Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Consultation on a Bioenergy Action Plan for Wales

February 2009

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MINISTER'S FOREWORD

The Welsh Assembly Government is building on its commitment to sustainable development. Specific actions in the "One Wales" programme for government are aimed at securing a sustainable environment through tackling climate change, supporting rural development, achieving sustainable energy production and consumption, and improving the local environment.

An essential task in addressing all of these issues is the development of a co-ordinated plan for bioenergy; that is, an agreed set of actions to make best use of our renewable biomass for the production of heat, electricity and, possibly, transport fuel.

This action plan complements the Renewable Energy Route Map for Wales which was issued for consultation in February 2008 and provides a more detailed assessment of the potential for bioenergy. It takes into account comments from the consultation. Pursuit of the actions in this plan will form part of the overall Welsh Energy Strategy to be published in 2009.

Increased use of bioenergy will reduce our use of fossil fuel and the associated carbon emissions thereby contributing to our campaign to address climate change – a key priority for the Assembly Government.

It will also generate new opportunities for forestry management, for private woodland owners, and for farmers. There will be business opportunities for those supplying, processing and distributing wood-fuel, energy crops, and even waste materials, as well as for those involved with fabricating, importing and installing equipment for generating energy from the biomass.

The bioenergy action plan will be included in our support programme to promote energy efficiency and renewable energy production on-farm, and in our support for indigenous woodlands. It will also encourage the development of community energy projects based on local biomass. These activities will help develop the rural economy and contribute to our energy use being more sustainable.

For a plan to be effective in meeting the huge opportunities presented by bioenergy for Wales, there must be a consensus across a wide range of public, community, business and government interests. I would urge you, therefore, to provide us with your comments on this consultation document and to share your suggestions for maximising the benefits of bioenergy for Wales.

Jane Davidson
Minister for Environment, Sustainability & Housing
Welsh Assembly Government
February 2009

Bioenergy Action Plan for Wales consultation

We are seeking your views on our plans to use bioenergy to help Wales reduce its carbon footprint.

The Assembly Government aims to use bio-energy to:

- significantly reduce greenhouse gases emissions;
- contribute to long-term fuel security;
- ensure that the public sector leads by example;
- encourage the development of sustainable forestry and agriculture; and
- support business development and job creation in all parts of the biomass energy supply chain.

Tell us what you think

Please send your comments by 22 May 2009 to:

Alun James
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Cathays Park
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CF10 3NQ

Or by e-mail to: energy@wales.gsi.gov.uk

We intend to publish a summary of the responses to this document. Normally, the names and addresses (or part of them) of their authors are published along with the response. If you do not wish to be identified as the author of your response, please state this clearly when you write or email us.

The Consultation on the Bioenergy Action Plan for Wales and its annexes can be downloaded from: http://wales.gov.uk/consultations under ‘Environment and Countryside’.

Bioenergy Action Plan for Wales

Contents

I. Executive Summary

The aim of this bioenergy action plan is to secure the annual generation in Wales of at least 5 terawatt-hours of electricity and 2.5 terawatt-hours of usable heat energy from renewable biomass by 2020, in ways that will result in a reduction of about 3 million tonnes of carbon dioxide emissions per year in comparison with generation based on fossil fuels. It would also contribute significantly to the achievement of the UK's target to produce 15% of the total energy used from renewable sources by 2020, and to the associated detailed objectives on renewable heat and power proposed in the UK Renewable Energy Strategy[1].

The Welsh Assembly Government is strongly committed to increasing the amount of energy derived from renewable sources and undertook a public consultation on a Wales Renewables Energy Route Map early in 2008[2]. The Route Map explores how best to exploit Wales's extensive natural renewable energy resources in ways which could make us more than self sufficient, in aggregate, in low-carbon electricity. It shows that, by 2025, the amount of electricity generated from on-shore and off-shore wind, hydropower, wave and tidal power, biomass and microgeneration sources could be more than we currently consume.

The aims of the Assembly Government regarding bio-energy are to:

- optimise the benefits of bioenergy use in Wales to significantly reduce the emissions of greenhouse gases while maintaining a high carbon content of soil;
- contribute to long-term fuel security;
- ensure that the public sector leads by example;
- encourage the development of sustainable forestry and agriculture; and
- support business development and job creation in all parts of the biomass energy supply chain.

The Assembly Government is particularly keen to see schemes developed that maximise carbon savings; for example:

- local biomass for domestic heating, especially off the gas network;
- biomass for CHP in industries with high heat loads;
- local biomass for generating heat or CHP in communities;
- biomass co-fired with coal in large, efficient power stations;
- contaminated waste wood used in CHP or power stations which comply with waste incineration regulations;
- residual municipal wastes, that cannot be recycled further, used to produce heat and power; and

[1] UK Renewable Energy Strategy Consultation Document, BERR, June 2008
[2] Renewable Energy Route Map for Wales consultation, February 2008 http://wales.gov.uk/consultations/

- 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.

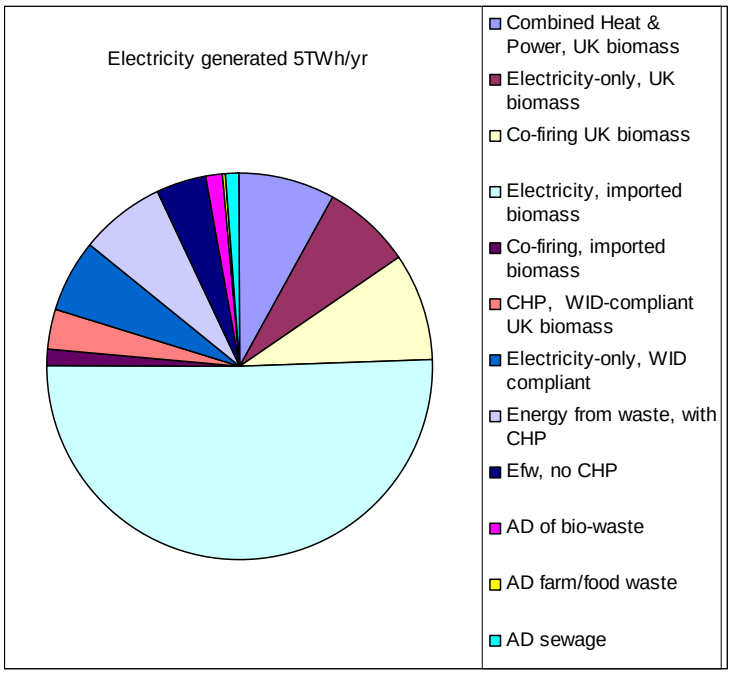
Existing support measures

Some of the Assembly Government's initiatives on bioenergy which are already underway are:

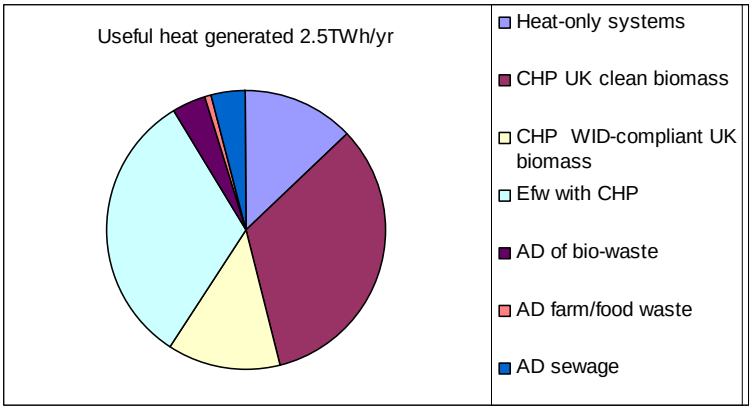
- generation of heat, or combined heat and electricity, for Assembly Government and other public sector buildings (e.g. new offices in Aberystwyth and Llandudno Junction will use biomass heating);
- community projects for heat or CHP generation (e.g. through development and support of a strategic community energy proposal using Convergence Programme funds); and
- support for anaerobic digestion projects (e.g. promotion of anaerobic digestion through financial support to winners of a competition to establish exemplar AD plants in Wales).

Potential energy generation in Wales from biomass

The breakdown of potential electricity and heat generation from biomass in Wales by 2020 is shown below:



The 5 terawatt-hours (electrical) from new biomass projects would be about 14% of current generation, and about 21% of our current use.



The 2.5TWh (thermal) per year envisaged from biomass heating and CHP would meet about 3% of our heating needs.

The amount of biomass required to generate this energy is estimated to be as follows:

UK biomass resources* required annually in oven-dry tonnes**	
Forestry woodfuel and non-contaminated waste wood:	692,000
Possibly contaminated waste wood:	345,000
Woody energy crops for heat and power:	267,000
Municipal-type waste:	846,000
Organic matter for anaerobic digestion (not oven-dry)	
Bio-waste***	340,000
Agricultural slurry & food waste:	250,000
Sewage sludge:	93,000
Imported biomass resources required for large-scale stations, built or in prospect (odt)	
Clean wood and other biomass:	1,630,000

* Biomass is an internationally-traded commodity and bioenergy applications in Wales will source the raw material from various locations, inside and outside Wales. However, an attempt is made at assessing the extent to which Wales's future bioenergy needs can be met from Welsh resources, and a distinction is made between British and imported biomass.
** Biomass quantities in this document are given in oven-dry tonnes unless otherwise indicated.
*** Bio-waste means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food-processing plants.

It is estimated that the amounts of biomass from Wales currently available for energy generation are:

Clean wood fuel	183,000 odt
Non-contaminated waste wood	150,000 odt
Possibly contaminated waste wood	412,000 odt
Woody energy crops for heat and power	1,200 odt
Municipal waste biomass	1,050,000 odt
Agricultural slurries	>1,000,000 t
Sewage sludge	>100,000 t

Therefore, international import considerations apart, there is potentially a large shortfall in terms of what has been identified as biomass needs, by 2020, and what is currently produced in Wales, other than for biomass from municipal waste, contaminated wood and slurries. For example, there is a shortfall of over 350,000 tonnes of clean wood fuel or non-contaminated waste wood, and a shortfall of over 260,000 tonnes of woody energy crops. There may be continued opportunities for woodfuel to be obtained from England and Scotland or from overseas, but this raises a range of transport-related issues.

The potential exists, in theory, for growing over 600,000 tonnes of woody energy crop annually in Wales, even if only 10% of the suitable land was used for this purpose. But it is unlikely that the value of woody energy crops for heat and power generation will be high enough in the short term to encourage farmers in Wales to grow them. The question of whether to introduce planting grants for woody biomass crops is being considered as part of the Axis 2 review of the Rural Development Plan, which was the subject of a consultation in autumn 2008.

The Assembly Government is not promoting the large-scale growth of annual energy crops for conversion to liquid transport fuels. As illustrated in the Gallagher report[3], there are serious concerns about displacement of food crops leading to an increase in food costs with the greatest impact on the poorest people. Nationally and internationally, biomass has to compete as a land-use against alternatives, including food production. In addition, planting of biomass crops is unlikely to be suitable on soils with a high carbon content, given the potential loss of carbon from the soil and the impacts on water management and biodiversity. Any proposal to plant biomass on such soils would need extremely careful assessment.

