Availability and Sustainability of Biomass for Heating in the UK

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Overview

- Background
- Feedstocks for biomass heating applications
- Availability, characteristics and origin of key indigenous and imported feedstocks
- Wider issues associated with different feedstocks
- Standards and certification schemes

Background: UK heating demand

- Generation of heat accounts for roughly 47% of the UK's total energy consumption by end-use, and 41% of the UK's total carbon emissions[1]

(1) UK Biomass Strategy, 2007, www.dti.gov.uk/energy/

Background: Energy from biomass in the UK

	Quantity	Year	Data Source
Bioethanol	3,789 GWh	2009/10	Renewable Fuels Agency, 2010 (1)
Biodiesel	10,205 GWh	2009/10	
Electricity	11,915 GWh	2010/11	DUKES 2011 (2)
Heat	12,370 Gwh	2010/11	

(1) Renewable Fuels Agency, 2010, 'RFA Quarterly Report 8',
(2) DECC, 2011, Digest of UK Energy Statistics, chapter 7, tables 7.1.1 and 7.4

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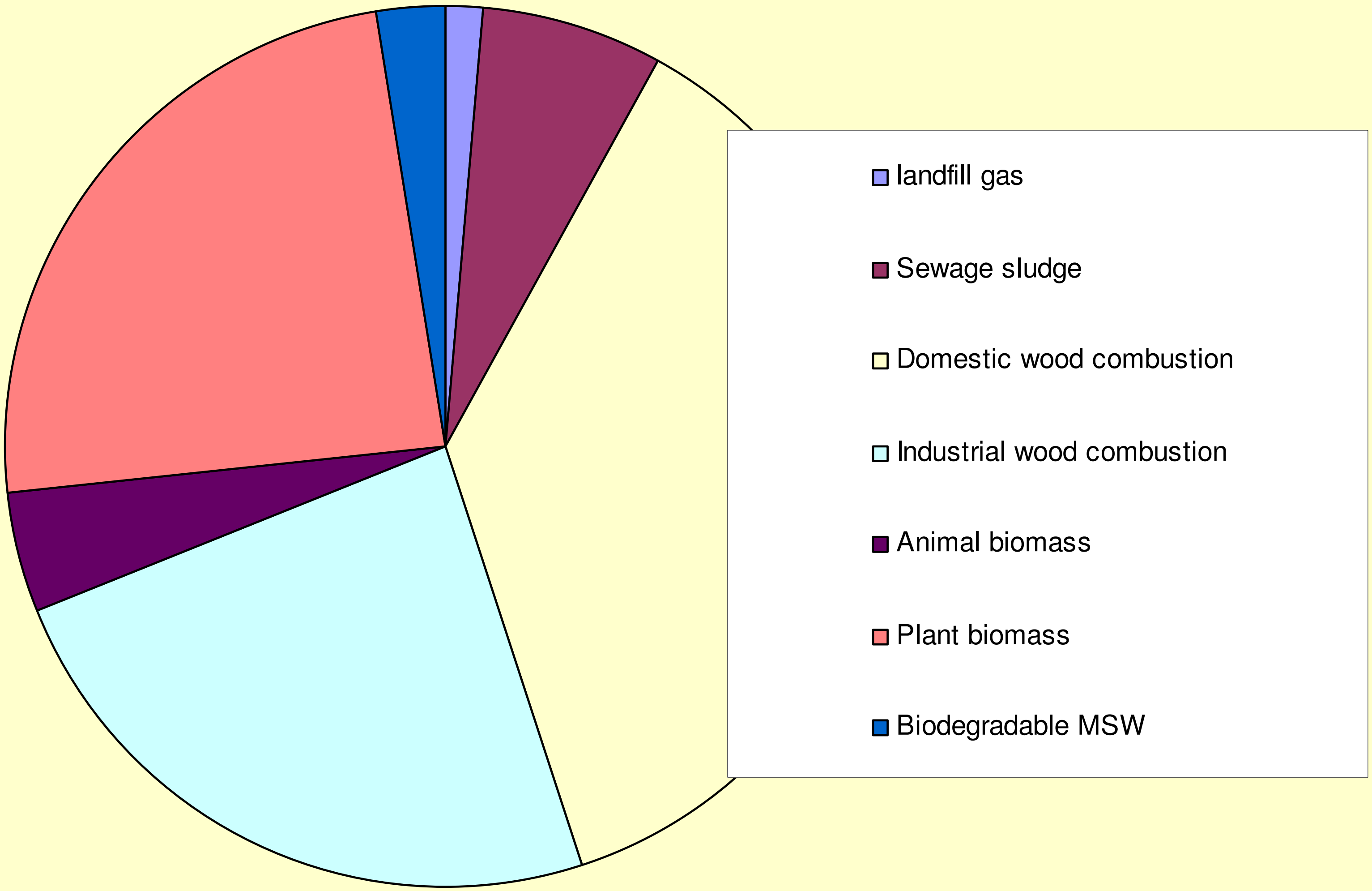
Feedstocks for biomass heating



