in over 450 bus shelters across Cardiff.

Case Study T8. "Your next bus"

Another real time example is the "Your next bus" service operating in South and West Yorkshire. Buses are tracked via GPS, expected arrival times at each stop are calculated via a connected central computer and passengers can access the real times via text on their mobile phones, or on the scheme's website. The system allows for interactive use of public transport and increased confidence. It has also been found to enable some bus services to improve their punctuality and reliability.

The Regional Transport Consortium, TraCC, refers to a similar real time scheme operating on Gwynedd buses, with the service deemed to be of particular use in rural areas where buses are less frequent. The service has also been shown to allow easier travel across different modes of transport. TraCC's draft regional transport plan draws attention to the substantial set up and running costs of real time systems and raises the issue of whether funds would be better allocated in improving service reliability.

Intermodal journey planners are services which allow travellers to plan their journey across modes of transport through providing co-ordinated travel times. **Traveline Cymru** provides this service on an all Wales basis. This could be enhanced at a Regional level through integration with existing and new real time information services. **WSP Regional groups and the Regional Transport Consortium could work with Traveline Cymru to deliver integrated information provision.**

<u>Decreased Public Transport Journey Time</u>

A number of novel opportunities for reducing overall journey time through fast payment systems are emerging in the UK:

Case Study T9. Stagecoach Tap and Go Payment[23]

The bus company Stagecoach are taking advantage of an opportunity to speed up passenger journeys – in 2009 they will be piloting a contactless bank card payment system on approximately 200 buses in Merseyside. This Tap and Go technology is similar to the Oyster Card system used in the London Underground and has also been previously used in black cabs. Its potential benefit in public transport use has now been recognised.

Case Study T10. Norwich Roadside Ticket Vending Machines[24]

The UK's first comprehensive roadside bus ticketing system, outside of London, has been introduced in Norwich. Funded through the European CIVITAS project, 16 roadside ticket vending machines have been installed across the city. The machines allow users to purchase a full range of ticket types across operators, tariffs and destinations. The machines give change and will soon allow payment via bank card. The vending machines have been installed at interchanges and key bus stops to reduce boarding and journey times. In addition to improved reliability and punctuality of bus services it is hoped that the system will increase bus use and provide savings on operating costs.

The need for, and delivery of, many of these innovative transport solutions are addressed within the regional transport plans. **WSP Regional groups should work with the Regional Transport Consortia to identify which of the above require further consideration / feasibility studies / piloting**, whilst assessing where the WSP Regional group can add value to current work and where they can help to initiate new work streams. **The recommended role of co-ordination and facilitation for WSP Regional groups may be of value to the Regional Transport Consortia through co-ordination of transport projects and facilitations of communication between operators.**

Rail

At a Regional group level, working with the Regional Transport consortium to identify the need, and build a case for, rail improvements and expansions, in order to influence Welsh Assembly Government and rail operative spending, is likely to be the main mechanism for improving rail services.

In order to facilitate future expansion and improvement to railway lines, **Regional groups should work with Regional Transport Consortia and local planning authorities to ensure that former railway line sites and suitable future sites are protected against alternative development in local development plans**.

Previously discussed actions for integration across transport modes are crucial to maximise the use of existing rail services e.g. through bike and car rental points at train stations; bicycle parking facilities to train stations; walking and cycling paths directly to train stations; adequate car parking provision at stations to facilitate park and ride by rail. New developments must, as discussed, be located to provide access to public transport nodes such as train stations.

Regional groups should explore opportunities for innovative rail solutions in key urban centres. Opportunities include:

- Ultra light rail – fuel cell powered trams small enough to easily access pedestrianised areas. A funding bid is currently being developed for an ultra light rail system to link the railway station and the town in Cheltenham using the route of a former railway line. It is proposed that this will be a lightweight hydrogen fuel cell based tram system, with hydrogen to be produced nearby in a new waste treatment facility.
- Personal rapid transit – small light electric powered vehicles suitable for mass urban transit. A personal rapid transit system will be piloted at Heathrow airport this year[25].

4.2.4. Reducing Car Dependence / Single Occupancy Use

Reducing Single Occupancy Car Use

A key focus in reducing transport emissions is reducing single occupancy car journeys. Several successful car share schemes are now operational across the UK e.g. http://www.nationalcarshare.co.uk/ and http://www.liftshare.com. Numerous resources advising on how to set up car share schemes are now available e.g. http://www.carplus.org.uk/Resources/pdf/TfLCarShareGuide.pdf which includes a set up checklist, template survey and sign up forms.

At a Regional level key opportunities for encouraging car sharing are:

- Communication and publicity of car share resources.
- Working with local service boards to incentivise car sharing within the public sector through reducing the number of car parking spaces available over time; allocating a number of spaces for shared cars only or introducing car parking fees.
- Working with key employers to devise travel plans which incorporate car sharing incentives for workplaces.
- Working with local authorities to identify the feasibility of, and opportunity for, park and share facilities. I.e. car parks where colleagues can meet, leave additional cars securely and travel on together in one car, e.g. Doncaster Council's M15 Park & Share scheme. This is applicable to long distance commuters into urban areas, or for city commuters from rural areas. A network of Park & Share sites ranging from those with less than 10 spaces available to ones with over 300 spaces are now in place in Northern Ireland. TraCC, the Mid Wales transport consortium, identifies that parking and sharing is already taking place in some rural laybys in Mid Wales. TraCC also recognise further opportunities for park and share in rural areas through using village halls and small cars parks. Through effective communication of facilities, WSP Regional groups can utilise existing under used car parks and large laybys to encourage parking and sharing.
- Car sharing lanes are now beginning to be piloted in England. A 1.7 mile, high occupancy vehicle lane linking motorways between Leeds and Bradford was opened

in March 2008. The lane, for use by cars with two or more occupants, coaches and buses, was created on a stretch of road where studies had previously shown that 84% of vehicles were single occupancy. WSP Regions with heavily congested commuter routes should research the potential for high occupancy vehicle lanes to increase car sharing. This need not be resource intensive in terms of infrastructure, with the possibility of utilising existing bus lanes.

Car Clubs

Car clubs provide an easily accessible and relatively affordable means of car rental, reducing the need for individual car ownership and can serve to integrate public transport modes. Individuals can sign up to become a car club member through paying an initial joining fee and an annual insurance fee, allowing them access to a fleet of rental cars. Rental cars are available from designated sites around a city after booking online or over the phone. Car clubs can provide a useful alternative to second car ownership. Locating rental cars at public transport interchanges can serve to help to integrate modes. Further integration of public transport can be achieved through ensuring multi-modal travel cards also cover car clubs. The car club Zipcar claim that each of its rental cars replaces 15 privately owned vehicles. **The WSP Regions should also consider how the use of electric cars and recharging points can be integrated with car clubs.**

Regional groups should work alongside the Regional Transport Consortia and approach private sector transport operatives to explore the feasibility of car clubs in dense urban areas, perhaps linked to a new development with limited car parking provision. For example, City Wheels car club in Swansea was the first car club in the UK for the use of housing association tenants. It is now proposed that car club vehicles will be located at a planned Coastal Housing City Living Development on Swansea Waterfront. See http://www.carplus.org.uk/carclubs/case-studies/swansea.htm.

Disincentives to Car Travel

Regional groups can utilise opportunities to disincentivise car travel, to promote car sharing and the use of public transport. **Potential avenues for exploration in conjunction with the Regional Transport Consortia and local authorities are:**

- Road charging in urban areas and re-investment of revenue in public transport or smarter choices.
- Improving car parking strategies with revenue to be re-invested in public transport or smarter choices.
- Traffic management to meet existing speed limits – enforcing speed limits to increase fuel efficiency.
- Lobbying the Welsh Assembly Government to divert funding for road expansion and building into sustainable transport modes and smarter choices.
- Exploring the need for car exclusion in town and city centres, limiting cars to key routes, whilst ensuring direct access for pedestrians, cyclists and public transport. Exploring the feasibility of bus gates as a means of excluding other traffic. The UK Government Department for Transport have produced some guidance on the use of bus gates, see http://www.dft.gov.uk/pgr/regional/buses/bpf/busprioritythewayahead12/busprioritythewayaheadhtmlve1073?page=7.

4.2.5. Walking and Cycling

Alongside the promotion of walking and cycling through smarter choices (as discussed in section 4.3.). See http://www.adsph.org.uk/downloads/policies/Take_action_on_active_travel_2009.pdf?PHPSESSID=q7ni4dm1bkb98vc7t06d9l1ql5 for opportunities to promote active travel. **WSP Regional groups must ensure the provision of a safe and attractive walking and cycling infrastructure.** Priority sites for cycle networks & facilities are urban employment sites, town centres, bus & railway stations, park & ride sites, visitor attractions, and public buildings. **Key actions for delivery of this infrastructure at a WSP Regional level are:**

1. Regional groups should work with constituent local authorities to ensure green corridors and cycle parking facilities are required in all new developments. The Walking and Cycling Action Plan for Wales 2009-2013 states that local authorities should adopt standards for secure cycle parking in local design and planning guidance[26]. Where possible, green corridors should be designed to link to existing cycling and walking networks.
2. Applying cycle parking standards to existing local authority buildings, key settlements and hubs. Working with the LSBs to introduce cycle parking standards to public sector buildings, with later work to target the private and third sectors with urban workplaces. Sustrans has produced guidance on cycle parking including locating, design and number of spaces, see http://www.sustrans.org.uk/webfiles/Info%20sheets/cycle%20parking%20info%20sheet.pdf.
3. Reallocation / reprioritisation of existing road space to favour walkers and cyclists as part of a thorough public transport audit. Opportunities include removing existing obstacles on walking and cycling routes; introducing quiet lanes in rural areas where vehicles are asked to travel at low speeds to create more favourable conditions for walking and cycling; creating 20 mph zones in urban areas to encourage walking and cycling; creating car exclusion zones in city centres.
4. As part of a thorough public transport audit identifying opportunities for walking and cycling routes e.g. disused railway lines and potential for canal side paths.
5. Working with constituent local authorities, the Welsh Assembly Government, Regional Transport Consortia and Sustrans to continue the expansion of existing walking and cycling routes with a focus on providing safe routes to schools and public transport interchanges.
6. Seeking funding to introduce bike pick up and drop off schemes at public transport interchanges and in town and city centres in conjunction with Regional Transport Consortia and local authorities.
7. Utilising refurbished bikes should be considered as a means of reuse to minimise waste to landfill.

8. Working with local authority planning and regeneration teams and public transport operatives to provide the infrastructure needed for the integration of walking and cycling with public transport. Important facilities include cycle parking at all public transport interchanges and provision of bicycle carrying facilities on public transport.

Case Study T11. Bike Pick Up and Drop Off – Velo'v in Lyon and Velib in Paris.

Distributed throughout Lyon 4000 bicycles are available for rental from 340 purpose built bike racks. The bicycles can be rented from any rack and deposited at any other in the city. Velo'v racks or stations are located on average at 300 metre intervals. The service is managed by an advertising agency, with advertising revenue covering the majority of the cost of the project. Membership to the scheme involves a small initial registration fee, with rental charges paid at the end of each journey dependent upon the length of time the bike is out of the racks. The first 30 minutes of any journey is free of charge. To guard against the theft of the bikes a credit card is required for rental, to be charged if a user's bike is not returned[27,28].