This Action Plan proposes:

- increasing public awareness of the benefits and availability of bioenergy;
- encouraging the increased use of biomass for heat and power generation;
- increasing the supply of woody biomass for energy production in Wales, having regard to the need to conserve soil carbon;

[3] Review of the indirect effects of biofuels; Prof. Ed Gallagher; 7 July 2008 http://www.dft.gov.uk/rfa/reportsandpublications/reviewoftheindirecteffectsofbiofuels.cfm

- providing more opportunities for skills improvement; and
- catalysing a coordinated approach, involving government, farmers, private woodland owners, industry, businesses and communities.

It is estimated that the anticipated increase in the use of bioenergy in Wales would create about 1,000 direct jobs.

Next steps

Input from consultees will be built into a final version of the bioenergy action plan for Wales which will be published in 2009.

Implementation of the final action plan will be monitored by a group of specialists in various related disciplines to ensure that rapid progress is made.

Also, the results from this bioenergy consultation, along with those from the Wales renewables energy route map and the proposed marine energy consultations will be taken into account in the overarching Wales energy strategy, also to be published in 2009.

II. Proposed Actions

Bioenergy application	Actions for the Welsh Assembly Government
ACTIONS TO INCREASE DEMAND FOR BIOENERGY	
Generic Actions	
Awareness raising and skills development	1. Promote the benefits of bioenergy as part of the public awareness campaign on climate change. 2. Work with schools, colleges of further education and professional bodies to ensure that there are sufficient resources to train people engaged in the supply of biomass, and engaged in designing, installing and maintaining bioenergy equipment of all types. 3. Work with building companies to promote the aspiration for new buildings in Wales to be zero-carbon from 2011. 4. Support the demonstration of zero-carbon buildings using biomass prior to 2011.
Heat Generation	
Domestic heating (individual premises)	5. Help to generate opportunities for supply of woodchip, pellets and logs. 6. Encourage the establishment in Wales of manufacturers of biomass boilers. 7. Support the Energy Saving Trust to increase demand and supply of biomass for heating.
District heating	8. Work with the third sector in engaging with communities on the benefits of district heating using biomass. 9. Initiate a project under the Climate Change framework of the 2007–2013 EU Convergence Funds programme to support community energy schemes, including biomass district heating.
Heating of hospitals, government offices, leisure centres, schools etc.	10. Assess the feasibility of biomass heating for buildings throughout the Welsh Health Estate. 11. Work with LAs to assess feasibility of biomass heating in existing as well as new buildings. 12. Investigate options for introducing biomass heating, where appropriate, into schools across Wales.
Space-heating for industry and businesses	13. Develop, with Carbon Trust Wales, EST and industry groups, information leaflets on biomass space heating targeted at specific types of industry and business.

Bioenergy application	Actions for the Welsh Assembly Government
Combined Heat and Power Generation	
Clean wood CHP schemes providing heat to industry, businesses and new property developments.	14. Provide a heat map for Wales to identify the opportunities for CHP in premises with large heat demands. 15. Promote CHP successes. 16. Work with Defra, EA Wales and Local Authorities on a scheme to ensure that anyone replacing a mid-sized furnace as part of a boiler plant (over 400kW) is aware of the potential for CHP. 17. Develop, with Cardiff University and Cardiff CC, detailed plans for a CHP scheme for Cathays Park.
Electricity generation without CHP	
Large-scale electricity generation	18. Work with the Department for Energy and Climate Change (DECC) to encourage developers of new biomass power stations to site them where there is a need for heat, and to make them combined heat and power plants.
Co-firing in coal-fired power stations	(No specific actions are proposed to encourage co-firing since there are sufficient incentives through the Renewables Obligation Mechanism – see section 3.3.1)
Transport biofuels	
Use of biodiesel and bioethanol	(No specific actions are proposed to encourage use of transport biofuels)
Energy from waste	
Use of residual municipal and commercial waste to generate electricity and heat	19. Work with LAs to engage with communities to explain the benefits of obtaining energy from waste (EfW). 20. Ensure appropriate air quality monitoring around EfW facilities to demonstrate compliance with regulations. 21. Encourage applications for EU Convergence Funds to support establishment of additional EfW generating plant.
Anaerobic digestion	
Use of AD to produce biogas to generate heat and power, and possibly use as transport fuel.	22. Provide funding over the next three years for local authorities to set up new services to separately collect and treat food waste from households in Wales. 23. Provide financial support to winners of a competition to establish AD plants (subject to planning permission); use as exemplars to encourage AD development across Wales. 24. Work with farmers' unions to increase awareness by farmers

Bioenergy application	Actions for the Welsh Assembly Government
	of benefits of AD. 25. Keep abreast of developments involving fuel cells linked with AD units and consider potential applications in Wales.

ACTIONS TO INCREASE SUPPLY OF BIOMASS	
Wood-fuel supply	26. Factor in the potential for woodfuel when considering the balance of use of the National Forest in the revision of the Wales Woodland Strategy and the use of the Assembly Woodland Estate through the next Forestry Commission Wales (FCW) Corporate Plan. 27. Encourage private woodland owners to harvest woodland sustainably, e.g. through FCW's Better Woodlands for Wales grant scheme. 28. Work with FCW and educational bodies to develop plans to overcome skills shortage in forest management. 29. Consider grant support for woodland as part of the review of land management schemes under Axis 2 of the Rural Development Plan. 30. Work with LAs to identify expected annual arboricultural arising and consider options for use as fuel.
Woody energy-crop supply	31. Consider the scope for introducing planting grants for woody energy crops as part of the review of land management schemes under Axis 2 of the Rural Development Plan. 32. Maintain awareness of competing demands for energy crops and food supply nationally and internationally to help ensure that Welsh Assembly Government policies are based on sustainable development principles. 33. Provide advice and guidance to farmers who wish to grow woody energy crops, e.g. through Farming Connect. 34. Support the use of Structural Funds for a programme on the development of a sustainable biomass industry in Wales.
Biofuel production	35. Support use of used cooking oil for biodiesel production. 36. Support the technical development of biofuels from non-food sources.
Supply of waste wood for energy generation	37. Work with LAs, building industry and other generators of waste wood on ways to minimise contamination of wood and to segregate it from other waste streams to improve ease of collection.

Supply of residual waste for energy extraction	38. Support LA initiatives to segregate non-recyclable residuals of MSW for use in EfW facilities, and to segregate food waste and other organic fraction of MSW to create additional fuel for AD schemes.

1. Introduction

1.1 Concern about climate change has resulted in government policies to reduce the emission of carbon dioxide and other greenhouse gases from power generation, heating and transport, and to increase the amount of energy generated from renewable sources.

1.2 The substitution of biomass for fossil fuels in the production of heat, power and transport fuels can help reduce carbon dioxide emissions, provided that new biomass is grown to replace that used.

Bioenergy overview

1.3 Biomass is defined by the Biofuels Directive[4] as the biodegradable fraction of products, waste and residues from agriculture (including vegetable and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. Bioenergy is defined as energy generated from biomass which may either be used directly as a fuel or processed into liquids and gases for the production of heat, electricity or transport fuels.

1.4 The main feedstocks for bioenergy are:

- Wood – low grade small roundwood, forest operation residues, arboricultural arisings, wood-processing co-products, and recovered wood wastes e.g. pallets;
- Annual crops – cereals, oilseed rape, sugar beet;
- Perennial crops – Miscanthus, reed canary grass, short-rotation coppice (typically willow and poplar), potentially ryegrass;
- Biomass in municipal and commercial waste; and
- Agricultural waste, food waste and sewage sludge.

1.5 Two accompanying documents contain annexes which underpin this action plan. These address:

A1 Calculation of bioenergy potential, biomass needs and potential carbon savings;

A2 Policy considerations;

A3 Assessment of production costs and market conditions;

A4 Environmental issues;

A5 Potential impacts of increased bioenergy demand on food production and other uses of biomass;

A6 Employment benefits of bioenergy options; and

A7 Bioenergy technologies.

[4] Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport. OJ L123/42 (17.5.2003)

Bioenergy hierarchy in terms of cost effectiveness

1.6 The UK biomass strategy[5] has assessed biomass use for energy generation in relation to the cost-effectiveness of carbon savings. The hierarchy is one of the key considerations in the development of a bioenergy action plan for Wales.

1.7 The most cost-effective options are expected to be:

- Energy from waste that would otherwise go to landfill
- Heat or CHP generation
- Electricity generation.

Electricity from non-waste biomass:

- Replacement of oil for heat and CHP in high-load applications
- Replacement of oil for commercial/industrial heat in seasonal load applications
- Medium-scale anaerobic digestion of agricultural arising for power generation of CHP replacing oil heating
- Replacement of gas for commercial/industrial heat in high load applications
- Co-firing on new coal power stations with carbon capture and storage
- Replacement of gas for commercial/industrial heat in seasonal load applications
- Small-scale anaerobic digestion of agricultural arisings for power or CHP replacing oil heat
- High-load district heating replacing oil
- Co-firing at existing and new coal fired power generation plant
- Replacement of individual domestic oil boilers with biomass
- Electricity generation from power plant fired exclusively on biomass
- Replacement of individual domestic gas boilers with biomass
- First generation transport biofuels.

Soil Carbon consideration

1.8 Current assessments for the UK greenhouse gas (GHG) inventory[6] assume that the GHG emissions from the combustion of biomass are zero. That is, the emissions of greenhouse gases, in terms of carbon dioxide emissions that would give the some climate change impact, are considered to be equivalent to the CO_2 removed from the atmospheric pool during the growing process.

[5] UK Biomass Strategy, Defra May 2007; www.defra.gov.uk
[6] National Greenhouse Gas Inventory: http://www.ghgi.org.uk/

1.9 However, combustion of the carbon content of biomass is not the only issue that needs to be considered in the context of the GHG inventory; the impact that the biomass growth has on the carbon content of soil must also be taken into account.

1.10 Changes in the use of land can result in an increase or decrease in the carbon content of soil.

1.11 The rate of CO_2 emissions from soil or the removal of CO_2 from the atmosphere by soil, through the accumulation of carbon derived from plant material and microbial processes, is dependent on a number of factors including land-use and soil type.

1.12 The figures below are first-order approximations, used to estimate carbon losses and gains for mineral and organic soils from various land-use changes; they do not take into account GHG emissions associated with fertilizer use or other energy inputs incurred during harvesting, processing or transporting the biomass[7].

1.13

Change in land-use *	Gain or loss of soil carbon for **mineral** soils** tonnes CO_2-equivalent per year per hectare
Farm grass to arable	- 3.7
Natural or woodland to arable	- 5.1
Natural or woodland to farm grass	- 1.4
Arable to farm grass	+ 1.8
Arable to natural or woodland	+ 2.5
Farm grass to natural or woodland	+ 0.73

* Natural vegetation includes permanent pasture; farm grass represents short-term ley.
** For mineral soils, carbon loss is averaged over 50-year period and carbon gain is averaged over 100-year period.

Change in land-use ^	Gain or loss of soil carbon for **organic** soils ^^ Tonnes CO^2-equivalent per year per hectare
Natural vegetation or woodland to arable or farm grass	- 29.4
Farm grass or arable to Natural vegetation or woodland	+ 4.9

^ Aggregation of land-use type is due to wider ranges within estimates
^^ For organic soils Carbon loss is averaged over 50 year period and Carbon gain is averaged over 300 year period.

