UK Bioenergy Strategy supplementary note: Carbon impacts of forest biomass

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This note aims to assist with the interpretation of the carbon impacts analysis set out in the UK Bioenergy Strategy (April 2012). The note presents questions and answers to some of the key technical issues raised by stakeholders in this field and is supplementary to the supporting documents available on the DECC website[1].

Question 1. How were the carbon impacts of using forest biomass for bioenergy in the UK assessed?

In developing the evidence base to inform the UK Bioenergy Strategy, DECC commissioned bespoke analysis on the carbon impacts of using forestry for bioenergy, compared to alternative end uses. The focus of the work was on UK practices. The analysis, undertaken by Forest Research and North Energy Associates and peer reviewed by experts in the field, used widely-accepted, rigorous methods for life cycle assessment (LCA). The key findings of this study are presented in Box 8, pages 29 – 31, of the Bioenergy Strategy and the accompanying report[2].

The research investigated different forest management scenarios for UK coniferous and broadleaf forests which are already under management, as well as unmanaged 'neglected' broadleaf forests. A large number of scenarios were examined. In particular, 282 production scenarios for managed conifer forests were considered, along with up to 214 production scenarios for managed broadleaf forests and 214 scenarios for bringing 'neglected' broadleaf forest back into production. Hence, the analysis covered a wide range of possibilities, even unlikely circumstances. Scenarios included: using harvested wood for bioenergy; using the harvested wood for materials (such as construction products); using harvested wood for a combination of materials and bioenergy; and leaving trees unharvested in the forest.

The scenarios involving harvesting wood from the forest investigated different uses of each part of the tree. The components of the trees considered were sawlogs, sawlog off-cuts from processing, small roundwood, small roundwood off-cuts, bark and branchwood. All scenarios involved using branchwood for bioenergy (i.e. combusted for heat and/or power generation), whilst the majority involved using the sawlogs for sawn timber (i.e. used for materials). Full details of these scenarios are in Tables 4.8 - 4.11 of the Forest Research and North Energy Associates report.

The 'relative GHG emissions' of each scenario were assessed on the basis of tonnes CO2-equivalent per hectare per year, over time horizons of 20, 40 and 100 years. Relative GHG emissions were defined as:

Relative GHG emissions = Absolute GHG emissions – Counterfactual GHG emissions.

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[1] http://www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/strategy/strategy.aspx

[2] Carbon impacts of using biomass in bioenergy and other sectors: Forests, 2012

Absolute GHG emissions were calculated on an annualised basis over a specified time horizon, as the sum of:

- The GHG emissions from carbon stock changes in forests
- The quantity of harvested carbon utilised (and hence sequestered) in wood products
- The GHG emissions associated with forest operations
- The GHG emissions associated with wood harvesting and extraction
- The GHG emissions associated with wood transport
- The GHG emissions associated with wood processing
- The GHG emissions associated with disposal of harvested wood products at end-of-life.

Counterfactual GHG emissions were defined as those that would occur if UK wood was not harvested (and utilised as specified for a particular scenario) and the services (i.e. energy and materials) that would have been supplied by the harvested wood were provided by other means (i.e. non-wood alternatives or imported wood). For example, four counterfactuals for power only generation from biomass were considered: natural gas electricity generation (CCGT); oil-fired electricity generation; coal-fired electricity generation, and UK average grid electricity. The full list of counterfactuals is in Table 4.4 of the Forest Research and North Energy Associates report.

Question 2. Does the use of wood from UK forests for bioenergy result in low or high GHG emissions compared to burning fossil fuels?

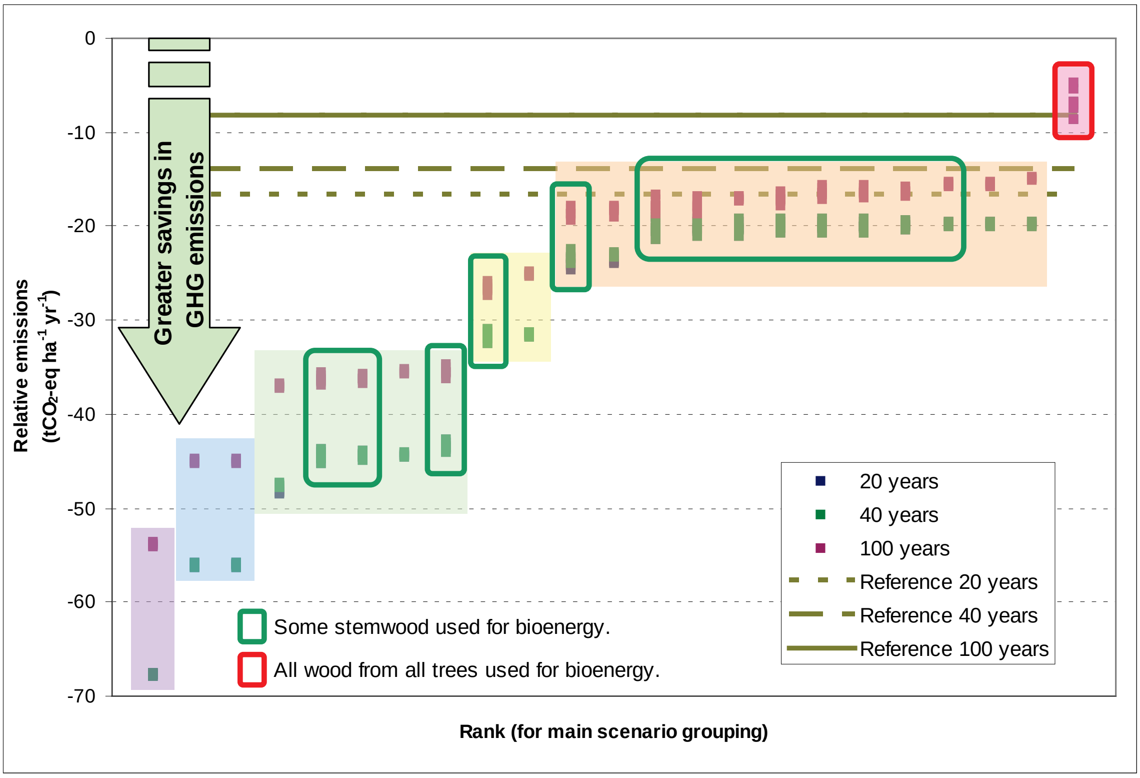
The results of the Forest Research and North Energy Associates analysis show that the use of wood from managed UK forests for bioenergy (in place of fossil fuels) usually has greater GHG benefits than leaving the trees unharvested in the forest, provided that it is produced as a co-product of wood utilised for materials (in place of alternative materials e.g. concrete).