The success of the scheme led to the launch of a bike pick up and drop off rental scheme in Paris in 2007 – with 20,000 bicycles distributed in over 750 racks across the city. Users can pay for a one day, weekly or annual card. Building upon this model there are now plans for an "Autolib" electric car rental scheme with 4,000 cars available for rental at stations across Paris.

Box T3. Mechanisms to promote travelling via more sustainable means

I. Work with local authorities to ensure Local Developments and supplementary planning documents require:

a) provision for walkers and cyclists in new developments including green corridors, cycle parking, showering facilities for cyclists in employment developments, wide pavements.

b) developments to meet public transport accessibility standards (to be developed in partnership by the WSP Regional Group, local authorities and the regional Transport Consortium).

c) limited car park space numbers in new builds & mandatory provision of cycle parking.

II. Work with local authority planning and regeneration departments to favour public transport, walkers and cyclists in road layouts through: filtered permeability – providing direct walking and cycling routes and limiting car travel to key roads; providing wide and continuous cycle lanes; bus gates allowing access to buses only or fast bus lanes.

III. Work with local authorities and local service boards to incorporate procurement of hybrid / electric vehicles into forward procurement models of the public sector.

IV. Seek funding to explore opportunities to pilot e.g. biogas fuelled public transport in conjunction with the private sector or an electric transport town or rural community.

V. Exploring opportunities for local authority planning officers to work with developers to incorporate recharging infrastructure into new developments to ensure they are future ready.

Box T3. Mechanisms to promote travelling via more sustainable means continued

VI. Improve public transport , walking and cycling networks through:

a) "Auditing" existing public transport networks to identify e.g. where a cycle route ends abruptly or where a bus time could be altered to better match e.g. end of shifts.

b) Facilitating discussion between public transport operatives to improve integration e.g. introduction of a travel card for all modes, synchronization of timetables, provision of a bike trailer on buses, bus bays and turning circles at train stations, bicycle storage at train stations, integration of signage.

c) Providing targeted demand responsive transport to key employment sites and main public transport routes.

d) Community transport provision especially in rural areas where frequent public transport is unlikely to be viable.

e) Exploring the feasibility of park and ride schemes to key urban centres and from rural areas to key public transport interchanges at work travel times.

f) Working with transport operatives to pilot / provide real time passenger information e.g. "Your next bus" text service, tap and go payment systems and on street ticket machines.

g) Working with the Transport Consortium to identify the need, and build a case for investment in train services.

h) Exploring opportunities for ultra light rail, electric trolley bus services or trams in and around urban centres.

i) Provision of safe and attractive walking and cycling infrastructure such as piloting bike rental pick up and drop off points in city centres.

VII. Reduce single car occupancy / car dependence through:

a) Car share promotion e.g. spaces allocated for shared cars only at public sector buildings, providing park and share car parks e.g. village hall car parks in rural areas.

b) Exploring the feasibility of car club establishment in dense urban areas perhaps linked to a new development with limited car parking provision.

c) Exploring the need for pedestrianisation and car exclusion on selected roads or charging in city centres.

Box T4. Measuring success for travelling via more sustainable means

- Percentage of Regional population using public transport on a weekly basis
- Percentage of journeys made on foot or bicycle
- Percentage of developments with green corridor and cycle parking facilities
- A public transport accessibility standard is developed and adopted for all new developments
- Percentage of developments with capped parking space provision
- Percentage of large developments and regeneration projects providing for walkers and cyclists e.g. inclusion of filtered permeability
- Number of public sector organisations committing to hybrid, electric or hydrogen vehicle procurement in forward commitment procurement models
- Establishment of a trial project for the use of e.g. biogas in public transport
- Number of electric car recharging points in the region
- Percentage of public transport operatives participating in integration projects and initiatives
- Number of worker car journeys displaced by demand responsive transport to key employment sites
- Number of bus services with real time passenger information service available
- Establishment of an ultra light rail or electric trolley bus service in the Regions' key urban centre(s)
- Number of bike rentals from city centre bike pick up and drop off scheme
- Number of businesses and public sector buildings allocating car parking spaces for shared cars only
- Number of cars using park and share facilities e.g. village hall car parks
- Establishment of a car club in dense urban areas
- Percentage area of inner city and town centres pedestrianised

4.3. Behavioural Change / Smarter Choices

The importance of the promotion of behavioural change is increasingly recognised. A study sponsored by MTRU Transport Consultants modelled the emissions reductions possible through improved vehicle technology alone, it found that this would deliver less than half of the emissions reductions necessary to meet 2050 emissions targets[6]. Promoting more efficient patterns of travel alongside technological advancements was deemed necessary and urgent. The Climate Change Commission for Wales concurs that changing travel behaviour should be a priority through a complementary programme of hard and soft measures[9]. Whilst so called hard measures such as investment in public transport infrastructure will enable reduced car dependence, a simultaneous programme of soft measures such as the provision of information is essential to guarantee its use.

Smarter Choices is the term coined for mechanisms which encourage more sustainable travel behaviour. The Welsh Assembly Government's Smarter Choices: Wales publication[29] gives complete guidance including numerous case studies. It defines Smarter Choices as:

- "*giving people better and more focused information about their travel options;*
- *marketing sustainable travel options more effectively, to encourage their use;*
- *making improvements to the way that services are organised to ensure they appeal to particular groups of potential customers;*
- *targeting transport advice and services to particular groups of the population;*
- *harnessing technology and facilities that reduce the need to travel."*[26]

Many of the previous solutions such as establishing car sharing schemes, promoting the use of teleconferencing and improvements to public transport services also fall under the heading of Smarter Choices. Crucial behavioural change mechanisms not previously discussed are outlined below.

4.3.1. Travel Planning

This is a tailored comprehensive plan of how an organisation or an individual can reduce travel emissions through encouraging and facilitating the use of more sustainable modes of

travel. A number of sustainable travel organisations now offer a travel planning service e.g. Sustrans, PTI Cymru, the four Regional Transport Consortia: Sewta, SWWITCH, TraCC and Taith. The content of the plan is dependent upon what types of journey the organisation makes and what public transport / walking cycling opportunities are available in the area. Typically travel plans will call upon a suite of initiatives such as provision of cycle parking, initiating a car sharing scheme and provision of public transport information. **Travel planning for residential areas, workplaces including local authorities, schools and tourist attractions are all features of a Low Carbon Region.** Local authority travel plans provide an opportunity for sustainable transport awareness raising and will provide a high profile example for businesses and schools to follow.

Residential Travel Plans – should be a requirement for any new large developments, as discussed in section 4.2.1. The Welsh Assembly Government's Smarter Choices: Wales publication recommends that all new housing developments of over 50 units should have a travel plan at planning application which should be implemented through a Section 106 agreement[29]**. Regions should explore in conjunction with local planning authorities opportunities to require developer funded travel plans for large new developments.**

Careful land use planning could be complemented by the creation of car clubs, perhaps to be part funded by the developer and the local authority. Developer contributions towards improving existing public transport stock, given increased passenger numbers, should also be sought through planning mechanisms. The new Community Infrastructure Levy proposed by the UK government (discussed fully in the Built Environment and Energy chapter, Section 2) will enable local authorities in to impose a charge upon most new developments to be spent on the infrastructure needs associated with development such as transport requirements.

Perhaps more importantly, residential travel plans can be created for existing residential areas – incorporating individualised travel marketing, establishment of car clubs, creation of cycle parking facilities, local school travel plans, local car sharing initiatives. How to fund and instigate these is more problematic than for new developments. **Regions or local authorities should consider creating a small dedicated Smarter Choices team, who as part of their remit could develop residential travel plans.**

Workplace travel plans – generally used as a tool to target single person car journeys for a whole organisation or a single site, should be implemented and frequently reviewed in all public sector buildings and business hubs. These can target employee commutes, employee travel within work hours and deliveries. Workplace travel plans should generally include a range of measures including:

- Promoting walking and cycling through the provision of cycle parking, showering facilities, lockers; provision of maps and information on cycle and pedestrian friendly routes and on public transport routes and times.

- Providing disincentives to car travel including permitting or charging for car parking spaces, making car mileage an ineligible expense between locations were public transport is available and reliable.

- Providing incentives for more sustainable travel including car parking spaces allocated for car share or pool cars, mileage allowances for work journeys carried out on foot or on a bike, provision of a demand responsive shuttle bus from settlements with high worker concentrations. The Royal Bank of Scotland has partnered with Stagecoach to provide real incentives for bus travel to employees – through RBS's employee benefit scheme employees can purchase an annual bus ticket, the benefit is income tax and National Insurance free.

- Providing alternatives to travel including video conferencing facilities, encouraging x day(s) a week home working.

Smaller organisations could produce travel plans in partnership with other nearby organisations e.g. whole business park travel plan. Large organisations could produce a template travel plan which could be refined and applied on an office by office level e.g. the NHS Wales travel plan tool kit. The Regional Transport Consortium SEWTA plans to target and work with businesses and organisation in the Region to produce and implement travel plans. **Each WSP Region should look to identify key workplaces e.g. business parks where they could pilot working together to create a travel plan**. Promotion of workplace travel plans should highlight potential savings including travel cost savings, reduced car park congestion and health benefits for staff.

The Regional Transport Consortium SWWITCH recommends appointing and providing training and support for “Travel Plan Champions” within the workplace. This individual or team of individuals, (possibly made up of representatives from different departments) can drive the agenda forwards and communicate the benefit of any training to other staff.

School Travel Plans – should target travel to and from school. Elements to integrate into a school travel plan include:

- Promoting walking and cycling through providing maps and information on local routes and networks, providing cycle parking facilities, introducing a pupil rewards scheme, holding cycling classes or courses.
- Promoting car sharing through instigating a car share scheme and making car parking spaces available only to shared cars only.
- Promoting bus travel through working with bus companies to provide demand responsive pick up and drop off points along the route and providing parents with full information on the services available.
- Awareness raising and promotion through sustainable school travel days and events, producing sustainable travel information packs for all pupils and creating a panel of pupils / teachers / residents & parents to work on sustainable travel ideas and events.

Tourist attractions – travel planning for the main attractions of an area has not been widely documented. SWWITCH has committed to working with tourism organisations and key attractions in the Region to promote more sustainable tourist travel. This should be explored Regionally in partnership with Visit Wales, the Regional Transport Consortium and the Regional Tourism Partnership and should tie in with the holiday travel recommendations in section 4.1.2.

The Department for Transport has produced an "Essential Guide to Travel Planning" which draws together the tried and tested experience of those already in operation, see http://www.dft.gov.uk/pgr/sustainable/travelplans/work/.

4.3.2. Individualised Travel Marketing (ITM)

This is a proactive method of promoting sustainable travel through providing a tailored information pack for households on alternatives to car travel in their area. These can include timetables and route maps for trains and buses, cycle and walking route maps, free trial tickets for local buses and trains, discount vouchers for local bike purchases or car club membership. Large scale individualised travel marketing schemes instigated in South Perth, Gothenburg and Viernheim resulted in car usage reductions of 14%, 13% and 12% respectively, employing measures such as provision of personalised timetables, home visits by bus staff with free tickets, letters and phone calls and mailing of information packs[30]. Individualised travel marketing has been a key component of the strategies of each of the three Sustainable Travel Towns in England. Sustrans' Travel Smart is the UK's leading ITM programme. Sustrans estimate that initiating Travel Smart across the 18 largest towns and cities in Wales would produce carbon reductions of 22,000 tonnes a year.