1.14 The figures show that conversion of farm grass, natural vegetation and woodland to cropland for bioenergy crops results in significant additional CO_2 emissions from soils. These emissions must be taken into account in estimating the impact of growing biomass for energy generation.

[7] Intergovernmental Panel on Climate Change: Generic methodologies applicable to multiple land-use categories: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf

1.15 They also show that conversion of cropland to short-rotation coppice results in increased soil carbon. However, the carbon gains may not be as much as presented above because of the more intensive management associated with short rotation coppice in comparison to more traditional woodland systems.

Biomass needs

1.16 In order to get an estimate of the amount of bioenergy that might be used in Wales in 2020, a scenario is constructed for each bioenergy application. These scenarios are based on current proposals for bioenergy projects, discussions with specialists in power industries and in biomass sourcing, and the expectation that a significant boost to bioenergy use will result from the Assembly Government's initiatives to tackle climate change (such as the aspiration for zero carbon buildings from 2011), alongside the UK Government's proposals on modification to the Renewables Obligation Mechanism.

1.17 The scenario for each bioenergy application is not intended to be an accurate prediction; rather, it puts forward assumptions for the potential market for bioenergy use in the production of heat, electricity and CHP. By comparing the potential demand with current supplies, we can get an estimate of the shortfall and consider options on how this can be overcome.

1.18 Actions are proposed to increase the uptake of the various heat and power applications of bioenergy, and for increasing the amount of biomass produced in Wales.

1.19 The reduction in carbon dioxide emissions as a result of using biomass instead of fossil fuels is estimated for each bioenergy application. However, an estimation of the amount of CO_2 released during the cultivation, transport and processing of the biomass itself has not been attempted since the Carbon Trust has estimated that these emissions are comparable to the greenhouse gas emissions arising from the extraction, processing and transport of fossil fuels[8]. The factors used to estimate CO_2 emissions are consistent with those recommended by Defra in their report "Greenhouse Gas Policy Evaluation and Appraisal in Government Departments" (April 2006) and with those used in the UK Biomass Strategy.

[8] Carbon Trust (2005) Biomass Sector Review for the Carbon Trust

2. The Welsh Assembly Government's Aims for Bioenergy

2.1 The aims of the Assembly Government regarding bioenergy are to:

- optimise the benefits of bioenergy use in Wales to significantly reduce the emissions of greenhouse gases;
- contribute to long-term fuel security;
- encourage the development of sustainable forestry and agriculture; and
- support business development and job creation in all parts of the biomass energy sector.

2.2 It is particularly keen to see schemes developed that maximise carbon savings; for example:

- local biomass for domestic heating, especially off the gas network;
- biomass for CHP in industries with high heat loads;
- local biomass for generating heat or CHP in communities;
- biomass co-fired with coal in large, efficient power stations;
- contaminated waste wood used in CHP or power 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.

Note: Schemes involving waste biomass would lead a hierarchy based on cost-effectiveness of carbon saving (as in the UK hierarchy shown in section 1.7) due to the low cost of the fuel or even receipt of gate-fees for avoidance of the cost of landfill disposal.

2.3 Guiding principles which will underpin our activities on the promotion of bioenergy are:

- sources of biomass, whether from the UK or imported, are sustainable;
- schemes provide good value for money in terms of energy generation and carbon reduction;
- achievement of benefits to communities and alleviation of fuel poverty;
- the largest biomass power stations source their fuel needs sustainably from overseas so as not to reduce the availability of locally-produced biomass for domestic heating and community-sized heat and power projects;

- an equitable balance is secured between the demand on agricultural land for food, energy crops and other non-food crops; and
- recognition of the carbon-saving benefits of a range of end-uses of biomass products as substitutes for fossil-fuel-based materials, such as renewable construction materials and renewable chemicals.

3. Demand for Bioenergy

3.1 Generic actions by the Welsh Assembly Government to promote demand

3.1.1 Awareness raising

The Welsh Assembly Government is embarking on a campaign to increase public awareness of the serious consequences of climate change caused by greenhouse gases. Ways in which everyone can help reduce their use of fossil fuels will be addressed in the campaign, with energy from sustainable biomass being promoted as a good alternative for the generation of heat and power. Providing publicity for exemplar projects will also help generate a positive attitude towards bioenergy.

We will:

1. ***Promote the benefits of bioenergy as part of the public awareness campaign on climate change.***

3.1.2 Skills development

A competent workforce, both in the supply of biomass and its end use for energy projects, is essential before people will have confidence in installing bioenergy equipment in their homes, businesses and industry. There is a role for the Sector Skills Councils, the Sector Skills Development Agency, institutes of Further Education and Higher Education, and professional bodies to develop and support appropriate courses to provide the necessary skills and training.

We will:

2. ***Work with schools, colleges of further education and professional bodies to ensure that there are sufficient resources to train people engaged in the supply of biomass, and engaged in designing, installing and maintaining bioenergy equipment of all types.***

3.1.3 Aspiration for zero-carbon buildings from 2011

Although powers on building regulations are not, at present, devolved to the Welsh Assembly Government, Ministers have announced that domestic and commercial buildings constructed from 2011 onwards should be ‘zero-carbon’. That is, the development should include measures to generate as much energy from renewable sources as is required to provide heat and lighting to the buildings. It is anticipated that many developers will opt for biomass heating to help meet this target.

We will:

3. ***Work with building companies to promote the aspiration for new buildings in Wales to be zero-carbon by 2011.***
4. ***Support the demonstration of zero-carbon buildings using biomass prior to 2011.***

3.2 Heat generation

3.2.1 Conversion of biomass to heat is very efficient (up to 90% efficiency) whereas electricity production is a less efficient process (typically 20-30% efficiency)[9]. However, heat needs to be used close to the point of generation whereas electricity can be distributed across large distances.

3.2.2 Generating heat accounts for roughly 47% of the UK's total energy consumption by end-use, and 41% of the UK's total greenhouse gas emissions. Three-quarters of that energy is used for space and water heating, primarily in the domestic sector.

3.2.3 The demand for heat in Wales is higher than the UK average due to its relatively larger industrial base; for example, 42% of gas supplied in Wales is to industry compared to 27% in the UK. An additional factor is the age of the housing stock, with more than 40% of houses in Wales having single solid walls – and therefore more difficult to insulate than cavity-walled houses - compared to an average of 27% in the UK[10].

Domestic heating

3.2.4 Use of biomass for domestic heating is becoming more attractive with increases in the cost of oil and gas, and with the availability of efficient log, wood-chip and pellet boilers, some of which have automatic feed. But the full potential for domestic biomass heating will not be realised unless there is an effective infrastructure to produce, store and deliver logs, pellets and wood-chip throughout Wales.

3.2.5 As demand for domestic biomass heating grows, opportunities will arise in Wales for employment in the production, processing and distribution of the fuel, and for the installation and maintenance of the boilers – and, ideally their manufacture.

3.2.6 The potential demand for the generation of heat from biomass in homes and individual buildings has been addressed by the Energy Saving Trust (EST) and Element Energy Ltd in work carried out in 2007 for the Welsh Assembly Government[11]. The analysis indicated that changes to planning regulations would have the greatest effect on the uptake of microgeneration and more demanding government targets would result in heat generation from biomass being the biggest contributor to carbon reductions, notwithstanding the need to reduce demand for energy.

3.2.7 EST assessed that the maximum yearly sales of biomass boilers in Wales would be around 850 units and the highest prediction of the number of 20 kilowatt (thermal) units installed by 2020 was about 18,000. The prerequisite for this high uptake was regulations affecting all new build (cf. section 3.1.3).

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[9] Future Energy Solutions, 2005 Renewable Heat and Heat from Combined Heat and Power Plants – Study and Analysis; http://www.berr.gov/uk/files/file21141.pdf

[10] Economic Development Committee; Report for Consultation; Review of Energy Policy in Wales; Part 1: Renewable Energy; April 2002

[11] Potential for microgeneration in Wales, Study and Analysis; EST February 2007

3.2.8 Scenario for domestic heating

The assumption used in this action plan is that it will be possible to install 10,000 domestic 15 kilowatt boilers in Wales by 2020.

We will:

5. ***Help to generate opportunities for supply of woodchip, pellets and logs.***

6. ***Encourage the establishment in Wales of manufacturers of biomass boilers.***

7. ***Support the Energy Saving Trust to increase demand and supply of biomass for heating.***

Larger space-heating demands

3.2.9 Some larger-scale biomass projects for heat are being developed across Wales; for example:

- Bluestone

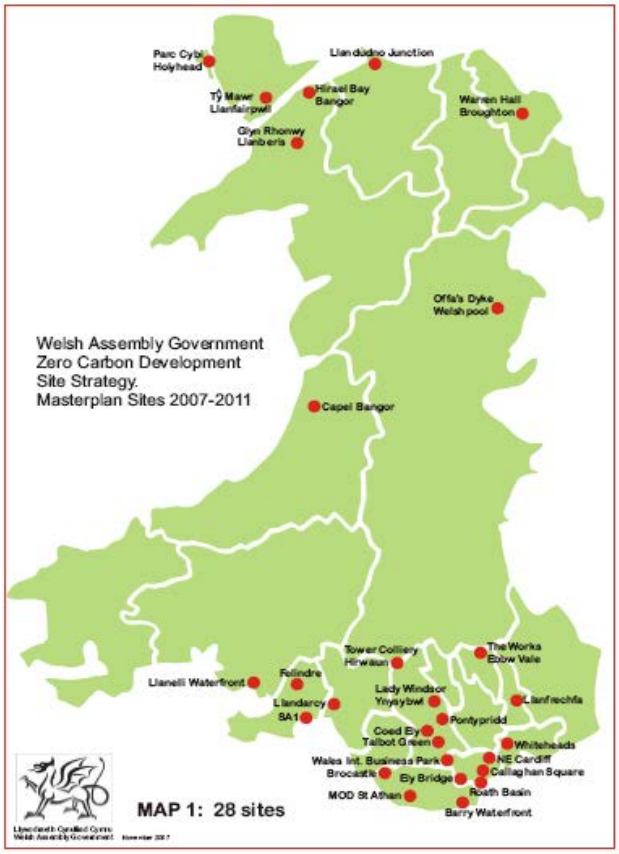
The Bluestone project in Pembrokeshire has created a demand for 2,600 dry tonnes of biomass per year to generate 2.5MW of heat. It is envisaged that 50% of the biomass fuel will come from locally-grown energy crops and 50% from locally-sourced woodchip[12].

- Community district heating

The Assembly Government is seeking ways to encourage more communities to adopt district heating schemes using biomass, similar to the 400kW(thermal) system already operating at Llanwddyn.

It is also working with contractors to develop plans for low carbon houses, leisure centres, schools and businesses on land that the Assembly Government owns across Wales (see map below). Biomass for heating, or for heat and power, will feature at many of these locations e.g. SA1 in Swansea, the Works in Ebbw Vale, and Parc Cybi in Holyhead. Mixed developments such as these have other sustainable development benefits, such as helping to reduce travel.