Source: DECC, 2011, Digest of UK Energy Statistics,

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Availability of feedstocks

- The biomass resource from UK feedstocks could reach around 10% of current UK primary energy demand by 2030, at a cost of less than £5/GJ [1]
- ***Plus a large global woody biomass element***
- Supergen Bioenergy research shows that the sustainable level of UK biomass resource is lower than this: 4.9% of total energy demand (4.3% of heat demands, 4.3% of electricity, and 5.8% of transport fuel). [2]
- ***Plus a large global woody biomass element***

(1) DECC, 2009, 'Biomass Supply Curves for the UK', www.decc.gov.uk/publications/

(2) Thornley et al., "Sustainability constraints on UK bioenergy development", Energy Policy, 2009

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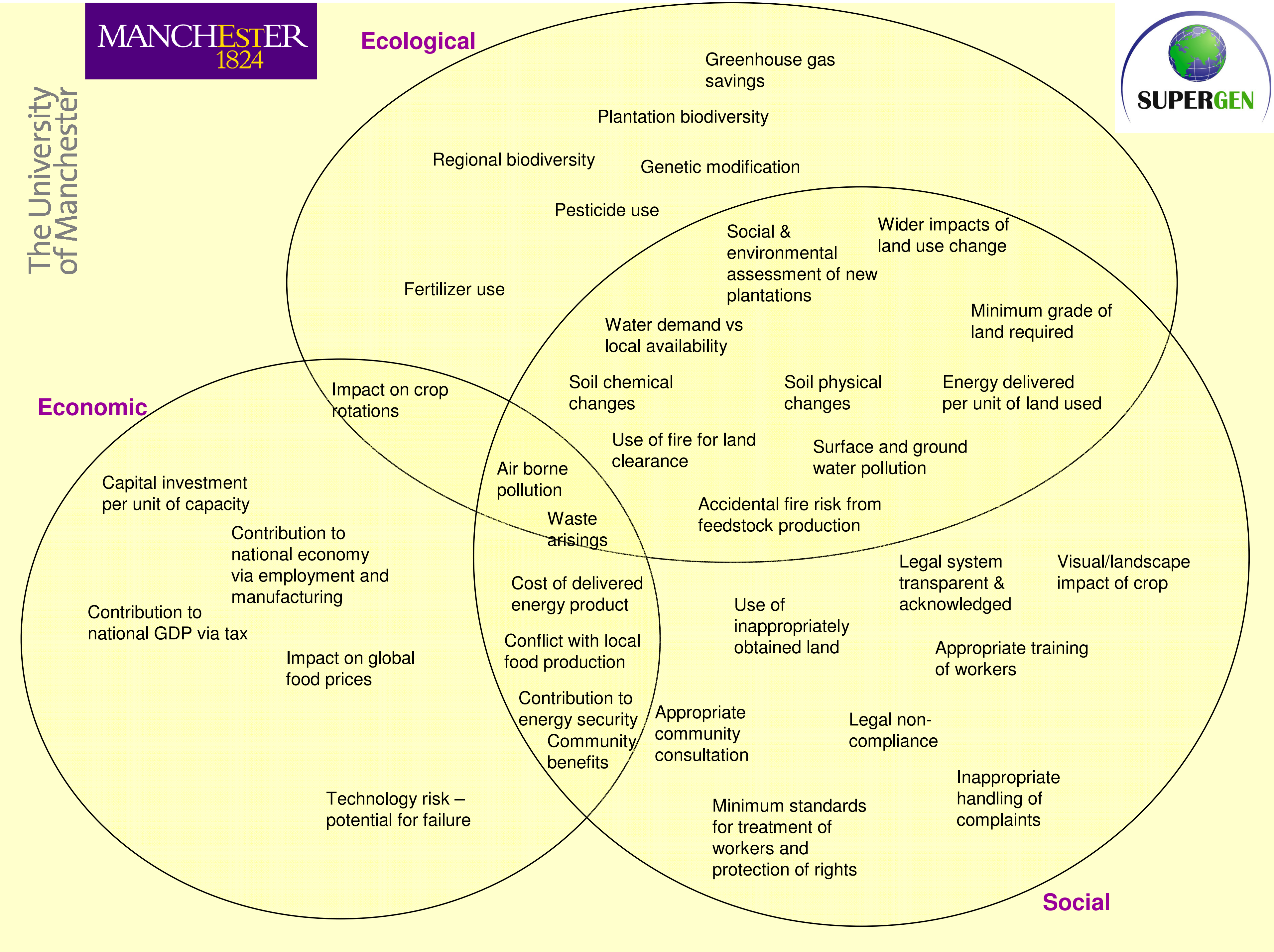
Future biomass supply