ITM could be instigated Regionally, in conjunction with the Regional Transport Consortium, by the creation of a smarter choices team who could target areas as part of a rolling programme.

4.3.3. Campaigns and Awareness Raising

Regional groups should work with local authorities to deliver educational and awareness raising campaigns. Opportunities are:

- Making more of existing national campaigns such as European Mobility Week, In Town, Without My Car! day, Bike Week, National Lift Share Day. Local authorities estates and public sector buildings provide an initial target for campaign publicity.
- Promoting eco-driving training i.e. training to promote better use of gears, anticipate road changes to avoid braking, drive at correct tyre pressures, switching off the engine for short stops (over 30 seconds) to increase fuel efficiency. Regional groups could work with Regional Transport Consortia to seek funding for a programme of eco-driver training courses, possibly targeting public sector staff.

- Working with the Regional Transport Consortia to engage public sector organisations and businesses in providing incentives for sustainable travel such as corporate bicycle or walking mileage allowance.
- Drawing upon innovative awareness raising and smarter choices campaigns for guidance to develop new behavioural change initiatives:

Case Study T12. Smart Trips, Portland[31]

The city of Portland, Oregon has implemented a comprehensive scheme to reduce single occupancy car journeys and promote the use of public transport, cycling and walking, car pools and car shares. “Smart Trips” has been implemented through a suite of measures. Measures include an order from sent out to all houses in the South West area of Portland for free individualised travel marketing resources such as a walking kit including walk maps, a pedometer and a timetable of guided walks (delivered by bike); cycling campaigns such as “Women on bikes” including guided bike rides and cycling clinics. Newsletters, events calendars, media coverage, workshops and clinics across the city have helped to raise awareness and increase participation. The creation of informative literature has been a key element of the programme e.g. the creation of useful cycling and walking maps highlighting not only walking routes but also potential destinations such as schools, farmer’s markets, and libraries. An important element of Smart Trips Southwest includes the provision of real time information on the next buses to nearby stops to around ¼ of households targeted through “Transit Tracker” cards. Of the 6000 households targeted in the South west 30% ordered travel materials or participated in an event.

Case Study T13. Cycling Ambassador Programme, Chicago and Toronto[32,33]

The U.S. cities of Chicago and Toronto operate Cycling Ambassador Programmes –with the dual objectives of increasing the number of trips made by bicycle and minimising bicycle collisions and injuries. The Ambassadors are teams of expert cyclists who bike across the cities to events and presentations to engage and educate communities. Toronto’s Ambassadors deliver many cycling initiatives including: “Bicycle Friendly Business Awards" – given to businesses encouraging customers and employees to cycle; “Bike month” – a series of over 100 cycling events such as races and bike to work days across the city; cycling courses for adults and children. In Chicago, during the summer months, teenagers who complete after school cycling courses can become Junior Ambassadors communicating their knowledge to their peers.

Case Study T14. Australian Bike Bus

In a number of Australian cities the use of bicycles to commute to work is being promoted through the Bike bus project. Cyclists are able to travel to work as a group, along a scheduled route, picking up additional commuters at timetabled stops along the way. Both express and social "buses" exist – catering for faster, experienced cyclists and inexperienced cyclists respectively. A dedicated website provides route schedule and timetable information as well as a forum for discussion.

Case Study T15. San Francisco Bike Buddy Scheme.

Bike Buddy schemes are a tested method of introducing inexperienced riders to commuting via bicycle in cities through pairing them with an experience cyclist who shares their route. The San Francisco bike buddy scheme, for example, pairs novices and mentors through an online forum see http://www.sfbike.org/?bikebuddy. Complementary projects ran alongside the forum include bike doctor events where volunteer bike mechanics will carry out basic bike maintenance, commuter convoys (as above bike bus programme) and educational workshops on topics such as fixing flat tyres.

In the WSP Regions of Wales the approaches highlighted in case studies T12-T15 could be utilised in towns and cities and could also be extended to create dedicated bike or walking buses for schools and workplaces. Bicycles are used for less than 1% of journeys to school in Wales[1] demonstrating the need for innovative school cycling programmes. **Regional groups could look to local cycling groups for potential advice and assistance in establishing such schemes. For rural schools the establishment of walking "buses" could help to reduce car dependency amongst local villages.**

Box T5. Mechanisms for behavioural change / smarter choices

I. Work with the regional Transport Consortium to promote and develop travel plans for local authority buildings, public sector buildings, key workplaces, schools, key tourist attractions and targeted residential areas. Promote the concept of a travel plan champion within each organisation.

II. Work with local authority planners to explore opportunities to require developer funded travel plans for large new residential developments.

III. Promote the pooling of resources across local authorities and regional transport consortia to create a small dedicated Smarter Choices team

IV. Instigate a rolling programme of individualised travel marketing in partnership with local authorities and the Transport Consortium to target key communities.

V. Implement cycling schemes such as: a travelling Cycling Ambassador Scheme – expert cyclists who travel between communities on bikes to deliver educational cycling events and cycling course; a bike bus project – cyclists commute to work or school along a set route with a set timetable; a bike buddy website – allowing inexperienced cyclists to pair up with experienced cyclists who travel the same commuter route.

VI. Work with local authorities to promote behavioural change e.g. through promotion of eco driving and making more of existing opportunities including in town without my car day, bike week, national lift share day.

Box T6. Measuring success for behavioural change / smarter choices

- Percentage of Regional population using public transport on a weekly basis
- Percentage of journeys made on foot or bike
- Number of schools and public sector buildings with an adopted travel plan
- Number of tourist destinations with an operational travel plan
- Creation of a Regional smarter choices team
- Number of households targeted through individualised travel marketing
- Number of people commuting to work through a bike bus project
- Number of children travelling to school with a walking or cycling bus
- Number of visitors to an established bike buddy website
- Availability of eco driver training within the Region

4.4. Freight

The transport of goods accounts of 33.4% of Welsh road transport emissions[3].

4.4.1. Local production and consumption

The local production and consumption of goods and services is a key tool in the reduction of emissions from freight. Local food production and consumption can be delivered through implementing the solutions discussed in the Rural Land Use and Food chapter of this report. Public sector procurement is the most effective tool at a Regional level for stimulating local markets e.g. a commitment to use local timber frames in all new public sector developments would give confidence to local timber producers.

4.4.2. Improving the Efficiency of Road Freight Transport

Within each Region groups should explore, in partnership with the Regional Transport Consortium and town / city councils the need to limit freight movement in key settlements. Introducing measures such as restricting delivery hours in key retail centres or creating a low emissions zone, allowing access to vehicles meeting emissions criteria only, will tackle congestion and simultaneously may help to stimulate better logistical planning and increased vehicle efficiency. In the city of Preston a lorry ban is currently being

considered in conjunction with the creation of a freight consolidation centre, from which, coordinated deliveries would be made to the centre via small electric vehicles.

Freight Consolidation and Logistics - **Consolidating freight movement in urban areas** e.g. consolidation centres operating in Bristol and Norwich. Consolidation centres have been successfully established for both the retail and construction sectors. A construction consolidation centre in London co-ordinates the delivery of material to four major construction sites. Within 18 months of operation it was shown to have reduced delivery vehicle movement by 70% and reduced CO_2 emissions by 73% across the four sites[34].

Case Study T16. Norwich Freight Consolidation Centre[35,36,37]

In 2007 Norwich County Council partnered with Foulger Transport Ltd to set up a freight consolidation centre to reduce vehicle movement in Norwich city centre. All supplier deliveries are made to an out of city consolidation facility in Snetterton, from which deliveries are grouped for co-ordinated delivery to the city centre. The consolidation centre was situated in existing premises owned by Foulger Transport (a warehousing and distribution company). Onward deliveries to retailers are made via low emission vehicles. Benefits for businesses include the ability for suppliers to deliver to the centre at any time of day; the opportunity for retailers to use the centre as a stock room for bulk deliveries to be delivered when needed; the availability of more frequent deliveries.

The establishment process involved: securing funding for development through the European Union CIVITAS initiative; inviting three companies with large goods vehicle operating centres in Norfolk to submit formal tenders; engaging with businesses, focussing upon retailers within two city centre malls; followed by contact with head offices to secure company sign up. By the end of 2008 the scheme had 22 customers including 2 major retailers. A full review of long term feasibility is due this year. Barriers recorded to date include the lengthy process of signing up new customer, the lack of incentive / force to encourage participation and the difficulty of engaging decision makers.

Project establishment was possible through funding allocated by the council from the European Union CIVITAS initiative. Under this initiative other positive sustainable freight measures have also been instigated in the city including allowing freight consolidation centre vehicles to use bus lanes, the establishment of a freight stakeholders club, trial of a traffic information system for freight operators.

See http://www.civitas-initiative.org/city_sheet.phtml?id=6 for a full list of sustainable transport measures implemented in Norwich through the CIVITAS initiative.

Consolidated deliveries can also be combined with consolidated reverse logistics – using delivery lorries to take waste away from construction sites or individual retailers. Return of waste materials to the consolidation centre will allow reuse of materials, particularly in the construction sector. The subsequent disposal of remaining waste will be most efficient if the consolidation centre is sited alongside waste recycling and disposal facilities.

Fleet Efficiency – There are multiple simple measures which can be undertaken by freight operatives to increase the fuel efficiency of their fleet. Opportunities include selecting efficiently designed vehicles e.g. those with aerodynamic cabs; those with a high volume to weight ratio to ensure vehicles are not filled before their maximum weight is reached and purchasing low rolling resistance tyres. Cost free options include increasing trailer fill to ensure maximum efficiency of each vehicle load, ensuring correct tyre inflation at all times to maximise fuel efficiency, good vehicle maintenance and adhering to efficient road speeds.

Efficient driving is another tool for improving fuel efficiency within a fleet. Safe and Fuel Efficient Driving (SAFED) courses are available for both LGV and HGV drivers in England through a government initiative. These one day courses teach better driving techniques such as awareness of fuel economy and improved use of gears. 17 light van drivers from Wales and West Utilities took part in a trial SAFED training day; resulting in an 8% improvement in fuel economy on the day[38]. **Regional groups could seek to secure part funding for eco-driver training for LGV and HGV drivers to be match funded by the industry.**

The Welsh Assembly Government has made available a host of free information on best practice for freight in Wales including a fuel management guide. See http://www.freightbestpractice.org.uk/default.aspx?appid=1961. **There may be a role for Regional groups to work with the Wales Freight Group and the Regional Transport Consortia to provide targeted fuel efficiency campaigns and advice for the freight industry, communicating the resources available to them**. At the least, Regional groups should seek to ensure local authority websites provide links to theses resources.

As discussed in the Technological Solutions Section 4.2.2 low carbon fuel options are increasingly being trialled and piloted. Many low carbon fuels are deemed to be suitable for LGVs and HGVs. **Regional groups could therefore seek private sector partnership to trial biofuel/ biogas or biomethane powered HGVs.**

4.4.3. Modal Switch

The Wales Freight Strategy highlights the range of CO_2 emission estimates associated with the various modes of freight transport. Despite variation between studies the overall trends remain the same, demonstrating the carbon intensity of road and air freight.