[12] Wales Energy crops Information Centre, http://www.energycropswales.co.uk/



Third Sector involvement

3.2.10 The third sector in Wales is very broad, covering a range of organisations, from charities, voluntary organisations, social enterprises, community businesses, through to housing associations and cooperatives. It has frequently championed environmental causes.

We will:

8. ***Work with the third sector in engaging with communities on the benefits of district heating using biomass.***

9. ***Initiate a project under the Climate Change framework of the 2007-2013 EU Convergence Funds programme to support community energy schemes, including biomass district heating.***

WEBS

A Wood Energy Business Scheme ran from March 2004 to March 2008 and succeeded in its aim of establishing numerous small-to-medium-scale wood-fuelled installations across Wales in the Objective 1 and Objective 2 (Powys) areas. Up to 50% funding was available to applicants for the capital costs of purchasing and installing wood-fuelled boilers, and associated infrastructure.

Forestry Commission Wales is in the process of developing a successor programme - WEBS 2. This builds upon the experience and track record of WEBS 1 and is made up of 2 inter-related strands. The first strand seeks funding through EU Structural Funds (Convergence and Competitiveness) to support eligible private sector SME projects, and the second strand seeks Rural Development Plan (RDP) funds for eligible wood-fuel supply chain activities. The total gross value of the 2 strands would be circa £21 million to further develop the small-to-medium (up to 3MW) renewable wood heat and energy market. A decision on the provision of EU Structural Funds is expected shortly.

Hospitals and Government buildings

3.2.11 The Welsh Assembly Government, Welsh Health Estate and Local Authorities in Wales are undertaking biomass projects in their buildings in order to reduce greenhouse-gas CO_2 emissions from the use of fossil fuel and as demonstrations to other organisations of the benefits of biomass heating. Examples are:

- a biomass heating system of 1.2MW(th) installed at Llwynypia Hospital;
- the Senedd building of the National Assembly for Wales which is heated by a 360kW woodchip or pellet-burning boiler as well as a ground-source heat pump system;
- the Welsh Assembly Government's new offices in Aberystwyth and Llandudno Junction which will rely on biomass heating;
- installation by Forestry Commission Wales of wood-chip boilers at two visitor centres on the Assembly Woodland Estate; and
- Ceredigion Council's installation of a 450kW wood-chip heating scheme at Aberaeron which heats the Council offices, a school, sheltered housing and a retirement home. Powys County Council has a similar scheme at the secondary school in Llandrindod Wells.

3.2.12 In December 2008, the Minister for Finance and Public Service Delivery announced the First Tranche of 19 Strategic Capital Investment Funding projects. The Forestry Commission's Wood Energy for Schools and Hospitals initiative will be incorporated into some of the 19 projects, where appropriate.

We will:

10. Assess the feasibility of biomass heating for buildings throughout the Welsh Health Estate.

11. ***Work with LAs to assess feasibility of biomass heating in existing as well as new buildings.***

12. ***Investigate options for introducing biomass heating, where appropriate, into schools across Wales.***

Industry and businesses

3.2.13 Industry and commercial establishments (e.g. hotels, retail) could also benefit from the adoption of biomass space heating.

We will:

13. ***Develop, with Carbon Trust Wales, EST and industry groups, information packs on biomass space heating targeted at specific types of industry and business.***

3.2.14 Scenario for larger-scale space heating

The scenario on which this document's assessments are made assumes that, by 2020, the following biomass space-heating systems will be in operation:

- 10,000 additional domestic biomass boilers of 15kW(th)
- Bluestone at 2.5MW(th);
- 50 community heating schemes at an average of 0.5MW(th);
- 3 hospitals at an average of 1MW(th);
- 30 WAG and LA offices at about 0.3MW each;
- 300 schools at 0.2MW;
- 100 industries at 0.1MW; and
- 50 businesses at 0.05MW.

3.2.15 The implications of these assumptions regarding use of biomass for heating on the amount of energy generated, biomass needed and CO_2 emission reductions are shown below.

Bioenergy type	Heat energy TWh(th)	Clean wood* from UK sources odt/y	Energy crops t/y	Area of energy crop ha**	Total CO_2 saved c.f. gas heating	Total CO_2 saved t c.f. oil heating t/y
Heat from clean biomass ***	0.34	67k	1.2k	0.1k	65k	92k

* 'Clean wood' refers to roundwood from the forest, brash, sawmill co-product, arboricultural arisings.
** For Bluestone project, Pembrokeshire.
*** 'Clean biomass' refers to clean wood plus energy crops.

Note: The numbers shown in tables throughout the document should be considered as rough estimates only, but have been left in non-rounded form in order to facilitate comparison with spreadsheet calculations in Annex 1.

3.3 Generation of electricity and combined heat and power

3.3.1 Renewables Obligation Mechanism[13]
A key driver to the increase in the amount of electricity generated from biomass is the financial support offered under the Renewables Obligation Mechanism. The current UK Government proposals for the number of Renewables Obligation Certificates (ROCs) awarded for each MWh of electricity generated from renewables depends on the technology employed in the generation, as shown below:

Band	**Technologies**	**Level of support ROCs/MWh**
Established 1	Landfill gas	0.25
Established 2	Sewage gas, co-firing on non-energy crop (regular) biomass	0.5
Reference	Onshore wind; hydro-electric; co-firing of energy crops; EfW with combined heat and power; geopressure; co-firing biomass with CHP; standard gasification; standard pyrolysis	1.0
Post-Demonstration	Offshore wind; dedicated regular (not energy-crop) biomass; co-firing of energy crops with CHP	1.5
Emerging	Wave; tidal stream; advanced gasification; advanced pyrolysis; anaerobic digestion; dedicated energy crops; dedicated biomass with CHP; dedicated energy crops with CHP; solar photovoltaic; geothermal; tidal impoundment (e.g. tidal lagoons and tidal barrages <1GW).	2.0

3.3.2 The Welsh Assembly Government welcomes the UK Government's initiative to ensure that biomass used for generation of electricity comes from renewable sources. In particular, it supports Ofgem having the power to suspend the provision of ROCs to an operator of a power station pending provision of an acceptable annual report on the sustainability of the biomass they have used. This report must satisfy Ofgem regarding the origins of the biomass and whether it has been sourced under any existing codes of practice or accreditation schemes, e.g. the UK Woodland Assurance Standard and the Roundtable on Sustainable Palm Oil.

[13] See Renewables Obligation Order 2009 for more details: http://www.berr.gov.uk/files/file49197.pdf

Combined Heat and Power Plants using clean biomass

3.3.3 The Biomass Action Plan produced by the European Commission in December 2005 encouraged Member States to support combined heat and power systems so as to benefit from the double dividend of heat and electricity.[14]

3.3.4 The UK government has set a target of 10GW of Good Quality CHP by 2010, i.e. schemes that have been certified as meeting the energy efficiency criteria prescribed by the UK's CHP Quality Assurance Programme[15]. A proportional target for Wales, based on relative population, would be about 500MW.

3.3.5 From April 2009, it is proposed that dedicated biomass CHP plants will earn 2 ROCs per MWh(e). This should greatly increase interest in the technology.

3.3.6 Among the other support measures for CHP introduced by the UK government are:

- favourable allowance allocations under Phase II of the European Union Emission Trading Scheme;
- exemption from the Climate Change Levy;
- business rates exemption; and
- enhanced capital allowances for plant and equipment with plans to expand eligibility to support combustion capacity of solid fuel recovered from waste streams (SRF).

3.3.7 The amount of useful heat and electricity that can be generated from a Combined Heat and Power (CHP) plant can be over 80% of the energy contained in the fuel. However, the efficiency of electrical generation may be less than 20% in small-scale CHP units. Therefore, if it were not possible to use the heat generated at certain times or seasons, CHP plants would not be carbon-efficient.

3.3.8 CHP can prove to be very effective in industrial high heat-load applications, where most such plants currently operate, and also for mixed-use community-scale projects that include the provision of heat, and possibly cooling, to various buildings such as leisure centres, schools, homes and offices.

3.3.9 Energy losses due to voltage change and grid transmission can be minimised if the electricity generated by CHP schemes is used locally, but grid connections will be necessary to provide a market for generation exceeding local needs, and to provide a guarantee of supply. From a carbon saving perspective, CHP plants should be run so as to maximise the total energy recovered rather than to maximise income from electricity generation.

[14] COM(2005) 628 final; Biomass Action Plan, http://ec.europa.eu/energy/res/biomass_action_plan/doc/2005_12_07_comm_biomass_action_plan_en.pdf

[15] Quality Assurance for Combined Heat and Power; Defra; http://www.chpqa.com

3.3.10 Two main markets for the heat generated from CHP are envisaged: heat for industrial processes and heat mainly for homes - particularly new housing estates associated with a variety of buildings as mentioned above.

3.3.11 Welsh Power Group are proposing to develop a 49MW(e) CHP plant at Newport Docks. The company intends to use Welsh-grown energy crops for part of the fuel load and are understood to be considering various options for purchasing or growing these crops.

3.3.12 There are also proposals for CHP schemes between 1 and 2 MW(e) at Pembroke, Merthyr and at Cathays Park, Cardiff. In addition, consideration is being given to the development of a large CHP scheme to provide heat and power to buildings owned by the Welsh Assembly Government, Cardiff University and Cardiff County Council in the Cathays Park area of Cardiff. At least three other CHP schemes below 0.5MW(e) are planned.

3.3.13 Scenario for CHP developments

It is assumed that, by 2020, in addition to the plants identified in 3.3.11 and 3.3.12 there will be 2 CHP plants of 1MW(e) providing heating for residential properties, and 3 plants of 1MW(e) providing heat mainly for industries.

For the CHP plant at Newport Docks, it is assumed that 25% of the fuel needs will be met by energy crops from Wales or elsewhere in the UK.

3.3.14 The implications of the scenario's assumptions regarding CHP plants are shown below:

Bioenergy type	Electricity generated TWh(e)	Useful heat energy TWh(th)	Clean UK wood t/y	Energy crops t	Area of energy crop He	Total CO_2 saved t
CHP from clean UK biomass	0.41	0.86	271k	69kt	6k	340k

We will:

14. Provide a heat map for Wales to identify the opportunities for CHP in premises with large heat demands.

15. Promote CHP successes.

16. ***Work with Defra, EA Wales and Local Authorities on a scheme to ensure that anyone replacing a mid-sized furnace as part of a boiler plant (over 400kW) is aware of the potential for CHP.***

17. ***Develop, with Cardiff University and Cardiff CC, detailed plans for a CHP scheme for Cathays Park.***

Electricity generation without CHP

Clean biomass from UK sources

3.3.15 Dedicated regular (i.e. not energy-crop) biomass plants which are not CHP will receive 2 ROCs per MWh if they use energy crops, and 1.5 ROCs/MWh if they do not.

3.3.16 The degree to which operators use energy crops will depend on the price differential between them and other suitable biomass, and their availability. At present there are no known plans to use energy crops in biomass-only power stations (not CHP) in Wales but it is envisaged that, for future plants, the extra ROCs available will lead to operators using woody energy crops for 25% of their fuel needs.