- Domestic wood – pellets (& chips) from forestry related materials or energy crops
- Industrial wood – chips from forestry related materials or energy crops, some waste wood, some forest residues
- Plant biomass e.g. straw
- More imports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Ecological
Economic
Social
Greenhouse gas savings
Plantation biodiversity
Regional biodiversity
Genetic modification
Pesticide use
Fertilizer use
Social & environmental assessment of new plantations
Wider impacts of land use change
Minimum grade of land required
Water demand vs local availability
Impact on crop rotations
Soil chemical changes
Soil physical changes
Energy delivered per unit of land used
Use of fire for land clearance
Surface and ground water pollution
Air borne pollution
Waste arisings
Accidental fire risk from feedstock production
Capital investment per unit of capacity
Contribution to national economy via employment and manufacturing
Contribution to national GDP via tax
Impact on global food prices
Cost of delivered energy product
Conflict with local food production
Contribution to energy security
Community benefits
Technology risk – potential for failure
Legal system transparent & acknowledged
Visual/landscape impact of crop
Use of inappropriately obtained land
Appropriate training of workers
Appropriate community consultation
Legal non-compliance
Inappropriate handling of complaints
Minimum standards for treatment of workers and protection of rights

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Greenhouse Gas Balances

- Should be calculated for a specific supply chain
- Greenhouse gas balances for UK heating systems using sustainable forestry are generally very good ~90%
- Chip systems generally give better GHG savings than pellets ~20% reduction in GHG savings
- Long distance shipping can be very energy efficient – ~10% reduction in GHG savings
- Land use change can reduce savings – not generally a big issue, but beware of indirect effects
- There is uncertainty about the long term impacts of high levels of residue removal

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Emissions & environmental performance

- Combustion of wood often results in higher levels of particulates and other airborne pollutants than combustion of natural gas
- Growth of woody material often results in higher levels of eutrophication & acidification than natural gas production because land is being used