Source / Mode	INFRAS Update 2004, MEET 1999, Eco-Logica 1994 [1]	European Commission CEC, DG XI [2]	EEA TERM 2003 27 EEA 31 [3]	STRAW Report [4]
Rail	20 / 40 (electric / diesel)	39-48	23	33
Road	100	207-280	123	193
Inland Waterway	-	40-66	31	44
Sea	10-20	-	14	-
Air	650	1,160-2,150	-	-

Sources

1. *Aviation Environment Federation (House of Lords Select Committee on European Union Minutes of Evidence)*
2. *Inland Waterways Association (www.waterways.org.uk)*
3. *Biomass Energy Centre (www.biomassenergycentre.org.uk)*
4. *Sustainable Transport Resources and Waste (www.straw.org.uk)*

Figure 4: Estimates of CO_2 emissions for various modes of freight transport. Source: Welsh Assembly Government (2008)[2].

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At an WSP Regional group level the main mechanism to influence the transfer of freight from road to more sustainable modes is to ensure that the Local Development Plans identify and plan for the infrastructure needed at key locations to enable the modal switch of freight. Through engaging with the Wales Freight Group and the Regional Transport Consortia the Regional groups can identify opportunities to add value to research and work on the modal switch of freight to rail or water. Regional groups wishing to play a more active role could approach large freight users in the Region directly to explore opportunities to switch to e.g. rail or inland waterways locally. The Tesco

distribution centre based in Magor has transferred numerous deliveries to rail in order to cut down distribution emissions, with little difference seen in the cost of road and rail delivery.

Regional groups can also seek to ensure the allocation and protection of potential railway line sites and sites which could serve as important interchanges between freight transport modes within each Region's Local Development Plans. Sites linking sea ports to key rail routes for example should be protected against alternative development to allow future use for sustainable transport of freight.

Box T7. Mechanisms to reduce emissions from freight

I. Promote local production and consumption e.g. local food consumption through the mechanisms highlighted in the Rural Land Use chapter of this report to reduce food freight.

II. Explore in partnership with regional Transport Consortium and town / city council the need to limit freight movement in city centres through charging / restricted delivery hours with a view to stimulating consolidation centre establishment / modal shift.

III. Explore in partnership with the regional Transport Consortium, the retail and construction sectors, the opportunity to establish strategically sited shared consolidation centres e.g. Norwich (alongside a waste disposal facility where possible to take waste away in the empty delivery lorry).

IV. Explore opportunities to secure part funding for eco-driver training for LGV and HGV drivers, to be match funded by the industry (equivalent to SAFED driver training government initiative operating in England).

V. Work with the Wales Freight Group / regional Transport Consortium to provide targeted fuel efficiency campaigns and advice for freight businesses e.g. procurement of aerodynamic cabs, correct tyre inflation, improved trailer fill.

VI. Seek a private sector partnership to pilot biofuel, biogas from anaerobic digestion or bio-methane from waste fuelled HGVs.

VII. Explore in partnership with the Regional Transport Consortium and the Wales Freight Group opportunities for the modal switch of freight to rail / water.

Box T8. Measuring success for reducing emissions from freight

- Percentage of food producers within the Region marketing and selling their produce locally
- Establishment of freight consolidation centres serving city centres
- Number of people attending eco driver training courses for LGV and HGV drivers within the Region
- Number of freight operatives trialling low carbon fuels such as biofuel
- Number of freight miles transferred to rail or water

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Waste

This document provides background information on a wealth of low carbon solutions for the waste sector alongside case studies, tips for replication and recommendations for delivery through the Wales Spatial Plan Groups. It was constructed through a significant desk based study as part of the *Low Carbon Wales: Regional Priorities for Action* project between January and April/May 2009. Given the dynamic nature and massive scope of the subject area it is recognised that this document cannot cover all potential carbon reduction solutions and that relevant policy and regulation may have progressed or changed since the time of writing. This is however a useful reference guide for Spatial Plan Regional Groups and wider stakeholders in the transition to low carbon.

Contents

1 Summary

In 2004 the waste sector in Wales contributed 0.9 $MtCO_2$ equivalent (or 2%) of the total emissions (41.8 $MtCO_2$ equivalent) for Wales. In comparison, for the same year, methane emissions from the waste sector in Wales contributed 18.8% of the national total, 95% of waste sector methane emissions were from landfill.

The familiar waste management hierarchy for minimising the environmental impact of waste shapes the format of this chapter i.e. management for prevention followed by minimisation, reuse, recycling, energy recovery and finally disposal. Amongst the opportunities identified for emission reductions are: industrial symbiosis to reduce consumption of raw materials; promoting low impact packaging and waste minimisation across the food sector; procuring reused furniture in local authority estates; setting up trade waste centres; and anaerobic digestion for food and agricultural waste at a local level to produce biogas for heat and power or biomethane as transport fuel. Suggested mechanisms for progressing or delivering solutions at a Regional level include working with local authorities to review and improve management of household waste; public education campaigns and influencing public sector procurement to stimulate greening of the supply chain.

As set out in section 3.3 of this report, SDC solutions for early consideration for reducing emissions from waste at a Regional level are to:

(1) Identify sites for and develop anaerobic digestion facilities linked to significant sources of biomass waste

(2) Significantly progress sustainable production and consumption for waste prevention and minimisation

Rationale for prioritisation:

1) Research suggests that it would be feasible to reduce emissions in the waste sector by at least 80% by 2050, with anaerobic digestion and mechanical biological treatment accounting for 75% of this total.

2) The average UK household purchases over 2.5 tonnes of materials each year. The prevention of waste has the highest potential for GHG emissions reductions from the waste sector.

2. Policy overview

There is a growing awareness of the interface between waste management policies and policy to tackle climate change. Methane (CH_4) is one of the six greenhouse gases (GHG) controlled by the Kyoto Protocol and methane emissions are particularly linked to landfill operations. Improved waste management can therefore help in achieving GHG emissions reductions, for example through methane recovery and diversion of biodegradable municipal waste from landfill [1]. Waste management makes a contribution to UK emissions of CO_2 through transport, processing and treatment of waste. Other forms of waste management have the potential to result in net reductions in greenhouse gas emissions, by recovering materials or energy and avoiding the requirement for primary resources [2].

The 2006 Stern Review [3] on the economics of climate change stated that waste is responsible for emitting 1.4 billion tonnes of carbon dioxide-equivalent emissions, half of which comes from landfill sites. The waste industry is responsible for 3% of the UK's emissions of gases that cause global warming. According to Stern, half of these emissions could be cut by 2020 at relatively low cost. Three-quarters of these emission cuts could be achieved at negative cost, with the remaining quarter at a cost of £5 per tonne of CO_2-equivalent emissions.

2.1. EU Policy

At a European level, there are three primary pieces of waste legislation:

1. The Waste Framework Directive (2006/12/EC) which aims to coordinate waste management in the Member States in order to limit the generation of waste and to optimise the organisation of waste treatment and disposal.

2. The Thematic Strategy on the Prevention and Recycling of Waste (COM(2005)666) which sets out guidelines and describes measures aimed at reducing the pressure on the environment caused by waste production and management. The main thrust of this Strategy is on amending the legislation to improve implementation, and on preventing waste and promoting effective recycling. This approach means that every item of waste is seen not only as a source of pollution to be reduced, but also as a potential resource to be exploited.

3. The Landfill Directive (1999/31/EC) which is intended to prevent or reduce the adverse effects of the landfill of waste on the environment. It requires a substantial reduction in the amount of biodegradable municipal waste (BMW) sent to landfill; a

ban on the landfill of various types of waste (including liquid waste and tyres) and the treatment of all wastes prior to landfill.

2.2. UK Policy

At a UK level, the Waste Strategy for England 2007 [4] has 5 key objectives:

- Decouple waste growth (in all sectors) from economic growth with more emphasis on waste prevention and reuse.
- Meet and exceed the Landfill Directive diversion targets for biodegradable municipal waste in 2010, 2013 and 2020.
- Increased diversion from landfill of non-municipal waste and secure better integration of treatment for municipal and non-municipal waste.
- Secure investment in infrastructure needed to divert waste from landfill and for the management of hazardous wastes.
- Get the most environmental benefit from that investment through increased recycling of resources and recovery of energy from residual waste using a mix of technologies.

The household waste recycling/ composting targets for England are 40% by 2010; 45% by 2015 and 50% by 2020.

2.3. Welsh Policy

The 2002 Wales Waste Strategy - *Wise About Waste*[5] has recently been reviewed. The revised Strategy, Towards Zero Waste[6], was launched for public consultation in Spring 2009. To meet Welsh Assembly Government commitments relating to sustainable development, one planet living and reducing greenhouse gas emissions, the Strategy takes a zero waste approach with the aim of moving waste as far up the waste hierarchy (Figure 1) as possible. The Strategy has two main aims:

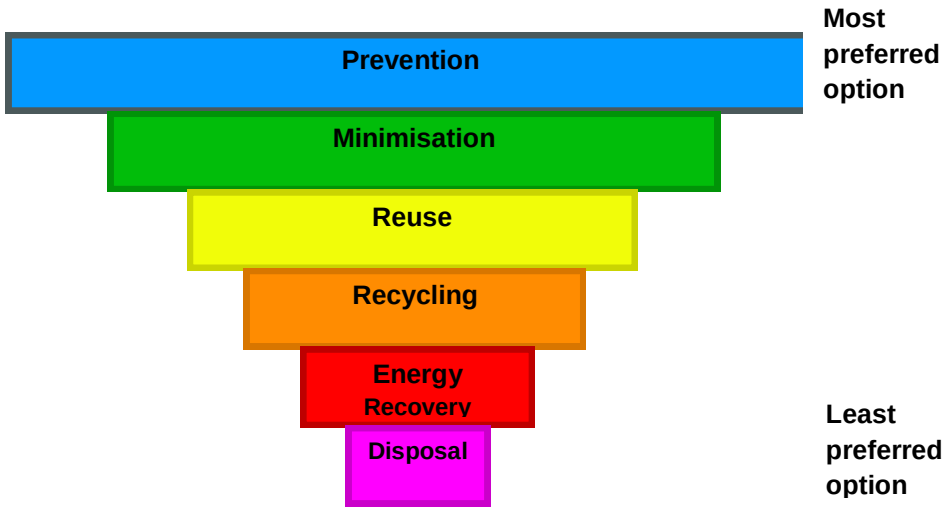
- Working towards zero waste and one planet living by 2050
- Developing a high recycling society (at least 70% recycling across all sectors) by 2025

To do this, the Welsh Assembly Government has targeted eight priority materials for action which, if managed in the optimum way, will give the greatest environmental benefits:

- food;
- paper and card;

- wood;
- metals;
- plastic;
- glass;
- textiles;
- green and garden waste

Figure 1: The waste hierarchy prioritises waste management techniques in the order of their environmental impact. Source: Reproduction based upon Welsh Assembly Government (2009)[6].