3.3.17 Scenario for electricity generation from clean UK biomass

A 13.7MW(e) biomass station has been built at Port Talbot and there is also a proposal for a 10MW(e) plant at Bridgend (both using 100% clean wood).

It is envisaged in this scenario that, in addition to these, another 2 plants at about 15 MW, will be in operation by 2020 (using 75% clean wood and 25% energy crops of UK origin).

3.3.18 The implication for energy generation and biomass needs are as follows:

Bioenergy Type	Electricity generated TWh(e)	Clean wood t/y	Energy crops t/y	Area of energy crop He	Total CO_2 saved t/y
Elec. gen. from clean UK biomass	0.39	249k	39k	3k	167k

Electricity generation from imported biomass

3.3.19 Users of biomass for purposes other than electricity production have expressed concern over the development of large biomass power stations. They fear that the financial incentives available via ROCs mean that the station operators

would be able to outbid other customers for UK biomass. This would be less of a concern if the largest stations were to use only imported biomass.

3.3.20 Prenergy Power Limited has received permission from the Department for Business, Enterprise and Regulatory Reform to develop, in a disused area of Port Talbot Docks, a 350MW power plant running on imported biomass. The scale of this plant is such that the clean wood fuel required could not be provided from Welsh or other UK sources. This is not intended to be a CHP plant.

3.3.21 Scenario for electricity generation from imported biomass

It is assumed that, by 2020, there will be one 350MW power plant running solely on imported biomass.

3.3.22 The implications of the scenario are as follows:

Bioenergy Type	Electricity generated TWh(e)	Imported Clean wood odt	Total CO_2 saved t
Elec. gen. clean imported biomass	2.61	1,579k	1,121k

3.3.23 Other developers may wish to make use of deep water harbours in Wales to set up additional large power stations using imported biomass. It is not possible to estimate the amount of power output from such plants by 2020 but, provided they use imported biomass they should not have an effect on indigenous supplies. The following table can be used as a guide to the impact of such new power plants[16]:

Type of power plant	Peak electrical power MWh(e)	Electrical energy per year TWh(e)	Useful heat energy per year TWh(th)	Woody biomass needed odt/y	CO_2 savings compared with grid-mix and gas heating. tonnes/y
Electricity-only	50	0.35	0	210,000	150,000
CHP	50	0.35	0.7	280,000	280,000

[16] **Assumptions:** Electricity generating efficiency is 33% for electricity-only plants and 25% for CHP plants; 50% of total heat produced from biomass in CHP plant is useable in industry, homes etc; Load factor is 80%; Biomass has calorific value of 18MJ/kg; Emissions of CO_2 for mix of power station on grid is 430t per GWh; Emissions of CO_2 for heating with gas is 190t per GWh.

We will:

18. Work with the Department for Energy and Climate Change (DECC) to encourage developers of new biomass power stations to site them where there is a need for heat, and to make them combined heat and power plants.

Co-firing

3.3.24 From April 2009, coal power stations that use biomass for some of their fuel needs will be able to claim 1 Renewables Obligation Certificate for each megawatt-hour of electricity resulting from the burning of energy crops, or 0.5 ROCs per MWh from other regular biomass. It is likely that the power companies will try to maximise their use of energy crops but there is no requirement that these originate in the UK. It is possible that some, at least, of the energy crop fuel will come from countries such as Brazil where it can be grown more efficiently. However, the cost of importing energy crops is likely to increase as more countries, including those where the crops are grown, use them increasingly to produce biofuels.

3.3.25 Co-firing takes place at two coal power stations in Wales: the 1500 MW(e) plant at Aberthaw, with biomass being used for up to 5% of its fuel needs, and the 380MW(e) plant at Uskmouth which uses imported biomass for up to 10% of its fuel needs.

3.3.26 No specific actions are proposed to encourage co-firing since there are sufficient incentives through the Renewables Obligation Mechanism.

3.3.27 Scenario for co-firing

It is assumed that, in future, 40% of Aberthaw's biomass needs will come from Welsh wood fuel, since markets for this have already been established, and 60% from UK energy crops (probably grown outside Wales).

For Uskmouth, it is assumed that 100% of the biomass will continue to be imported.

3.3.28 The implications of the co-firing scenario are:

Bioenergy type	Electricity generated TWh(e)	Clean wood (UK sources) t	Imported Clean wood t	UK energy crops t	Area of UK energy crop He	Total t of CO_2 saved c.f. coal	Total t of CO_2 saved c.f. grid mix
Co-firing UK biomass	0.56	105k		158k	13k	396k	198k
Co-firing imported biomass	0.08		53k			72k	36k

3.4 Liquid biofuels for transport

3.4.1 Liquid biofuels – bioethanol and biodiesel – can replace fossil fuels used in transport or in the generation of heat and power. They can lead to reductions in the emission of greenhouse gases if the crops used to produce the biofuels absorb more carbon dioxide in the growing process than is emitted during planting, cultivating and harvesting the crop and producing the final fuel product.

3.4.2 The Renewable Transport Fuel Obligation (RTFO) places a legal obligation on transport fuel suppliers to supply 5% of all forecourt fuel from renewable energy sources by 2013-14. In addition, the European Union has agreed to set a binding minimum target, to be achieved by all Member States, for biofuels to contribute 10% of overall EU transport petrol and diesel consumption by 2020, subject to production being sustainable, second-generation biofuels being available, and successful amendments made to the fuel quality directive.

3.4.3 The Welsh Assembly Government has not made a commitment to support the production of biofuels from energy crops grown in Wales due to concerns about the potential for biofuel crops to displace food crops and the energy requirements for the production of biofuels.

3.4.4 In view of the EU and UK legislation requiring use of biofuels, the Assembly Government does not think further encouragement of demand is needed.

3.4.5 Scenario for biofuels

Biofuel use in Wales will be in accordance with UK and EU requirements.

3.5 Energy from waste biomass

Waste (contaminated) wood as fuel source

3.5.1 Electricity-generating stations based on waste wood contaminated with heavy metals or halogenated hydrocarbons have to meet the stringent requirements of waste incineration regulations. They will also qualify for 1.5 ROCs per MW(e) (2 ROC for CHP) as they are dedicated biomass plants, provided that the plant operators can provide evidence to Ofgem that the energy content of the fuel is more than 90% derived from biomass. They will also benefit from low cost source material, or even receive payment for accepting waste wood that would otherwise have to go to landfill.

3.5.2 The contamination precludes the wood from being recycled so most of it is currently disposed of in landfill. Recovery of the energy from the wood is far preferable provided it can be done in compliance with waste incineration regulations.

3.5.3 There is an operating CHP plant at Shotton with an electricity output of 20MW and heat output about 40 MW(th). The fuel is a combination of waste from the

Shotton paper mills (about 100k t/yr with calorific value about 3MJ/kg) and moist waste wood (about 250k t/yr with a calorific value of about 9MJ/Kg). The equivalent fuel input in odt (at 18MJ/kg) is assessed to be about 140k t/yr.

3.5.4 There are proposals by Express Power to build a 23MW biomass plant (possibly CHP), able to take waste wood, at Rassau, South Wales[17].

3.5.5 Scenario for use of contaminated wood for power generation

It is assumed that, in addition to the Shotton CHP plant and the Express Power plant, there will be one additional plant using contaminated wood with a peak power output of 20 MW(e).

3.5.6 The implications for electricity and heat generation, and biomass needs are as follows:

Bioenergy type	Electricity generated TWh(e)	Useful heat energy TWh(th)	Possibly contaminated biomass t/y	Total CO_2 saved t *
CHP	0.17	0.34	137k	139k
Electricity only	0.3		208k	130k

* This total does not include the benefit of any reduction in methane from anaerobic decay of the waste wood.

Energy from municipal, commercial and industrial waste

3.5.7 There are a number of incentives for obtaining energy from waste material:

- landfill costs are increasing (landfill tax is to rise to £48/t for biodegradable waste by 2010-2011 financial year; tighter standards to be imposed; and requirements introduced for pre-treatment before disposal);
- Local Authorities have to meet landfill diversion targets;
- the total amount of landfill capacity in Wales is reducing rapidly; and
- there is a drive for resource efficiency.

3.5.8 However, the public is often wary of energy from waste schemes and will need to be reassured that they are safe, well-monitored, and that regulations are being complied with.

[17] http://www.express-energy.com/power/

We will:

19. Work with LAs to engage with communities to explain the benefits of EfW.

20. Ensure appropriate air-quality monitoring around EfW facilities to demonstrate compliance with regulations.

21. Encourage applications for EU Convergence Funds to support establishment of additional EfW generating plant.

3.5.9 Scenario for EfW

The scenario assumes that, by 2020, there will be 5 EfW CHP plants each generating 10MW(e) and providing heat to industries. It also assumes there will be 3 EfW electricity-only plants, each generating 10MW(e).

3.5.10 The implications are:

Bioenergy Type	Electricity generated TWh(e)	Useful heat energy	Municipal-type waste	Total CO_2 saved t *
Efw with CHP	0.37	0.85	554k	321k
Efw with no CHP	0.22		292k	96k

* This total does not include benefit of any reduction in methane that would have been produced if the waste had decayed anaerobically.

Anaerobic Digestion

3.5.11 Anaerobic digestion (AD) is the breakdown of organic matter by bacteria in the absence of oxygen to produce a biogas which is a mixture of about 60% methane and 40% carbon dioxide. This can be used to generate heat and power or as a transport fuel. The residual liquor can be used a liquid fertiliser, and the residual fibrous material as a soil conditioner.

AD of bio-waste

3.5.12 “Bio-waste” means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food-processing plants.

3.5.13 The European Council has recently adopted the revised Waste Framework Directive (WFD) which includes a number of important policies and targets, including Article 22 on bio-waste. This states:

- Member States shall take measures, as appropriate … to encourage:

(a) the separate collection of bio-waste with a view to the composting and digestion of bio-waste;

(b) the treatment of bio-waste in a way that fulfils a high level of environmental protection; and

(c) the use of environmentally-safe materials produced from bio-waste.

3.5.14 The Welsh Assembly Government will provide funding over the next three years for local authorities to set up new services to separately collect and treat food waste from households in Wales. £2M for procurement support will be provided each year from 2009-10 to 2011-12, and an additional £20M in the third year for capital support.

3.5.15 AD is also being promoted for biodegradable waste from commercial and industrial sources such as food and drink manufacture and catering, with the Assembly Government providing funding to the Waste and Resources Action Programme (WRAP) to run an Anaerobic Digestion Capital Grant Competition.

3.5.16 To arrive at an estimate of what AD of bio-waste could contribute to renewable energy generation, the scenario for this action plan assumes there will be the equivalent of 20 AD plants, each of 0.5 MW output, by 2020 with a total bio-waste input of 300,000 tonnes per year. The actual number and size of the AD plant needed will be the subject of investigation by the Welsh Assembly Government and Local Authorities.

AD of agricultural wastes

3.5.17 Agriculture in Wales emits 1.64 Mt Carbon out of the total Welsh emissions of 13.55 Mt Carbon. The agricultural component is divided into:

- 0.13 Mt Carbon as carbon dioxide;
- 0.76 Mt Carbon as methane; and
- 0.74 Mt Carbon as nitrous oxide.