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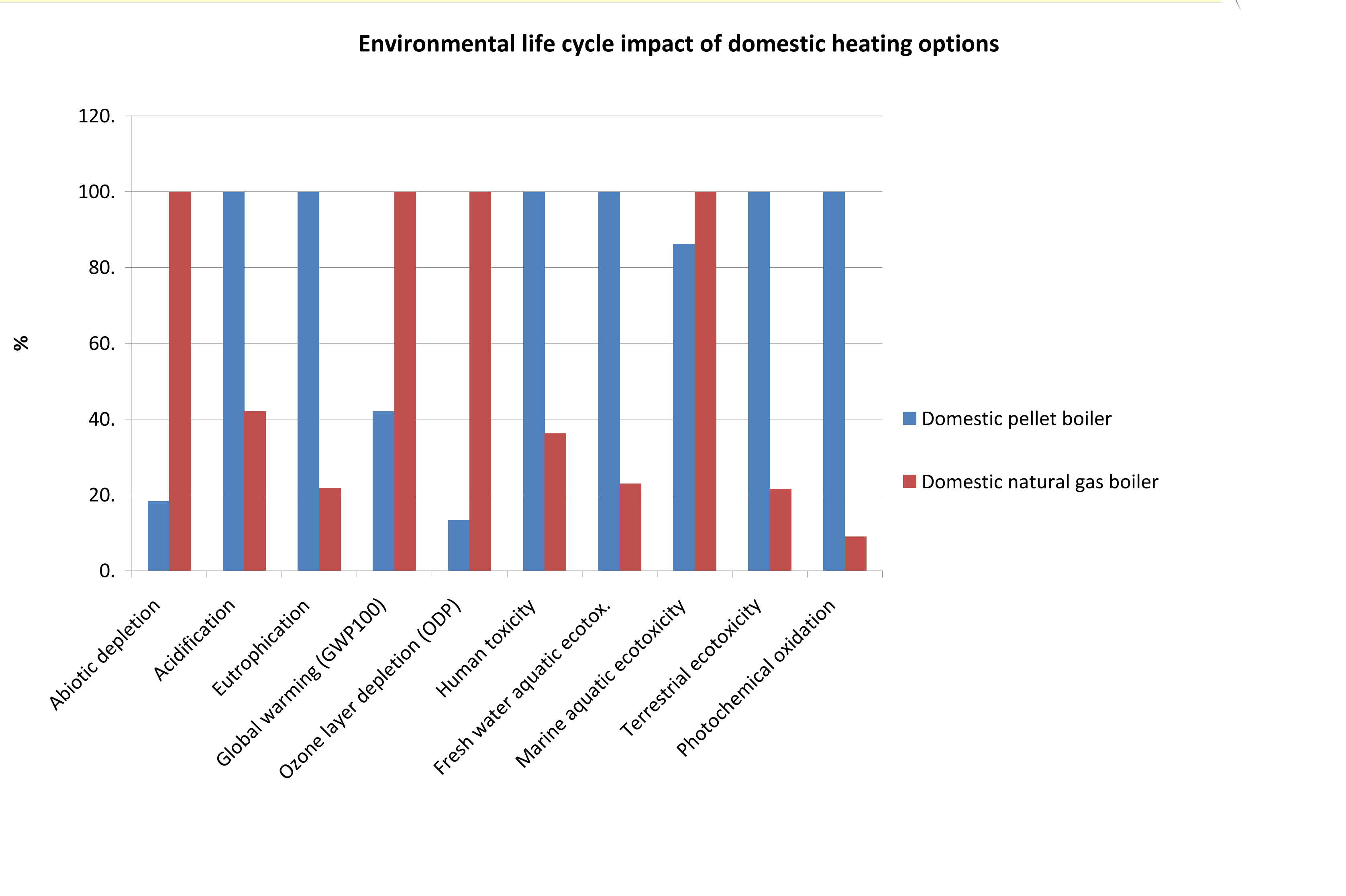

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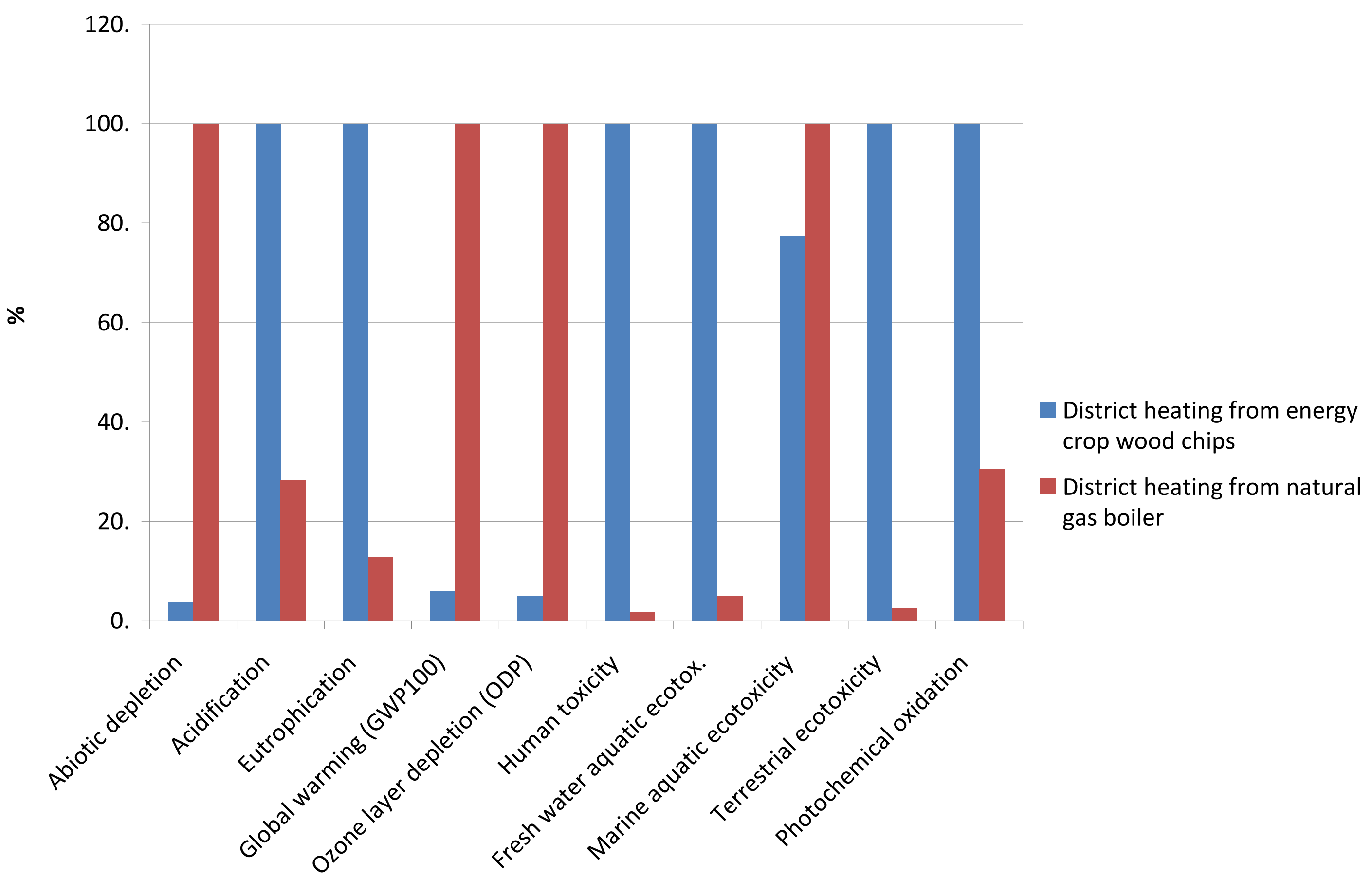
Environmental life cycle impact of larger scale heating options