To achieve zero waste and one planet living by 2050, the focus is on high waste minimisation targets. To achieve a high recycling society (70%) by 2025, the focus is on source segregated and closed loop (production system in which the waste of one process or product is used in making another product) recycling systems with the recyclate used directly in Welsh manufacturing. The materials focus aims to ensure maximum efficiencies and economies of scale through the integration of collection and treatment of municipal, commercial and industrial (C&I) and construction and demolition (C&D) wastes where applicable. Anaerobic digestion of food and other putrescible wastes is strongly supported. The Welsh Assembly Government promotes the use of small-scale locally based solutions to adhere to the proximity principle.

For any residual waste created in the medium term, landfill sites will be phased out with the development of high energy efficient energy from waste (EfW) plants. There will be a tapering cap on the amount of residual waste permitted to be treated at EfW facilities starting at 42% in 2015/16 and tapering to 30% in 2025. Levels of EfW greater than 30-35% begin to have a negative carbon balance as they involve combustion of energy intensive materials that are better recycled [7].

The high level Strategy document is a framework which describes the outcomes Wales needs to achieve. It provides clear direction of the policies and principles the Welsh Assembly Government favours in order to achieve these outcomes. The Strategy will be supported by an Evidence Plan (which contains the supporting evidence and data) and Sector Plans. Sector Plans will be delivery documents, and contain the detailed actions needed to support the outcomes, policies and principles in the high level Strategy. Initial sector plans will include: municipal waste; construction & demolition; retail; waste management and infrastructure.

Bioenergy Action Plan for Wales [8]

The Welsh Assembly Government is particularly keen to see bioenergy schemes developed that maximise carbon savings; for example:

- contaminated waste wood used in combined heat and power (CHP) stations which comply with waste incineration regulations;
- residual municipal wastes, that cannot be recycled further, used to produce heat and power; and
- agricultural slurries and food wastes used to generate biogas for local heat or CHP schemes, or for transport.

Schemes involving waste biomass would be among the most cost effective means of saving carbon emissions due to the low cost of the fuel or even access to gate-fees for avoidance of landfill costs.

TAN 21 Waste

This TAN is intended to facilitate the introduction of a comprehensive, integrated and sustainable land use planning framework for waste management in Wales through the introduction of Regional Waste Plans. The advice highlights the role of the planning system in providing adequate facilities for reuse, recovery and disposal of waste which minimises adverse environmental impact and avoids risk to human health.

Planning considerations in waste issues, implications for unitary development plans and development control are included. Differing types of waste are considered in more detail, specifically municipal, C&I, agricultural, C&D, special and hazardous waste.

Regional waste planning http://www.walesregionalwasteplans.gov.uk/

Regional waste plans are non-statutory land use planning frameworks for the regions and are intended to inform the Local Development Plans. In terms of waste planning, Wales is split into three distinct regions and various Local Authority waste consortia are in the process of procuring waste infrastructure within each of the three regional areas.

North Wales

The North Wales waste planning region is made up of 7 Unitary Authorities and Snowdonia National Park Authority. For the purposes of regional Waste Planning Powys is split into two. The former Montgomeryshire falls within the North region and the rest of Powys falls within the South East region.

North Wales Waste Treatment Project: Flintshire, Denbighshire, Conwy, Gwynedd and Isle of Anglesey Authorities are working jointly to procure a sustainable and integrated waste management solution that will assist with the reduction of GHG emissions from landfill. Wrexham has a 'watching brief' on this procurement process. There are also plans for an anaerobic digestion hub serving Conwy, Flintshire and Denbighshire.

South West Wales

The South West Wales planning region is made up of 6 unitary authorities and the Brecon Beacons and Pembrokeshire Coast National Park Authorities.

All 6 authorities in the SW region are working together to assess options for residual waste treatment/ disposal; the treatment of kitchen waste and the potential for anaerobic digestion. Pembrokeshire is also working with Dairy UK and First Milk on the supply of a

centralised AD plant at Haverfordwest. This project is funded by the Rural Development Plan Supply Chain Efficiency Scheme and may be replicable in other parts of Wales.

South East Wales

The South East Wales planning region is made up of 10 unitary authorities and the Brecon Beacons National Park.

Blaenau Gwent and Torfaen – Joint Waste Procurement: Joint waste procurement project for a sustainable waste treatment and disposal facility. The project covers procurement of anaerobic digestion, an interim organics contract (awarded to Wormtech), a longer term organics contract and a residual waste contract.

Rhondda Cynon Taf – Merthyr Tydfil Partnership: A project to procure treatment solutions for source segregated kitchen waste and residual waste. As part of this project Covanta Energy has put forward plans to build a 70MW power plant in Merthyr using waste as fuel. The target date for operations to begin is 2014. The project will treat about 825,000 tonnes of waste per year and cost around $570 million. It will be financed, built, owned and operated by Covanta Energy. The facility has the potential to provide electricity for 180,000 homes.

Prosiect Gwyrdd: A project to procure residual waste treatment solutions for 5 local authorities in SE Wales (Vale of Glamorgan; Cardiff; Newport; Monmouthshire; Caerphilly). As a result of this initiative, Viridor Waste Management has a submitted a planning application for a £150 million EfW plant in Cardiff to treat 350,000 tonnes of residual waste from the 5 authorities. The plant would be capable of producing 30MW of energy a year using Combined Heat and Power (CHP) technology, to be fed into the National Grid. The heat would be used by local businesses.

South East Wales Energy Partnership: The core objective of this group is to make a significant difference in reducing the carbon footprint of the region through activities and projects that implement energy policy of the Welsh Assembly Government. AEA[9] identified potential in the region for renewable energy from biomass in the form of waste wood. Waste wood is collected as a separate waste stream at civic amenity sites in each of the local authority areas in the South East. It is estimated that 20,000 tonnes of waste wood is collected annually and this could supply a number of community heating or CHP schemes. AEA recommended SEWEP open discussions to secure this waste stream before it is contracted on a longer term basis. It should be noted that if the wood is contaminated then any EfW/CHP facility proposed would need to comply with the Waste Incineration Directive.

Central Wales Waste Strategy: a project supported by the Welsh Assembly Government's Making the Connections Improvement Fund to establish new and sustainable ways of dealing with residual municipal waste in mid Wales. Additional funding from the regional Capital Access Fund will assist in the procurement activities. Both Ceredigion and Powys LAs are involved in the procurement. An anaerobic digestion sub-group is assessing the feasibility of such facilities in the region including links to energy and biofuel production and farm generated wastes. Research undertaken suggests that a residual waste facility is not viable within the region.

Strategic Environmental Assessment (SEA) of the Wales Spatial Plan

The SEA of the Wales Spatial Plan provided guidance on how the Plan can provide positive influence in terms of sustainable waste management:

- Promote higher resource efficiency;
- Promote the use of secondary and recycled materials (preferably sourced locally) to grow the market for recycled goods, for example in the construction and maintenance of developments and infrastructure projects;
- Encourage the reduction, reuse, and recycling of waste;
- Set the framework at the national and Regional level to reflect the need for sustainable use of natural resources.

3. Background

Wise About Waste [5] set a progressive and challenging programme for managing waste in Wales, and a great deal has been achieved since then:

- Meeting two years early the target to landfill less than 0.675 million tonnes of biodegradable municipal waste by 2010.
- A substantial increase in the amount of municipal waste being recycled and composted. Wales has met the municipal waste recycling/ composting targets for 2003/4 (15%) and 2006/07 (25%), and is on course to reach the 2009/10 of 40%.
- A substantial reduction in the volume of commercial and industrial waste - to 64% of the level produced in 1998/99.
- Reducing the amount of industrial and commercial, municipal and hazardous waste going to landfill.
- Wales is on course to reach the re-use or recycling target for construction and demolition waste of at least 85% by 2010.

In 07-08, 1.8 million tonnes (excluding abandoned vehicles) of municipal solid waste (MSW) was produced of which 33.6% was recycled/ composted [10]. Two rural authorities (Ceredigion & Powys) are at top of the recycling/ composting table in Wales 47.9 and 42.2% respectively. The Welsh Assembly Government has commissioned a survey of waste production and management in the C&I sector and this is due for publication Spring 09. According to an EAW survey for 05-06, the C&D sector in Wales produced 12.2 million tonnes of waste during this period of which approximately 56% was reused on site.

Greenhouse gas impacts of waste management [4]

- Methane emissions from (biodegradable waste in) landfill account for 40% of all UK methane emissions and 3% of all UK greenhouse gas emissions. (Methane is 23 times as damaging a greenhouse gas as carbon dioxide).
- Current UK recycling of paper, glass, plastics, aluminium and steel is estimated to save more than 18 million tonnes of carbon dioxide a year through avoided primary material production (equivalent to annual use of 5 million cars or 14% of UK transport sector emissions).

According to DEFRA research [11], in 2004 the waste sector in Wales contributed 0.9 $MtCO_2$ equivalent (or 2%) of the total emissions (41.8 $MtCO_2$ equivalent) for Wales. In comparison, for the same year, methane emissions from the waste sector in Wales contributed 18.8% of the national total, 95% of waste sector methane emissions were from landfill.

The Welsh Assembly Government has committed to achieve annual carbon reduction-equivalent emission reductions of 3% per year by 2011 in areas of devolved competence. Overall, the waste sector in Wales is reported to be responsible for less than 10% of emissions covered by this target. Waste contributes less than 5% of Wales' direct GHG emissions [12]. These are direct methane emissions from landfill and do not include indirect emissions i.e. embodied energy within products that end up in the waste stream.

4. Opportunities for Reducing Emissions at a Regional Level

4.1. Waste Prevention and Minimisation

The average UK household purchases over 2.5 tonnes of materials each year [13]. The prevention of waste being generated results in the largest reduction in GHG emissions. Waste prevention can be achieved through the sustainable production and consumption agenda (SCP). For example, the WWF One Planet Wales Report [14] identifies a number of opportunities to reduce waste as a result of addressing SCP including:

- Promoting low impact packaging and waste minimisation across the food sector.
- Integrating supply chains so that there is less consumption of raw materials and waste production is reduced (e.g. industrial symbiosis).
- Considering the impact of a products design on its lifecycle with an aim of reducing wastage, maintenance and energy consumption.
- Reducing the energy footprint of waste by increasing waste recovery (e.g. anaerobic digestion).
- Designing products so that they can be re-used or easily remanufactured.

For example, in the UK we throw away a third of the food we buy - 6.7 million tonnes of food is wasted each year. The production, storage and delivery of food to homes utilises energy. If we stopped wasting all this food we could save at least 15 million tonnes of CO_2. This equates to taking 1 in 5 cars off the road (http://www.lovefoodhatewaste.com/).

Wales Spatial Plan Ecological Footprint data indicates little difference in consumption patterns across the spatial Regions in Wales. The Ecological Footprint (gha/capita) is lowest in the South East 4.9 and highest in the Central Region 5.3. **Through public education campaigns, Spatial Regions have an influencing and awareness raising role in terms of waste minimisation and prevention but can also assist in changing business practices and stimulate markets through changes to procurement.** Wise up to Waste produced by Envirowise [15] provides guidance to the public sector on waste minimisation campaigns and promotes the concept of the introduction of waste champions to raise awareness and stimulate action. Businesses implementing waste minimisation initiatives can save 1% of their turnover through reduced purchasing costs and more efficient practices.