3.5.18 AD process has potential benefits in reducing methane emissions from manure storage and spreading, and substituting for fossil fuels in energy production[18]. Other benefits of AD are:

- the reduction of pathogens and faecal indicator organisms which can pollute water courses;
- stabilisation of organic matter, reducing chemical and biological oxygen demand in water courses;
- increased availability of nutrients by converting less available organic nitrogen to ammoniacal nitrogen;

[18] AEA Technology Assessment of methane management and recovery options for livestock manures and slurries December 2005.

- conservation of fertiliser nutrients (N, P and K) from the raw manure, reducing the need for artificial fertiliser use and associated emissions from manufacture; and
- better infiltration/incorporation of manure into soil, reducing leaching and run-off.

3.5.19 Defra has examined AD plants in two categories:

a. On-Farm AD plants (OFADs).
   A Defra study of two units showed that they had poor efficiency, poor temperature control, and high leakage rates. The main reasons for poor uptake of on-farm AD units were the poor economic return due to high capital costs with little or no income to cover costs, and technical problems compounded by lack of operational knowledge and poor availability of technical support. Mechanical problems were common, often resulting from the corrosive sulphide gases in biogas.

b. Larger Centralised AD (CADs) facilities that supplement farm manure and slurry with imported feedstock.
   Blending of manure/slurry with other organic wastes enhances biogas yields and operational efficiency since food wastes tend to have greater biogas yield potential than farm slurry.

3.5.20 A CAD plant that utilises farm slurry will typically have additional waste offloading, reception and storage facilities, plus blending and pasteurisation equipment. CADs have major operational advantages over OFADs due to:

- economies of scale;
- access to a more continuous supply of feedstock via blending. (The problem with farm slurry is that it is less available in summer when livestock are outdoors, although some intensive pig systems have animals housed throughout the year.);
- better opportunities to use specially-trained personnel;
- ability to blend manure with other waste to improve gas yield;
- receipt of gate fees for accepting waste that may otherwise be subject to landfill tax e.g. biodegradable municipal waste, food waste; and
- scope for commercial exploitation of gas and heat generated by the AD process.

3.5.21 The viability of AD schemes of different sizes is assisted by the proposed provision of 2 ROCs per MWh for electricity generated using this “emerging technology” (see 3.3.1).

3.5.22 There is a proposal to develop a centralised anaerobic digestion (CAD) plant in Pembrokeshire, with a generating capacity of about 1MW(e) peak. The organic material will come from a large dairy farm and a cheese processor. It is assumed that it will be a CHP plant.

3.5.23 The scenario envisions a second plant, of similar size, possibly in the dairy-farming area of north-east Wales.

AD of Sewage

3.5.24 There are also opportunities to reduce methane emissions, and generate energy, from AD at sewage treatment works. At present Dŵr Cymru/Welsh Water operates 13 AD units using sewage sludge with a total power output of 2.9MW(e).

3.5.25 The company has plans to introduce four Enhanced AD units each with a peak power output of about 1.3MW(e), bringing the company's total generating capacity to 8.2MW(e) and 15 MW(th) of useful heat. Approximately 6MW(th) of this useful heat will be utilised to sustain the Advanced AD process leaving about 9MW(th) available for other use[19].

We will:

22. Provide funding over the next three years for local authorities to set up new services to separately collect and treat food waste from households in Wales.

23. Provide financial support to winners of a competition to establish AD plants (subject to planning permission); use as exemplars to encourage AD development across Wales.

24. Work with farmers' unions to increase awareness by farmers of benefits of AD.

25. Keep abreast of developments involving fuel cells linked with AD units and consider potential applications in Wales.

3.5.26 Scenario for Anaerobic Digestion

The scenario assumes that, by 2020, there will be:

- twenty municipal Anaerobic Digestion facilities using bio-waste to generate a total of10MW(e) of electricity and 14 MW(th) of useful heat;
- two large Central Anaerobic Digestion facilities, generating a total of 2MW of electricity plus 3MW of useful heat; and
- DC/WW will be operating AD plant using sewage sludge to generate about 8MW of electricity and 15 MW of useful heat.

[19] Correspondence with Dŵr Cymru/Welsh Water 3 October 08.

3.5.27 Implications:

Bioenergy Type	Electricity generated TWh(e)	Heat energy generated TWh(th)	Bio-waste, agricultural waste & sewage sludge t	Total CO_2 saved t *
AD from bio-waste	0.07	0.10	339k	107k
CAD	0.01	0.02	229k	16k
AD from sewage	0.06	0.10	93k	74k

* This total includes an assessment of the amount of CO_2–equivalent savings from a reduction in the methane that would have been released from the agricultural waste and sewage in the absence of an AD plant (assuming 10% of the sludge etc. would have decayed anaerobically).

4. Summary of Anticipated Demand for Heat and Power Generation and Biomass Requirements

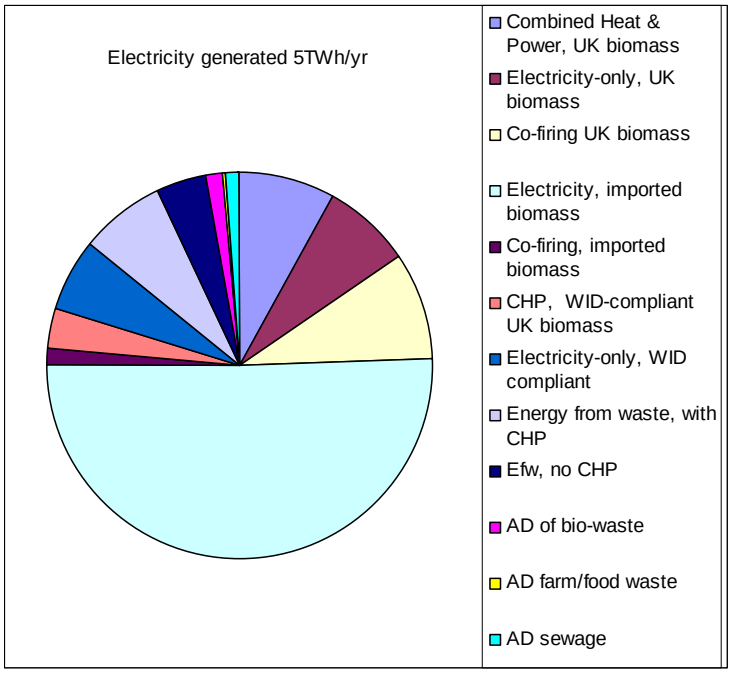
4.1 The following table shows the potential heat and power generation based on the assumptions made in this document for the uptake of different bioenergy technologies. It also shows the quantities of biomass of different types needed and the carbon dioxide saving from its use compared with use of fossil fuels.

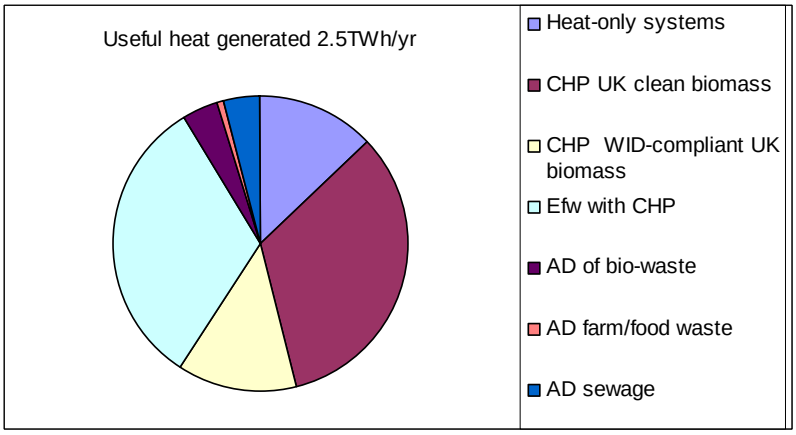
Bioenergy type	Electricity generation TWh(e)/y	Useful heat energy TWh(th)	CHP heat energy rating MW(th)	Clean wood (UK) kt	Imported clean biomass kt	Waste wood kt	UK energy crops kt	Area UK energy crop Ha	Municipal-type waste t	Farm waste/ sewage sludge kt	Total CO_2 saved kt
Heat: UK biomass (UKb)		0.34		67			1.2	0.1			65
CHP: UKb	0.41	0.86	251	271			69	6			340
Electricity-only: UKb	0.39			249			39	3			167
Co-firing: UKb	0.46			105			158	13			396
Electricity imported b	2.61				1,579						1,121
Co-firing: imported b	0.08				53						72
CHP poss. contam. b	0.17	0.34	80			137					139
Electricity poss. contam. b	0.30					208					130
Efw with CHP	0.37	0.85	227						554		321
Efw no CHP	0.22								292		96
AD of bio-waste	0.07	0.10	29							339	107
AD centralised (farm & food waste)	0.01	0.02	6							229	16
AD sewage	0.06	0.10	29							93	74
TOTALS	**5.2**	**2.6**	**622**	**691**	**1,632**	**345**	**266**	**22**	**846**	**661**	**3,041**

Biomass types needed for heat and power generation shown in above table

Row number	Biomass
1-4	Non-contaminated biomass sourced in the UK
5-6	Non-contaminated biomass imported
7-8	Possibly-contaminated biomass subject to waste incineration regulations
9-10	Municipal-type waste material, after recycling & recovery
11-12	Farm and food waste plus slurry and sewage

4.2 The data in the above table can be represented diagrammatically as follows:





Analysis of estimates of bioenergy demand

4.3 Current electricity generation in Wales is about 35TWh/yr of which about 24 TWh/y is consumed in Wales. Hence the 5 TWh from new biomass projects would be about 14% of current generation, and about 21% of our current use. Of the 5TWh/y envisaged, about 2.4 TWh/yr would be generated from biomass produced in Wales or other parts of the UK, and 2.6TWh/yrs from imported biomass.

4.4 Current heat demand in Wales is 76TWh/yr. The 2.5TWh (thermal)/y envisaged from direct heat and from CHP would meet about 3% of our needs.

4.5 The total amount of good-quality CHP envisaged is about 593MW(th) peak rating, comprising: 251MW from plants using clean biomass, 80MW from potentially-contaminated biomass, 227MW from municipal-type waste and 35MW from AD. The 2010 target set by the UK government is 10GW (see section 3.3.5) which, on a population pro-rata basis would mean about 500MW(th) for Wales. Actions to increase the number of CHP plants in Wales, preferably feeding heat to industry, are proposed in this action plan (Actions 14 to 17).

Biomass requirements

4.6 To meet the biomass needs of the bioenergy scenario discussed above, we would need the following quantities from UK sources:

- 692,000 odt of clean wood or non-contaminated waste wood;
- 345,000 odt of waste wood which may be contaminated (i.e. requires that the plant complies with waste incineration regulations);
- 267,000 odt of UK energy crop for heat and power;
- 846,000 tonnes of municipal-type waste;
- 210,000 tonnes farm slurry;
- 340,000 tonnes of food waste and other bio-waste; and
- 93,000 tonnes of sewage sludge.

4.7 In addition, we would need about 1,600,000 odt of imported clean wood from sustainable sources*. The mass of the actual moist wood imported could be over 2,500,000 tonnes.
(* Defra is considering international sustainability standards and is proposing that plant operators provide Ofgem with statements to verify that the biomass has been sourced sustainably.)