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Wider issues for wood pellets

Feedstock		Feedstock Specific Environmental Performance
Wood Pellets	Positive Impacts	▪ High proportion of traded pellets are manufactured to sustainability standards. ▪ Combustion properties can be better than chips ▪ Numerous international sources for trade - North America, Scandinavia etc. – energy security ▪ May make use of wood processing wastes
	Negative Impacts	▪ Environmental performance is highly reliant on the source and sustainability of the biomass resource. ▪ Embodied energy (& carbon) associated with transportation and drying ▪ Local air pollutant impacts for small scale/domestic facilities.

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Wider issues for wood chips

Feedstock		Feedstock Specific Environmental Performance
Wood Chips	**Positive Impacts**	▪GHG balance often better than pellets ▪Sustainable forestry certification ensures many key issues are addressed
	Negative Impacts	▪Environmental performance more variable than for pellets in small installations ▪Transportation impact can be higher than for pellets ▪Degradation in storage may lead to significant losses ▪Competition with other wood uses ▪Dynamics of the GHG balance – when was the carbon sequestered?

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Wider issues for forest residues

Feedstock		Feedstock Specific Environmental Performance
Forestry Residues	**Positive Impacts**	▪ Much of the UK's 2.8 Mha managed woodlands have no significant economic value - highly untapped market ▪ Promote rural development through sustainable forest management schemes. ▪ Woodfuel industry would promote greater management of UK woodland areas
	Negative Impacts	▪ Removing the forest residue prevents the return of nutrients and organic matter to the soil. ▪ Carbon sequestration reduced. ▪ High capital cost of energy plants. ▪ Forests will have to be highly managed.

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Wider issues for straw

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Feedstock		Feedstock Specific Environmental Performance
Straw	**Positive Impacts**	▪ No major social or land implications ▪ Established production, processing & conversion technologies. ▪ Positive rural economy benefits in areas where there is surplus.
	Negative Impacts	▪ Competing uses e.g. animal bedding ▪ Loss of soil nutrients (could be addressed by returning ash to soil). ▪ Loss of soil organic matter ▪ Low bulk density – transport impacts & economic viability

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Wider issues for waste wood

Feedstock		Feedstock Specific Environmental Performance
Waste Wood Material	**Positive Impacts**	▪ If embodied energy is low compared to the calorific value GHG savings can be achieved compared to recycling the material. ▪ Avoided landfill: estimated 5-6 million tonnes per year generated; 1.4 million tonnes of this recovered.
	Negative Impacts	▪ Airborne emissions particularly from metals/halogen additives to the wood. ▪ Compliance with the Waste Incineration Directive often entails larger, high cost facilities.