4.1.1. Carbon impacts of reusable nappies

An Environment Agency life cycle analysis (LCA) study [16] assessed the environmental impacts of a child using disposable nappies for the first two and a half years of its life and a child using shaped cloth nappies for the same period. The report shows that, in contrast to the use of disposable nappies, it is consumers' behaviour after purchase that determines most of the impacts from reusable nappies and so public education is key to reducing carbon emissions. Cloth nappy users can reduce their environmental impacts by:

- Line drying outside whenever possible.
- Tumble drying as little as possible.
- When replacing appliances, choosing more energy efficient appliances (A+rated machines are preferred).
- Not washing above 60°C.
- Washing fuller loads.
- Reusing nappies on other children.

4.1.2. Construction and Demolition

As part of the Wales Waste Strategy revision, a sector plan will be developed for the construction and demolition sector. The C&D sector already reuse or recycle 85% of the waste they produce but there is an opportunity to do more. Waste minimisation in the construction and demolition sector requires the engagement and involvement of individuals and organisations along the entire supply chain. Three definitive stages of a construction project can be identified for which waste minimisation activities could be implemented. These include:

Contractual stage

At the contractual stage there is the opportunity to put in place obligations for waste minimisation for all project partners through planning policy. **Voluntary targets could be set for waste reduction and the incorporation of recycled content on all public sector funded projects.** There could be opportunities to reduce impacts through implementing the Demolition Protocol on all new developments. The 2008 Demolition Protocol has been developed, by the Institute of Civil Engineers, to provide an overarching framework which enables the waste hierarchy to inform approaches for managing buildings and structures at the end of their lives. http://www.ice.org.uk/knowledge/specialist_waste_board.asp

Design Stage

At the design stage in a construction project there is much opportunity for waste minimisation activities - architects and designers play a fundamental role.

Construction Stage

Waste minimisation can be achieved on site through the development of clear, site specific waste management guidelines and site waste management plans. Consultation on Site Waste Management Plan regulations in Wales will take place in Spring 09 and are likely to be more stringent and detailed than those in England.

Waste segregation also assists in the sustainable management of on site waste. The Wales Waste Strategy C&D Sector Plan will look at ways of encouraging source segregation practices.

Case Study W1. Waste Minimisation in UK Department for Work and Pensions

The UK Department for Work and Pensions (DWP) organised a Swap Shop [17]. DWP operated over 1132 sites, with varying layouts and different in-office administration structures and rationalising this large estate led to items becoming surplus to original requirements.

The Sustainable Development Team developed the intranet based Swap Shop site to minimise waste and impact on budgets by ensuring that surplus or unwanted goods were redistributed around the DWP businesses. Other than the small amount of time spent on working up the initial design for the page and the ongoing daily commitment to listing the items, the project has minimal overheads.

An intranet based form is completed and emailed to the SD Team. The advert is checked and styled by the team and then uploaded. Those advertising and those wanting to claim goods deal directly, making their own arrangements to collect, or transport through the Department's courier service. Adverts stay on the system for a month or are removed on request.

The exact weight and number of goods redistributed are difficult to measure due to the diversity, quantity, varying weight and cost of items, ranging from pens to plasma display screens. The fact these items have not gone to landfill and that the need to buy new has been avoided is satisfactory measure enough but we are developing a catch all system to quantify the savings in more detail. Such has been the success of the scheme that last year wanted pages were introduced. Overall the scheme is immensely popular scheme and its appeal lies in its simplicity, the feeling of getting something for nothing and not throwing away something which is of use to others.

Box W1. Mechanisms for waste prevention and minimisation

I. Set a framework at the Regional level to reflect the need for the sustainable use of natural resources.

II. Promote higher resource efficiency across all sectors by encouraging waste reduction, reuse, recycling and composting.

III. Promote the use of Welsh recyclate in Welsh manufacturing, e.g. in construction and maintenance and infrastructure projects.

IV. Promote low impact packaging and waste minimisation across the food sector.

V. Integrate supply chains so that there is less consumption of raw materials and waste production is reduced e.g. through industrial symbiosis.

VI. Consider the impacts of a products design on its lifecycle with an aim of reducing wastage, maintenance and energy consumption.

VII. Choose and promote the design of products that can be reused or easily remanufactured.

VIII. Set voluntary targets for waste reduction and the incorporation of recycled content on all public sector funded construction projects.

IX. Reduce impacts through implementing the Demolition Protocol on all new developments.

X. Support the use of Site Waste Management Plans by the construction and demolition industry.

XI. Any major public sector capital expenditure should seek to reduce waste arising throughout product life cycles, as well as sharing knowledge of these processes with government, and with the private sector.

Box W2. Measuring success for waste prevention and minimisation

- Volume / weight of municipal waste sent to landfill
- A framework for the sustainable use of natural resources is set a Regional level
- Volume of Welsh recyclate used in manufacturing within the Region
- An initiative is established to promote low impact packaging and waste minimisation across the food sector
- Targets are set for waste reduction and the incorporation of recycled content for all public sector funded construction projects
- Percentage of developments with Site Waste Management Plans
- Volume of public sector waste is reduced through procurement for waste minimisation
- Number of industrial units participating in industrial symbiosis

4.1.3. Reuse

Waste reuse happens when items or materials can be used again without changing their nature. This includes refurbishment and repair. Reuse is important, and is the part of the waste hierarchy most often overlooked. Not only does it move material use up the waste hierarchy, but it also provides social and economic benefits to Welsh communities, such as opportunities for jobs and increasing skills and access to low cost furniture and appliances.

In 2007-08, 10,554 tonnes of materials were reused via Third Sector organisations in Wales – this included 9,602 tonnes of furniture [18]. The London Community Recycling Network recently proposed a simple calculation that putting a tonne of furniture and appliances to reuse could save 8.7 tonnes of carbon emissions

(http://www.lcrn.org.uk/sites/default/files/bookFiles/carbon_impacts.pdf). Using this estimation, Third Sector reuse organisations in Wales saved approximately 83,537 tonnes of carbon in 07/08.

There are several things local authorities can do to improve reuse:

- Make improvements to bulky household waste collections to maximise reuse and recycling. Step by step guidance is available from Network Recycling & FRN [19] http://www.frn.org.uk/pdfs/New%20Toolkit%20Jan%202006.pdf

- Work with Third Sector reuse organisations and consider procuring reused furniture on LA estates and also the provision of reused furniture to social housing tenants via a Starter Pack scheme http://www.starterpacks.org.uk/
- Consider paying reuse credits –guidance is available on this topic [20, 21].
- Ensure adequate provision for reuse at Household Waste Recycling Centres.
- Promote freecycle networks, local charity shops and organise 'give and take' days.
- Support reusable nappy schemes & education on their use.

Box W3. Mechanisms to increase reuse

I. Make improvements to bulky household waste collections to maximise reuse and recycling.

II. Consider procuring reused furniture on public sector estates and the provision of reused furniture for social housing tenants.

III. Ensure adequate provision of reuse at household waste recycling centres (HWRCs).

IV. Promote freecycle networks, local charity shops and organise 'give and take' days.

V. Support reusable nappy schemes and education on their use.

Box W4. Measuring success for reuse

- **National Strategic Indicator 14 WMT/001:**
  The percentage of municipal waste (i) Reused and/or recycled

- **Core Indicator Set WMT/007:**
  The percentage of municipal waste received at all household waste amenity sites that is reused, recycle or composted

- Percentage of furniture items procured on public sector estates which is reused furniture
- Percentage of furniture provided for social housing tenants which is reused furniture
- Number of freecycle networks within the Region and number of users
- Establishment of a Regional reusable nappy scheme alongside provision of educational material on their use

4.2. Recycling

Recycling involves the reprocessing of a waste material into a usable item, either in the same form as the original product or into a different product. To achieve recycling, the appropriate waste materials must be separated from the mixed waste stream.

Most LCA studies show that recycling offers more environmental benefits and lower environmental impacts than other waste management options [2, 22]. Recycling of paper/cardboard, glass, plastics, aluminium and steel in the UK in 2006 saved between 10-15 million tonnes of CO_2 equivalents compared to applying the 2006 available mix of landfill and incineration with energy recovery of the same materials. This equates to about 10% of the annual emissions of the transport sector or removing 3.5 million cars off UK roads [22]. However, with materials such as glass, the type of recycling has a large impact in determining the relative emissions savings compared with either incineration or landfill. Closed loop glass recycling is preferable to both incineration and landfill but open loop recycling such as glass to aggregates is disadvantageous. Segregated collection of glass is need for maximum GHG savings [23].

The Evidence Plan of the revised Wales Waste Strategy supports closed loop recycling as the best environmental option for all priority materials in terms of reducing the ecological

footprint [24]. For glass and plastic - open loop recycling can be more damaging to the environment:

- Closed loop recycling of dense plastics will reduce the ecological footprint by 60%. Open loop recycling will increase the footprint by 28%.
- Closed loop recycling of plastic film will reduce the ecological footprint by 47% and open loop recycling will increase the footprint by 27%.
- Glass has one of the lowest ecological footprints per tonne. Open loop recycling will increase the footprint.

While focussing on AD and MBT technology for reducing emissions, a report by the Committee on Climate Change [25] also described increased recycling rates as a "*cost-effective*" option for reducing emissions. It stated: "*We do not assume significant UK emissions savings from recycling, but the potential to reduce emissions both from UK landfill and from global primary extraction means that the policy framework should cover recycling*."

4.2.1. Collection of dry recyclables

Evidence from the London Borough of Camden suggests that the carbon footprint of co-mingled collection systems including transfer of waste and sorting at a Materials Recycling Facility (MRF) was greater than for kerbside sorted waste collection 37.43kgCO_2/tonne compared with 21.11kgCO_2/ tonne. Co-mingled collections can reduce their CO_2 footprint by looking at collection options that divert newspapers and magazines direct to reprocessors rather than incurring energy costs in transport and high energy MRF sorting. Contracts that encourage the use of green tariff electricity use at the MRF will substantially reduce the CO_2 emissions from this element of the collection and recycling process [26].

As a result of this evidence, in February 2009, Camden Council approved plans to introduce separate collections for paper and card and to direct this material straight to reprocessors. The adoption of the 'twin-stream' collection for its dry recyclable material instead of the existing commingled collection system will come into effect in April 2010. Other changes under the approved plans are to include individual colour glass collections from recycling bring sites.

The revised Wales Waste Strategy supports recycling via source segregation and using low energy processes as the best environmental option for materials collection from all sectors. Evidence suggests that kerbside sorting of materials improves closed loop recycling and hence reduces the ecological footprint.

4.2.2. Best practice at Household Waste Recycling Centres

The Network Recycling report providing a National Assessment of Civic Amenity Sites[27] identified nine factors which were very influential on the recycling rate of CA sites:

- the 'infrastructure' factors: (work by increasing the range of recyclables & reusables).
    - number of bulk recyclables collected
    - number of small recyclables collected
    - presence of a system for reuse which collects a substantial range of reusable items
- the 'people' factors: (work by increasing the segregation efficiency of recyclables/reusables)
    - signage: quality, clarity & completeness
    - staffing numbers & efficiency
    - presence of contract incentives
    - presence of a high coverage of kerbside dry recycling (66% + of district covered)
    - a negative effect was caused by height barriers affecting public mood
    - a negative effect was caused by increases in deprivation

The key finding was that recycling rates can be greatly improved on the majority of sites *without large financial outlays.* Relatively simple changes such as the ones listed above can massively improve recycling rates.