4.8 A number of proposed and anticipated projects will be WID-compliant; that is, compliant with regulations consistent with the Waste Incineration Directive (2000). Their requirement for about 345,000 odt of waste wood may be easier to meet because they will be able to use material which is potentially contaminated with heavy metals or halogenated compounds and, therefore, unsuitable for most non-energy purposes.

4.9 If 2.5% of the transport fuel used annually in Wales were to be supplied from energy crops, an additional 150,000 tonnes of UK energy crop would be needed (see section 5.3).

5. Biomass Resources

5.1 Wood fuel

5.1.1 From the Forestry Research website, the yields for timber production in Wales are predicted for the next 5 years[20] to be about 375,000 odt from Forestry Commission sites, and about 460,000 odt from private woodland, giving a total of about 835,000 odt. There are many different markets for this timber, with which fuel use competes (see Annex 5).

5.1.2 Current potential operationally-available woodfuel resources in Wales are as follows[21]:

Product	Quantity available in **absence** of competing markets [thousand odt/yr]	Quantity available in **presence** of competing markets [thousand odt/yr]
Stemwood 7-14cm diameter	128	13
Poor quality stemwood	70	70
Stem tips	5	5
Branches	68	68
Sawmill conversion products	166	17
Arboricultural arisings	14	10
Short rotation coppice	0.2	0.2
Totals	**451**	**183**

5.1.3 Ways of meeting at least some of the shortfall of about 510,000 odt a year (692k-183k) are:

- improved harvesting of forests and woodland;
- increased use of biomass from arboricultural activities;
- growth of energy crops suitable for heat and power generation;
- use of clean wood sustainably sourced from other parts of the UK;
- use of imported wood; and
- use of non-contaminated waste wood.

5.1.4 To harvest an extra 100,000 odt/yr would require 20,000 hectares of new high-yielding woodland. Should the revised Woodland Strategy for Wales seek to convert some of the coniferous woodland area to native species, the productive potential of the woodland area would be reduced since conifer tends to yield about 12 green tonne/ha per year whilst broadleaf achieves 4 green tonne/ha per year. However these changes are necessary to deliver other objectives including woodland resilience to climate change and would occur over a long period of time.

[20] www.forestry.gov.uk/woodfuel/FWDOCGEN
[21] Woodfuel resource in Britain: H Mackay (2003). Final report B/W3/00787/REP, URN03/1436

Woodland management choices are a much bigger determinant of overall timber and fibre yield than individual species productivity. Therefore, any effects could be mitigated through enhanced management of more Welsh woodland, as well as the creation of new mixed, multiple-objective woodland containing a proportion of high-yielding species. In addition, much higher yields can be obtained when growing conifers and broadleaf species as Short Rotation Forestry crops, within a sustainable forest management system i.e. at a site level, single-purpose objectives can be part of a wider management approach[22].

5.1.5 It must also be recognised that some of the non-stem biomass cannot be recovered because of the need to retain nutrients in forests and woodlands, and some branches must be used as ground cover to reduce damage by tractors. In addition, smaller woodland sites can have poor access thereby limiting the amount of biomass that can be brought to market.

We will:

26. Factor in the potential for woodfuel when considering the balance of use of the National Forest in the revision of the Wales Woodland Strategy and the use of the Assembly Woodland Estate through the next Forestry Commission Wales (FCW) Corporate Plan.

27. Encourage private woodland owners to harvest woodland sustainably; e.g. through FCW's Better Woodlands for Wales grant scheme.

28. Work with FCW and educational bodies to develop plans to overcome skills shortage in forest management.

29. Consider grant support for woodland and energy crops as part of the review of land management schemes under Axis 2 of the Rural Development Plan.

30. Work with LAs to identify expected annual arboricultural arising and consider options for use as fuel.

5.2 Energy crops for heat and power generation

Current production

5.2.1 About 1,200 oven-dried tonnes of Miscanthus is currently grown on about 100 hectares in Pembrokeshire. This is used to provide 50% of the heat energy for the Bluestone project.

[22] Forestry Commission communication.

Potential for growth of energy crops

5.2.2 Husbandry trials in Wales on Short Rotation Coppice (SRC) willow and Miscanthus have been undertaken and have shown these to be viable energy crops for electricity and heat production. Other energy grasses such as Switchgrass and Prairie Cordgrass have not been fully tested although they should not be ruled out. To date, 97ha of Miscanthus, 34ha of SRC willow and 12ha of Reed Canary Grass have been grown in Wales.

5.2.3 If the anticipated shortfall of 510,000 odt of biomass needs, identified in 5.1.3, were to be met from energy crops grown in Wales, this would amount to around 42,000-51,000 ha of land (if yield is in the range10-12 odt/ha).

Land availability

5.2.4 The Welsh Assembly Government carried out a detailed analysis to identify how much farmland in Wales is agronomically capable and environmentally suitable for growing energy crops. After excluding land with unsuitable soils, steep slopes and environmental designations, the study identified approximately 600,000 hectares that could grow these crops. However, competing demands for livestock and other crops mean that only a small proportion of this total is ever likely to be used for energy crops.

5.2.5 The analysis indicated that the crop is capable of being grown extensively across Wales and that there is considerable potential for its use in local energy production. It is likely to be more attractive to farmers in areas with moderate/poorer quality farmland (Grades 3b and Grade 4 in the MAFF Agricultural Land Classification system) as much of this land is unsuitable for higher-value arable crops.

5.2.6 In theory, there is sufficient potential land to grow feedstock for the forecasted bioenergy needs in Wales. However, it will be important to consider the competing demands for land – particularly in the context of climate change and its impact on food resources.

5.2.7 Uncertainty still surrounds the commitment of large power stations to source local biomass feedstocks. If substantial amounts are obtained from international resources, this will act as a depressant on local prices paid.

5.2.8 The amount of energy crops that might be obtained from Wales depends on whether Welsh farmers will feel confident that there is a long-term market for any energy crops they grow. It also depends on the viability of growing energy crops in comparison to other crops that could be grown on the same land.

Research on energy crops

5.2.9 In spite of the uncertainties, the Welsh Assembly Government considers it important for Welsh organisations to be involved in appropriate research on energy crops. The following are among the initiatives which have been, or are being, undertaken in Wales:

Project	Lead researchers
Willow for Wales	Collaboration of IGER, Welsh businesses and universities
Ryegrass as an energy crop	IBERS/Greenfinch
Growth of marine biomass as an energy crop	Bangor University
The genetic improvement of Miscanthus for biomass	IBERS
Energy crops in the Atlantic space (ECAS)	IBERS
Salix project	Wales Biomass Centre, Cardiff University
Alternative Crops for Renewable Energy (ACRE)	Wales Biomass Centre, Cardiff University
Hydrogen from biomass	University of Glamorgan
Hydrogen from farm waste (Intereg project)	Carmarthenshire Energy Agency

We will:

31. Consider the scope for introducing planting grants for woody energy crops as part of the review of land management schemes under Axis 2 of the Rural Development Plan.

32. Maintain awareness of competing demands for energy crops and food supply nationally and internationally to help ensure that Welsh Assembly Government policies are based on sustainable development principles.

33. Provide advice and guidance to farmers who wish to grow woody energy crops, e.g. through Farming Connect.

34. Support the use of Structural Funds for a programme on the development of sustainable biomass and bioenergy applications.

5.3 Liquid biofuels

Production of biofuels

5.3.1 The Welsh Assembly Government's position on liquid biofuels is one of caution. It is concerned about the potential for biofuels crops to displace food crops and the high energy requirements for the production of biofuels.

5.3.2 The favoured crop in the UK for the production of biodiesel is oilseed rape, though other vegetable oils, waste cooking oil and animal fats can be used to produce biodiesel through a transesterification process. Oilseed rape oil can also be used as a transport fuel with little processing, but engine modification is recommended prior to use.

5.3.3 Bioethanol is produced by fermentation of grains (wheat etc.) and other materials. It can require a considerable amount of energy to produce thereby limiting the amount of carbon dioxide saving compared with use of petrol. In the future, it is likely that the cost of making bioethanol from ligno-cellulosic perennial energy crops (second-generation fuels) or in conjunction with renewable chemicals substituting for petrochemicals (the biorefinery concept) will be less, making bioethanol production more efficient.

Biodiesel from oilseed rape

5.3.4 It is anticipated that most biofuels used in Wales will be imported or produced from energy crops grown elsewhere.

Biodiesel from animal fats and used cooking oil

5.3.5 The Environment Agency has produced, with the Waste and Resources Action Programme (WRAP), a Quality Protocol for waste vegetable oil, intended to facilitate its use. An EA news release in October 2007 stated that the Protocol will "save businesses the time and costs associated with meeting waste regulations", and:

"In deregulating biodiesel made from waste vegetable oil, the product can better compete with biodiesel derived from virgin oil. This will also increase the volume of waste vegetable oil recovered from places like takeaways, restaurants, chip shops and food manufacturing sites. It should also reduce the amount disposed to sewer with all the benefits that will bring to the water industry."

Biodiesel from oil-bearing algae

5.3.6 It is possible to cultivate oil-bearing algae in nutrient-rich water with added carbon dioxide and a good source of light. An oil can be extracted through pressing or by chemical processes and this can converted to biodiesel through a transesterification process. The process works well on a laboratory scale, but it is not yet commercially viable on a large scale.

Bioethanol

5.3.7 There are no current plans to produce bioethanol on a large scale in Wales.

5.3.8 Scenario for Transport Fuel Production

It is considered unlikely that the Welsh Assembly Government will provide financial support for the planting of energy crops for the production of transport fuel other than through the Aid for Energy Scheme.

There may be private initiatives to set up biofuel production plants in Wales, using energy crops from Wales, elsewhere in the UK and from overseas but it is not possible at this time to estimate the total amount of energy crops for transport that might be grown in Wales.

We will:

35. ***Support use of used cooking oil for biodiesel production.***

36. ***Support the technical development of biofuels from non-food sources.***

Biofuels potential in Wales

The Welsh Assembly Government has no plans to support the planting of energy crops for the production of transport fuel. However, the UK biomass strategy envisages that, by 2010, 5% of the transport fuel used in the UK will be biofuels of which half (2.5% of total) will be imported and half home-produced. It assumes that roughly half of the biofuel will be biodiesel and half bioethanol.

The following assessment of the potential production is included in order to demonstrate the theoretical impact on land-use in Wales of meeting 2.5% of our fuel needs from wheat and oilseed rape.

Assuming that use of transport fuel in Wales is about 5% of that in the UK, it is estimated (from figures in 'UK Energy in Brief', BERR July 07) that about 1 million tonnes of diesel and about 900,000 tonnes of petrol was used in Wales in 2006. If 2.5% of this was to come from energy crops we would need to produce 25,000t of biodiesel and 22,500 tonnes of bioethanol (see 5.3.5).