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Wider issues for energy crops

Feedstock		Feedstock Specific Environmental Performance
Short Rotation Coppice (SRC)	**Positive Impacts**	▪ Good GHG balance per unit area of land ▪ Income diversification in rural areas ▪ Positive for soil properties, erosion and biodiversity and nitrogen leaching compared to arable crops[1].
	Negative Impacts	▪ Farmer income low compared to arable farming. ▪ Long term commitment required ▪ Water demand is high. ▪ Visual impact

(1) Rowe. R, et al, 2009, '*Identifying potential environmental impacts of large-scale deployment of dedicated bioenergy crops in the UK'*, *Renewable and Sustainable Energy Reviews*, *13, Issue 1, 271-290*

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Imports

- Imports are essential to substantially increase UK bioenergy production
- Heat is a lower value product and so imports are less significant than for biofuels, bioelectricity and biochemicals, but pellet import is substantial
- Sustainability certification for woody materials is more established than for other bioenergy feedstocks

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Standards and certification: the European Renewable Energy Directive

- Applies to biofuel production
- Includes mandatory sustainability criteria and monitoring/reporting requirements.

EU Sustainability Criteria for Biofuels/liquids		
Greenhouse Gas Emissions Savings	**Biodiversity**	**Land Use**
1) GHG emission savings from biofuels/liquids • **≥35%** from 1st April 2013. • **≥50%** from 1st January 2017. • **≥60%** from 1st January 2018	1) Raw materials not obtained from land with high biodiversity value (forest or grassland)	1) Raw materials not obtained from land with high carbon stock e.g. wetlands, forests, peat land

UK RTFO

- Sustainability reporting themes:
  - Carbon conservation
  - Biodiversity conservation
  - Soil conservation
  - Sustainable water use
  - Air quality
  - Workers and land rights

RFA, 2010), "Renewable Transport Fuel Obligation" from www.renewablefuelsagency.gov.uk

Netherlands Sustainable Production of Biomass Initiative

- 'Cramer Committee for Sustainable Production of Biomass' set up to develop a certification system & criteria for assessing the production & conversion of biomass for energy, fuels and other chemical processes.
- Sustainability assessment themes:
  - Greenhouse gas emissions
  - Competition for food/local energy/materials
  - Environment & Biodiversity
  - Prosperity
  - Social wellbeing

Germany's 'International Sustainability & Carbon Certification' Initiative

- International sustainability certification system focusing on biomass and bioenergy, related to transport and liquid biofuels.
  - Certificates for sustainable cropping provided to farmers
  - Certification for all participants of supply chains
- Themes:
  - Biomass sustainability requirements
  - GHG emissions savings and the calculation methodologies
  - Traceability and mass balance

Roundtable on sustainable biofuels

- Addresses indirect impacts, land use changes, food security etc.
- Minimum GHG emission saving threshold of 50%
- 12 core principles including:
  - Soil, Air, Water & Conservation
  - Human and labour rights
  - Rural & Social Development
  - Local food security
  - Greenhouse gas emissions

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Concluding comments

- Biomass heating market can grow substantially from sustainable UK production
- Meeting government targets is likely to require imports
- There should be a substantial sustainable wood fuel resource available internationally
- Certification frameworks are evolving and focusing on greenhouse gases, biodiversity, land, water and increasingly on social impacts
- Areas to watch (not necessarily covered in forestry certification schemes)
  - GHG balance (pellets, drying, land use, soil carbon)
  - Airborne emissions
  - Land use & future food provision
  - Eutrophication & acidification
  - Soil nutrient & long term carbon balances
  - Competing uses
  - Social impacts of changes in land use

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More information

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- Gilbert et al., 2011, “The influence of organic and inorganic fertiliser application rates on UK biomass crop sustainability“
- Upham et al., 2011, “The sustainability of forestry biomass supply for EU bioenergy: a post-normal approach to environmental risk and uncertainty”
- Thornley et al., 2010, “Assessing the sustainability of bioelectricity supply chains”
- Thornley et al, 2010, “Cost effective carbon reductions in the bioenergy sector”
- Thornley et al., 2009, “Integrated assessment of bioelectricity technology options”
- Thornley et al., 2009, “Sustainability constraints on UK bioenergy development”
- Thornley, P., 2008, “Airborne emissions from biomass based power generation systems” –
- Thornley et al., 2008, “Quantification of employment from biomass power plants”

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