A report by Network Recycling and Biffa [28] recommends the development of 'trade recycling centres' by councils and/or private contractors. These trade centres would be able to dispose of all types of waste, while offering a reduced price for sorted recyclables, with no

minimum charge. A set up similar to a CA site could enable small traders to sort their waste as they dispose of it. This facility could be combined with systems for selling back recycled and/or re-usable goods such as bricks, crushed hardcore, compost and wood to other traders.

Box W5. Mechanisms to increase recycling

I. Move from co-mingled collection of waste to source segregated or twin stream collection systems.

II. Focus on source segregated and closed loop recycling systems.

III. Improve collection efficiency by optimising routes to reduce vehicle fuel consumption.

IV. Make improvements to bulky household waste collections to maximise reuse and recycling.

V. Improve recycling rates at HWRCs by following best practice guidance.

VI. Consider setting up trade waste recycling centres.

Box W6. Measuring success for increasing recycling

- **National Strategic Indicator 14 WMT/001:**
  The percentage of municipal waste (i) reused and/or **recycled**

- **Core Indicator Set WMT/007:**
  The percentage of municipal waste received at all household waste amenity sites that is reused**, recycled** or composted

- Number of local authorities within the region operating source segregated or twin stream collection systems
- Number of local authorities within the region operating closed loop recycling systems
- Reduction in mileage travelled by waste collection through route optimisation
- Establishment of a Regional trade waste recycling centre

4.3. Composting

Composting is the breaking down of garden (green) and/ or kitchen (food) wastes (organic wastes) by micro organisms (small organisms) such as bacteria in the presence of oxygen and water, this process is called biodegradation. The process results in elevated temperatures of the waste, the production of CO_2, water and a stabilised residue. Depending upon whether non organic materials (e.g. plastics) are present in the input waste, the process can produce compost, soil enhancer or mulch, which all helps improve the condition of soil.

Box W7. Mechanisms to increase composting

I. Treat food and other putrescible waste (e.g. agricultural slurries) by anaerobic digestion (AD) to produce biogas for local heat /combined heat and power (CHP) or to produce biomethane for transport.

Box W8. Measuring success for increasing composting

- **National Strategic Indicator 14 WMT/001:**
  The percentage of municipal waste (ii) Composted or treated biologically in another way

- **National Strategic Indicator 15 WMT/002:**
  The percentage of biodegradable municipal waste sent to landfill

- **Core Indicator Set WMT/007:**
  The percentage of municipal waste received at all household waste amenity sites that is reused, recycled or **composted**

- Establishment of an anaerobic digestion facility in each local authority

4.3.1. Anaerobic Digestion

Research [25] indicates that anaerobic digestion (AD) and mechanical biological treatment (MBT) technologies have significant potential to reduce GHG emissions. The report claims it would be feasible to reduce emissions in the waste sector by at least 80% by 2050 with AD and MBT accounting for 75% of this total. ERM[3] also highlighted significant potential for greenhouse gas and energy demand savings with energy recovery through anaerobic digestion of agricultural manures/slurries.

Similarly, one of the key conclusions from the Eunomia[29] study on greenhouse gas balances of waste management in London showed that, in terms of greenhouse gas emissions, waste management scenarios using mechanical biological treatment (followed by anaerobic digestion) and gasification (followed by autoclave), coupled with hydrogen fuel cell technologies were the best performing. Pending the commercialisation of hydrogen fuel cells technologies, scenarios using MBT, AD and gasification linked to CHP gas engines are the best performing on reducing greenhouse gas emissions.

AD is the biological treatment of organic waste in the absence of oxygen, using microbial activity to break down the waste in a controlled environment. The process takes place within a digester, which is a warm, sealed, airless container and results in the production of biogas, which is a mixture of methane and CO_2. Linked to combined heat and power (CHP) gas engines AD can generate a renewable source of energy. Alternatively, the biogas can be upgraded to replace transport fuel. DEFRA[30] reported that capturing biogas from 1 tonne of food waste saves between 0.5 and 1 tonne of CO2 equivalent compared to landfill. Defra has given AD 'double ROCs' (Renewable Obligation Certificates), a system which makes the technology more economically attractive, and also re-classified the digestate it produces from a waste to a product as part of the WRAP Waste Protocols Project.

The use of AD is strongly recommended at a Local and Spatial Plan Regional level as appropriate. The use of AD for source segregated food waste has the specific advantages of generating both biogas and digestate. Work is currently underway by WRAP to develop Quality Protocols enabling the digestate from such AD systems to be used as a fertiliser on agricultural land providing additional benefits for rural areas. The use of digestate as a fertiliser will reduce the use of fossil fuel based fertilisers thus improving the carbon footprint of organisations using it. The sale of surplus energy and digestate offers a potential additional revenue stream and valuable diversification for rural businesses[30].

AD facilities should be located next to a continuous heat load that matches or is greater than heat output of the CHP facility. Such sites can be located via the industrial heat map www.industrialheatmap.com which is a data source set up to assist power station developers to explore fully opportunities for CHP, including community heating when developing proposals for new power stations. The Welsh Assembly Government has also been working with the Carbon Trust to develop a heat map of Wales for use in optimising site location.

Significant heat loads within Wales include Dairy Crest Ltd in Haverfordwest which is already being explored via SW Wales regional waste partners led by Pembrokeshire CBC. In NE Wales, various chemical companies with significant heat loads exist as well as Associated Co-operative Creameries, Cadbury Trebor Bassett and Kellogs and also Kimberley Clark (pulp and paper). These areas should be explored by the NE Spatial Region for development of AD facilities in partnership with industrial partners.

Case Study W2. BiogenGreenfinch Anaerobic Digestion Plant

In April 2007, Bedfordshire County Council working with Mid Beds District Council launched a food waste collection trial funded by WRAP. Approximately 6,000 households in Cranfield, Flitwick, Shefford, Sandy and Potton participated in the trial as an additional recycling service running alongside normal rubbish and recycling collections. MiD Beds District Council had operated an alternate weekly collection (AWC) of residual (rubbish) waste since 2004. Trial areas consisted of mainly low density housing in semi-rural locations, with a range of housing types. Residents taking part in the trial received a small brown (25L) food waste bin to put out for kerbside collection, a kitchen caddy to collect the kitchen scraps and a roll of biodegradable corn starch bags to line the kitchen caddy. Replacement liners were provided on request.

The food waste was collected once a week in a bespoke vehicle (Eurocargo Chassis Cab/ Terberg Toploader) and taken to the BiogenGreenfinch AD plant in Twinwoods. During the trial, approximately 600 tonnes of food waste were diverted from landfill, a participation rate of 71.5% was achieved and the Kg per household served was 1.95. Due to the success of the trial, Mid Beds District Council is now rolling out food waste collections to all 52,000 properties in Mid Bedfordshire. http://www.bedfordshire.gov.uk/EnvironmentAndPlanning/RecyclingAndWaste/FoodWasteTrialCaseStudy.aspx

The AD treatment process generates biogas (a mixture of methane and CO2) which can be used for renewable energy production. For example, biogas can be used to generate electricity and heat to power on site equipment, and the excess supplied to local businesses or the National Grid. AD also produces a nutrient rich digestate that makes a good fertiliser that farmers can use as a cost effective alternative to chemical fertilisers [31].

BiogenGreenfinch operates the commercial AD facility at Twinwoods. The AD plant processes up to 30,000 tonnes of food waste per annum [31]. The AD plant is designed to integrate with a state of the art pig finishing unit owned by Bedfordia Farms and housing 4,800 pigs. The two facilities are connected by an underground pipeline feeding the pig slurry from the finishing unit to the AD plant. BiogenGreenfinch also recognised that the AD plant could provide a solution to food chain waste and this was built into the design. The AD plant has a small footprint and the enclosed process ensures there is significantly lower odour levels than normally occur from animal waste. The 600 tonnes of food waste from Mid Bedfordshire households taking part in the 11 month trial was mixed with the pig slurry and also with local food manufacturers' waste.

The AD treatment process generates heat and a biogas which is converted into 1.2MW of renewable electricity [31]. The heat generated is used as part of the process while the electricity generated is sold back to the National Grid is enough to power roughly 1,000 homes. The nutrient rich digestate is used as a biofertiliser on the adjacent arable farmland of Bedfordia Farms. The bio-fertiliser is used as a high grade soil conditioner achieving better results than traditional fossil fuel-based fertilisers. The bio-fertiliser is more readily available to the crop and it also provides significant cost savings as there is no longer a need to purchase fossil fuel derived fertilisers. As a result, soil management and quality have improved and slurry is no longer an issue.
http://www.biogen.co.uk/bigpicture/twinwoods.asp

4.4. Mechanical Biological Treatment (MBT)

MBT is a generic term for an integration of several processes, primarily of a mechanical and biological nature. An MBT plant can incorporate a number of different processes in a variety of combinations and can be built for a range of purposes. The process recovers materials and energy from 'residual' waste (i.e. the waste left over after recycling by separation at source). The aim of the process is to further reduce environmental impacts before disposal of the residual waste and to gain additional value from the recovery of materials. Though MBT reduces waste it still leaves a significant residual waste which must go for final disposal either by landfill or by some thermal treatment. It is not therefore, a 'stand-alone' treatment for residual waste but is an intermediate process requiring integration with a waste disposal facility.

4.5. Energy from Waste (EfW)

Conventional thermal treatment is already a mature and well established technology. EfW or 'incineration with energy recovery' involves the combustion of waste [typically unprepared raw or residual Municipal Solid Waste (MSW)] under controlled conditions, to reduce its volume and hazardous properties, and to generate electricity and/or heat. EfW facilities are designed to burn the waste as efficiently as possible and require process control measures for emissions and extensive flue gas cleaning equipment. There is a requirement to deal with the residues of the combustion process. There are two principal solid residues from such systems: the bottom ash, which is the solid remainder of the waste after processing; and the flue gas treatment residues from the air pollution control process. The bottom ash may be recycled into appropriate construction applications or disposed of to landfill. The volume of waste needing disposal following combustion is reduced by approximately 90%, limiting the need for landfill. Biodegradable Municipal Waste (BMW) content in the outputs is also reduced to zero.

The incineration scenarios modelled in the Eunomia[29] study on greenhouse gas balances of waste management in London were amongst the worst performing on greenhouse gas emissions, with all but one of the scenarios being a net contributor to climate change. This could be improved if the burning of plastics no longer takes place and there is provision for good quality combined heat and power (CHP). A key advantage of anaerobic digestion and gasification over incineration is that they can be coupled with more efficient generation technologies, whilst incineration remains locked to the use of a steam turbine.

Sustainable Development Commission and Energy from Waste

A review by the Sustainable Development Commission Scotland[32] concluded that energy from waste may be, in the right circumstances, compatible with sustainable development and a move towards a zero waste society. With regard to energy from waste plants in Scotland they specifically advocated that:

- no waste be thermally treated unless separation of recyclables has first taken place
- energy from waste systems need to be evaluated on their ability to reduce carbon emissions
- energy from waste plants should recover energy to a minimum efficiency level of 60% (it is likely that the Welsh Assembly Government will also only support EFW plants operating at this level of efficiency)
- schemes should be developed in accordance with the proximity principle
- discussion and planning about local infrastructure must only take place following proper engagement of local communities and stakeholders
- operators must follow high standards of good practice in site management and work to establish good neighbour agreements
- the Renewables Obligation should continue to support advanced technologies and CHP only
- schemes developed using public private partnerships or future alternatives should use clear output criteria so that schemes do not undermine wider policy.