	UK consumption million tonnes * (2006)	Wales estimated consumption (5% on pro-rata by population) tonnes	Biofuel from Welsh feedstock to meet half of 5% RTFO requirement t	Biofuel yield (t/ha)**	Crop hectares needed
Petrol	18.144	900,000	22,500	2.3	9,800 ha Wheat (~80kt of crop)
Derv	20.146	1,000,000	25,000	1.08	23,200 ha Oilseed rape (~70kt of crop)

* UK Energy in Brief, July 07 - Dept for Business, Enterprise and Regulatory Reform, National Statistics Publications
**http://www.defra.gov.uk/farm/crops/industrial/research/reports/biofuels_industry.pdf

Welsh production in 2006 was 15,524 ha of wheat and 2,614 ha oilseed rape. It can be seen from the above that the existing wheat area would meet the 2.5% RTFO scenario in the unlikely event that most home grown wheat was used for this purpose. However, there would need to be an increase of about 8 fold in the area of oilseed rape.

In 2006, there were around 163,600 ha of arable land in Wales. Of this, around 64,000 ha was classed a "tillage" with the remainder under temporary grassland. Therefore, there is in theory sufficient land in Wales currently under tillage to meet biofuel targets. The situation in practice will, of course, be influenced by the market prices for food and livestock feed.

The first cold press oilseed rape plant in Wales was opened in June 2008. The plant, which is located at Llanfihangel Glyn Myfyr, Conwy, and owned by BML Bio-fuels Ltd, is expected to produce about 1.3M litres per year of pure vegetable oil which can be used as a transport fuel after conversion of the vehicle. The company aims to source the 4,000 t of rape seed required annually from local farmers in North Wales, but some may come from elsewhere in the UK.

5.4 Waste biomass for heat and power generation

Waste wood

5.4.1 WRAP estimates of waste wood in Wales are as follows[23]:

Wood (not furniture) in MSW:	29,000 t
Furniture in MSW:	18,000 t
Wood in commercial and industrial waste streams:	225,000 t*
Wood in construction and demolition waste streams:	290,000 t
Total:	562,000 t

*Assuming arisings in Wales to be 5% of that in UK.

5.4.2 The amount of this waste that may be available for use as clean fuel is unknown, but WRAP estimate that, for the UK as a whole, there is 3Mt of waste wood that could be used in plant that do not meet the requirements of waste incineration regulations. If Welsh arisings were at 5% of the UK total, the amount available for use as clean fuel in Wales total would be 150,000 tonnes.

5.4.3 Subtracting the 150,000 t of clean wood fuel from the 562,000 t of total waste wood (5.4.1) indicates there are 412,000 tonnes available for use in plants that comply with waste incineration regulations.

5.4.4 Scenario for waste wood resource

> It is assumed there will be, on average, 150,000 tonnes of clean wood recoverable from waste streams in Wales, and 412,000 t of possibly contaminated wood. The latter material can only be used in plant complying with waste incineration regulations.

We will:

37. Work with LAs, building industry and other generators of waste wood on ways to minimise contamination of wood and to segregate it from other waste streams to improve ease of collection.

[23] "Reference document on the status of wood waste arisings and management in the UK" The Waste & Resources Action Programme, June 2005

Municipal, commercial and industrial waste

5.4.5 Municipal waste

Around 69% of municipal waste, excluding construction and demolition wastes, is combustible. This figure drops to 65% if construction and demolition wastes are included[24]. Total municipal waste arisings for 2005-6, excluding abandoned vehicles, was around 1.9 million tonnes in Wales. Making an assumption that 30% is available for combustion processes, and that waste growth per annum is around 2% for municipal solid waste (MSW), the total MSW for 2009-2010 is predicted to be around 2 million tonnes, of which about 0.6 million tonnes per annum could be diverted to EfW without compromising other initiatives. However, this figure could change as a consequence of future recycling requirements.

5.4.6 Commercial and Industrial waste

The amount of industrial and commercial wastes produced each year in Wales is about 5.28 million tonnes[25]. Of this, 2.43 million tonnes are mineral wastes and 2.2 million tonnes of the remaining 2.85Mt is reused, recycled, composted or incinerated. This leaves 0.65 Mt which is currently landfilled or used for land recovery. It is assumed that 70% of this, i.e. 0.45M tonnes per year could be made available for energy production.

5.4.7 Hence, the available mass of combustible municipal and commercial/industrial waste is:

Source	**Total tonnes/y**	**Combustible content tonnes/y**
Municipal solid waste	2,000,000	600,000
Commercial/industrial waste (excluding mineral waste)	2,850,000	450,000

5.4.8 Scenario for municipal, commercial and industrial waste

The scenario envisages the use of about 850,000 tonnes per year of municipal-type waste for energy generation by 2020, i.e. about 80% of the potentially available combustible component of waste.

Food waste

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

[24] AEA compositional analysis of Welsh municipal waste arisings.

[25] Estimates by ESRC Centre for Business Relationships, Accountability, Sustainability and Society (BRASS) at Cardiff University, and Environment Agency Wales 2003 Commercial and Industrial Waste Survey.

5.4.8 Scenario for food waste

This action plan envisages about 340,000 tonnes of food waste mainly from municipal waste streams being used to generate heat and power in 20 AD facilities with an average peak electrical power output of 0.5MW.

Note: This scenario may be conservative when the amount of waste from food processing companies is taken into account, but some of this is expected to be used in agricultural AD facilities along with farm waste (see below).

Agricultural wastes

5.4.11 Current arisings in Wales of animal wastes, including manures, slurries and effluent (which are not legally 'waste') are about 6 million tonnes a year, but most of this is not readily recoverable.

5.4.12 Local Authorities have plans to collect waste food separately from other wastes. This can then be used along with agricultural waste and slurries in centralised anaerobic digestion units.

5.4.13 Scenario for agricultural wastes

This action plan envisages about 250,000 tonnes of agricultural slurry and food wastes being used for AD in two centralised facilities.

Sewage sludge

5.4.14 Dŵr Cymru/Welsh Water staff estimate that there will be over 100,000 tonnes of dry sewage sludge available annually for generation of energy through anaerobic digestion.

5.4.15 Scenario for sewage sludge

It is assumed that about 37,000 tonnes of sewage sludge (total solids) will continue to be used in the existing AD units and a further 56,000 tonnes will be used in new Advanced AD units. All these units will be CHP plants.

We will:

38. Support LA initiatives to segregate non-recyclable residuals of MSW for use in EfW facilities, and to segregate food waste and other organic fraction of MSW to create additional fuel for AD schemes.

5.5 Comparison of biomass requirements and resources

5.5.1 UK wood biomass for heat and power:

Biomass type	Amount required k odt	Amount currently available from sources in Wales k odt	Amount needed from elsewhere in the UK k odt
Clean wood fuel	692	183	359
Non-contaminated waste wood		150	
Waste wood which may be contaminated	345	412	0
Energy crops for heat and power	267	1	266

5.5.2 Imported biomass for designated large power stations:
Imports for the proposed Prenergy plant, and for Uskmouth co-firing will be the equivalent of 1,630,000 oven-dried tonnes. The actual mass of moist wood could be twice this. It is not anticipated that Welsh biomass will be used for the Prenergy or Uskmouth plants.

5.5.3 Municipal waste for heat and power, post recycling:
The scenario envisioned in this document would require about 850,000 odt of municipal waste. There is about 1,050,000 t currently available.

5.5.4 Anaerobic digestion, using farm waste, food waste and sewage sludge:
The twenty anaerobic digestion (AD) facilities envisioned for municipal food waste would require about 300,000 tonnes of food waste. This quantity is consistent with policy initiatives on municipal waste management.
Additional AD facilities to deal with waste from food-processing companies.

The two centralised anaerobic digestion (CAD) plants envisioned would require about 250,000 t per year of moist organic material. This could constitute different kinds of animal slurry plus food waste arising from food processors or municipal collection. Several million tonnes of slurry are theoretically available, but the practical difficulties associated with its collection and transport means that the initial CAD plants are likely to be associated with large dairy farms, or groups of farms in close proximity.

Plans of Dŵr Cymru/Welsh Water for AD from sewage sludge will require about 93,000 of solid sludge, which is less than the total available.

6. Employment Prospects

Estimates of the number of direct jobs which could be created by the different schemes discussed in this document are shown in the following table. More information is presented in Annex 6.

	Large heat system	CHP clean biomass @ 1MW	CHP clean biomass @ 2MW	CHP 20MW+ plants	Electricity Clean Biomass	Electricity Imported wood fuel	Electricity waste wood	EfW No CHP	EfW with CHP	AD	Forest residue collection
No. of units or MW	267MW	6 units	5 units	2 units	6 units	1	2	3	5	40	100k odt
Conver-sion factor	0.2 jobs/ MW	2 jobs/ Unit	5 jobs/ unit	48 jobs/ unit *	48 jobs/ Unit*	Ref[26]	40 jobs/ Unit	20/ unit	20/ unit	4/ unit	2 jobs per 10kt
Jobs	**53**	**12**	**25**	**96**	**288**	**150**	**80**	**60**	**100**	**160**	**20**

* 15 on site, 17 transport, 16 forestry

The 1,000, or so, jobs created would be increased if products such as boilers were to be manufactured in Wales.

These employment prospects tie in with a broader Green Jobs Strategy which is being developed by the Welsh Assembly Government[27]. This will be the Welsh Assembly Government's framework for actions to enable businesses and organisations in Wales both to improve their own environmental performance and also to take advantage of business opportunities that arise as our society moves towards more resource efficient climate-conscious living and working.

7. Next steps

Comments are invited on the proposals set out in this consultation document, especially on the list of actions intended to energise the bioenergy sector.

The consultation will run from 28 February to 23 May. Input from consultees will be built into a final version of the action plan for publication in 2009. The final bioenergy action plan for Wales will be monitored by a group of specialist in various related disciplines to ensure that rapid progress is made on its implementation.

[26] http://www.prenergypower.com/employment.html
[27] Green Jobs for Wales – a consultation, http://new.wales.gov.uk/consultation/det/2008/buseconomy/greenjobs/consultationen.pdf?lang=en

Glossary

AD	Anaerobic Digestion
BERR	Department for Business, Enterprise and Regulatory Reform
Bio-waste	Biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food-processing plants
CHP	Combined Heat and Power
Clean biomass	Biomass which is not contaminated with heavy metals or halogenated hydrocarbons. Includes clean wood and other non-liquid organic materials.
Clean wood	Roundwood from the forest, brash, sawmill co-product, arboricultural arisings
Contaminated waste wood	Wood that may be contaminated with heavy metals or halogenated hydrocarbons. Plants using this material have to meet the stringent requirements of waste incineration regulations.
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EfW	Energy from waste
EST	Energy Saving Trust
FCW	Forestry Commission Wales
IGER	Institute of Grassland and Environmental Research
IBER	Institute of Biological, Environmental and Rural Sciences
Imported biomass	Clean wood and other organic materials, like olive stones
LA	Local Authority
MSW	Municipal solid waste

odt	Oven-dry tonnes. The mass of biomass when all the moisture extracted. In practical situations at least 30% moisture is common.
RDP	Rural Development Plan
Regular Biomass	Biomass which is not from energy crops
ROC	Renewables Obligation Certificate
SRC	Short Rotation Coppice
SRF	Solid Recovered Fuel
WEBS	Wood Energy Business Scheme
WID	Waste Incineration Directive
WRAP	Waste and Resources Action Programme