4.6. Landfill

This method of waste management is the most familiar and can be described as the deposit of waste onto or into land. Growing concerns about environmental problems associated with landfill coupled with the growing awareness that landfill is wasteful of resources, has led to the current position that landfill is no longer regarded as the preferred option for the management of waste. Landfill capacity in Wales is running out. For example, Cardiff's landfill site at Lamby Way is due to close in 2009 and the site at Newport reportedly only has a 3 year lifespan remaining. Capturing and converting landfill methane into biomethane and using it to fuel collection vehicles reduces the consumption of diesel fuel, the major source of waste-related transportation emissions.

Case Study W3: Biomethane Vehicle Fuel Trial, Camden

Camden Town Council operates a range of initiatives to reduce the greenhouse gas emissions of their activities including measures to 'green' their fleet of 320 vehicles. One such initiative involves a partnership with Veolia Environmental Services Ltd and Gasrec to trial biomethane as a vehicle fuel. Gasrec is the UK's first commercial producer of liquid biomethane (LBM) fuel. Compressed biomethane will be used to fuel one of Veolia's caged vehicles operating on the refuse collection, recycling and street cleansing contract with Camden. A biomethane refuelling station has been located at Camden's York Way transport depot. Capturing and converting landfill methane into biomethane and using it to fuel collection vehicles reduces the consumption of diesel fuel, the major source of waste-related transportation emissions.

The Camden trial follows the establishment of a biomethane facility at the Aldbury landfill near Guildford in June 2008 via a partnership between Gasrec, gas and engineering firm BOC and waste management company SITA UK. The technology for liquefying the gas is provided by BOC's parent company, the Linde Group, while BOC will operate the plant, which is expected to have an operational life of around 15 years. The facility can recover around 85% of methane contained in landfill gas emitted from the site, to produce enough liquid fuel (c. 5,000 tonnes per annum) to power up to 500 light vehicles or 150 HGVs.

The fuel runs more cleanly and quietly, achieving up to 70% carbon savings compared to standard diesel and is particularly suited to vehicles operating in the urban environment. It is estimated that substituting diesel with the LBM produced from Albury will reduce CO2 emissions by c15,000 tonnes per annum. LBM produced from landfill is the only commercially available B100 fuel that is waste derived. It also has the lowest carbon intensity of any B100 renewable fuel. LBM already meets the strictest criteria for sustainability and carbon intensity under the provisions of the UK RTFO.
http://www.gasrec.co.uk/mediadetails.php?ID=12

Gasrec aims to sell the liquid biomethane to commercial haulage firms and waste management companies to replace diesel in their vehicle fleets and the Camden trial is a step in this direction. The Camden trial is currently using biomethane produced from the Aldbury landfill gas. In the near future Gasrec will be opening a new site in Reading where an anaerobic digestion plant will be used to generate biomethane.

The vehicle used in the Camden trial is an Iveco Daily light commercial vehicle (supplied to Veolia by Gasrec). This is one of the latest generation of natural gas powered vehicles and ideal for operating with compressed biomethane. The trial will investigate the performance of the biomethane fuelled Iveco vehicle in comparison with existing Veolia vehicles running on compressed natural gas. The project aims to demonstrate that biomethane is a commercially competitive and environmentally sound fuel that can be directly substituted for natural gas.

Camden commissioned research to investigate the life cycle environmental impacts of different transport bio-fuels to inform their fleet procurement policy. Biomethane was shown to have the lowest overall environmental impacts (based on air quality and green house gas emissions) compared to bio-ethanol and bio-diesel.

If the trial proves successful additional biomethane vehicles will be used in Veolia's fleet. As Veolia is one of Camden's largest contractors, the long-term use of biomethane in Veolia's fleet will help reduce the NOX, PM10 and CO2 emissions associated with Camden's waste management services. Camden Town Council also intends to procure biomethane vehicles during 2009.

www.camden.gov.uk/ccm/content/environment/air-quality-and-pollution/air-quality/greening-camdens-vehicle-fleet.en;jsessionid=58687F832284A5F81245A4CE495A8C7B.node1

Box W9. Collection and treatment

I. Integrate the collection and treatment of municipal solid waste (MSW), construction and demolition waste (C&D) and commercial and industrial waste (C&I).

II. Place a cap on the treatment of residual waste by energy from waste (EfW) of 30-35%. Any EfW facilities should be at least 60% efficient and linked to CHP.

III. Segregate contaminated waste wood for use as biomass in CHP facilities that comply with the waste incineration directive (WID).

IV. Capture and convert landfill methane into biomethane as a replacement transport fuel.

Box W10. Measuring success for collection and treatment

- **Core Indicator Set WMT/005**
  The percentage of municipal waste used to recover heat and power

- Establishment of an anaerobic digestion facility in each local authority
- Volume of landfill methane captured and converted into biomethane as a replacement for transport fuel

4.7. Transport & waste

4.7.1. Route Optimisation & improved fleet management

Improving collection efficiency by optimising routes can significantly reduce vehicle fuel consumption, collection costs and greenhouse gas emissions associated with waste management. LAs can reduce greenhouse gas emissions and improve the cost effectiveness of waste management by designing compact collection routes, equalising workloads between different routes, minimising the distance travelled from the unloading site, and considering traffic patterns along the route. Software packages are now available to ease the task of manually re-routing collection vehicles (e.g. LogiX & Roundbuilder) and to optimise the performance of waste collection and disposal fleets. For example, route optimisation efforts in the City of San Diego (USA) saved an estimated 23,000 miles per year reducing emissions of carbon dioxide by 788 tons[33].

A study using route optimisation software on domestic collection round data from three waste collection authorities in north Hampshire, found a refuse collection vehicle (RCV) mileage saving of 5.9% was modelled for joint working between authorities where the RCVs were allocated to depots optimally [34]. This basic model shows the impact that redesigning collection rounds to allow cross-boundary collections, using a combined vehicle fleet and shared depots can have in reducing vehicle mileage.

4.7.2. Waste by Rail

http://www.freightonrail.org.uk/CaseStudyWasteByRail.htm

Transporting waste by rail (or water) reduces GHG emissions. Per tonne carried rail produces between 5 and 10 times less GHG emissions than road transport[35].

4.8. Behavioural Change

Public education campaigns widely in use across Wales include promotion of Real Nappies, Stop Junk Mail, Compost Awareness Week and Waste Minimisation Week. Local Authorities can access waste awareness support via the national media campaign Waste Awareness Wales (WAW) http://www.wasteawarenesswales.org.uk/ . WAW is linked to the UK Recycle Now http://www.recyclenow.com/ media campaign delivered by WRAP. Resources are available, such as the Love Food Hate Waste http://www.lovefoodhatewaste.com/

campaign, to encourage public engagement in waste prevention and reduction. UK based initiatives such as the recently announced 'zero waste regions' project will hopefully act as demonstrators for innovative and replicable practices that enable waste prevention in schools, households and businesses, and support Local Authorities in taking leadership reducing the overall environmental impact of waste. A total of six places have been chosen to implement zero waste plans. For example, the West Midlands will create a Zero Waste region, focussing on businesses and organisation that produce a large quantity of waste, identifying region-wide waste infrastructure needs, improving co-operation and cutting business waste right across the region. A zero waste places initiative is planned for Wales in 2009-10.

4.9. Procurement

The public sector at all levels can stimulate greening of the supply chain, including reduction of waste through better product and packaging design, by pushing for such market efficiencies through the procurement system. The use of Value Wales' Sustainability Risk Assessment tools (https://www.buy4wales.co.uk/PRP/strategy/procstrat/sustainableriskassessmentandperformancemonitoring.html) and the sustainability function of Value Wales' Benefits Reporting Model (www.buy4wales.co.uk/PRP/10688.file.dld) will help in this regard. The public sector needs to change the rules so that resource conserving businesses out-compete resource wasting businesses. Local governments need to support the most beneficial alternatives to landfills and encourage systems that treat waste as a resource.

The Sustainable Development Commission report, Sustainable Development in Government 2008[17] looked at sustainable waste management practice in the UK Government. Recommendations for improvement included:

- Government must advocate the use of sustainable procurement practices to better control the input of consumable materials into departmental operations, in addition to the positive contractual changes already made to manage the outflow of waste materials.

- Waste contracts and recycling services are not being used to their full capacity. Opportunities for collaborative procurement across government to share these contracts and services, where it would be beneficial, have not been fully recognised. While the primary emphasis must be on reducing the amount of waste produced in accordance with the waste hierarchy, infrastructure to recycle is available and

government has a duty to set and enforce contracts which make use of this infrastructure to its full capacity.

- Where waste volumes are low and costs are high, the use of inter-organisational waste contracts should be explored to achieve economies of scale. For example, larger volume waste streams could be undertaken on a more regional basis which allow for more cost effective and innovative waste and recycling solutions.

- Any major public sector capital expenditure projects should seek to aggressively reduce waste arising throughout product life cycles, as well as sharing knowledge of these processes with government, and with the private sector.

Case Study W4. Procurement for Sustainability in New South Wales

Sustainable Choice is local government resource developed in New South Wales (NSW) to assist with purchasing for sustainability. The NSW local government sustainable procurement programme provides support and guidance to councils on products and services that save energy or water; have recycled content, are non toxic, have GHG or biodiversity benefits, or advance social or other environmental objectives. The resource is aim to facilitate information sharing and capacity building. It is a membership scheme requiring joining local authorities to adopt a council resolution to commit to sustainable procurement, put a sustainable procurement team in place and incorporate sustainable procurement into policy including providing staff education and reporting on progress. http://www.lgsa-plus.net.au/www/html/956-sustainable-choice.asp

Box W11. Delivery through partnerships

I. Introduce waste minimisation champions throughout the public sector to raise awareness and stimulate action.

II. Implement consistent waste awareness campaigns across spatial regions to stimulate behavioural change across all sectors.

III. Consider joint working to redesign collection rounds to allow cross-boundary collections and also the sharing of vehicles and depots for optimum efficiency.

IV. Work with major retailers to help supplement local recycling infrastructure.

V. Where waste volumes are low and costs are high, explore the use of inter-organisational waste contracts to achieve economies of scale.

Box W12. Measuring success for delivery through partnerships

- Number of public sector organisations with waste minimisation champions
- A waste awareness campaign is implemented across Spatial Plan Regions
- Cross-boundary working on waste collection is underway
- Major retailers have / are supplementing local recycling infrastructure

Funding

Welsh Assembly Government RCAF/ SWMP

WRAP Organics Funding Guide

EU Convergence – Materials Efficiency Framework

Welsh Assembly Government- Strategic Capital Investment Fund - £26m for AD

RDP Supply Chain Efficiency Scheme

Making the Connection Improvement Fund

WRAP Capital Access Fund for AD (must include 60% C&I food waste) & construction waste recycling infrastructure – through Welsh Assembly Government MAP programme

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