This is illustrated in Figure 1 below (adapted from Figure 5.12 in Section 5 of the research report), which shows the results of the relative GHG emissions for the different groups of investigated scenarios, when considering UK managed coniferous forests. Also shown are the reference lines of GHG emissions involving ‘leaving trees in the forest’ with time horizons of 20, 40 and 100 years. It should be noted that the reference lines have negative values of GHG emissions (i.e. carbon stocks continue to accumulate in the forest when harvesting is stopped).

The figure clearly shows that many scenarios involving harvesting of wood result in relative GHG emissions that are even more negative than the reference lines (i.e. greater GHG benefits). All of these scenarios involve the production of bioenergy from branchwood, whilst a number (enclosed by the green bubbles in the figure) also involve production of bioenergy from parts of the stem wood[3]. This conclusion applies over both short-term and long-term time horizons, i.e. 20 years and 100 years respectively.

There are, however, a few specific scenarios where the analysis concludes that the GHG emissions from use of wood for bioenergy would be relatively high, compared to 'leaving the trees in the forest' to continue to grow and accumulate carbon. These scenarios involve situations where all the wood harvested from forests (i.e. nearly all of the above-ground biomass from all of the harvested trees) is used exclusively for bioenergy, instead of providing a mix of bioenergy and materials (e.g. sawn timber and wood-based panels). In Figure 1, these cases are enclosed by a red bubble.

Figure 1: Impacts on GHG emissions of different scenarios for the harvesting and utilisation of wood for materials and bioenergy, or for bioenergy only.



Notes: Results are ranked from left to right in descending order in terms of relative GHG emissions. All scenarios are for conifer forests managed for production in the UK. Results are shown for three time horizons (20, 40 and 100 years). Note that results for a 20 year time horizon are almost coincident with those for a 40 year time horizon and are obscured. The coloured bands indicate groups of scenarios with similar levels of relative GHG emissions and are described in detail in the table below.

[3] The scenarios enclosed in green bubbles involve: sawlogs being used for sawn timber (e.g. construction); small roundwood, sawlog off-cuts and small roundwood off-cuts being used for a mix of materials and bioenergy; and bark and branchwood for bioenergy

Group No	Mean relative emissions (t CO_2-eq ha^{-1} yr^{-1})		Scenario	Scenario forming group					
	20/40 year time horizon	100 year time horizon		Sawlogs		Small Roundwood		Bark	Branchwood (50%)
				Main	Off-cut	Main	Off-cut		
1	-68	-54	04	Sawn timber	Particleboard	Particleboard		Fuel	Fuel
2	-56	-45	10	Sawn timber	Particleboard	Pallets	Particleboard	Fuel	Fuel
			16	Sawn timber	Particleboard	Fencing	Particleboard	Fuel	Fuel
3	-45	-36	03	Sawn timber	Fuel	Particleboard	Particleboard	Fuel	Fuel
			05	Sawn timber	Particleboard	Fuel	Fuel	Fuel	Fuel
			15	Sawn timber	Particleboard	Fencing	Fuel	Fuel	Fuel
			17	Sawn timber	Particleboard	Fuel	MDF	Fuel	Fuel
			22	Sawn timber	Particleboard	Paper & card	Paper & card	Fuel	Fuel
4	-32	-26	13	Sawn timber	Fuel	Fencing	Particleboard	Fuel	Fuel
			19	Sawn timber	MDF	Fencing	Particleboard	Fuel	Fuel
5	-21	-17	02	Sawn timber	Fuel	Fuel	Fuel	Fuel	Fuel
			06	Sawn timber	Fuel	MDF	MDF	Fuel	Fuel
			07	Sawn timber	MDF	MDF	MDF	Fuel	Fuel
			08	Sawn timber	MDF	Fuel	Fuel	Fuel	Fuel
			09	Sawn timber	Fuel	Pallet	Fuel	Fuel	Fuel
			11	Sawn timber	MDF	Pallet	MDF	Fuel	Fuel
			12	Sawn timber	Fuel	Fencing	Fuel	Fuel	Fuel
			14	Sawn timber	Fuel	Fencing	MDF	Fuel	Fuel
			18	Sawn timber	MDF	Fencing	Fuel	Fuel	Fuel
			20	Sawn timber	MDF	Fencing	MDF	Fuel	Fuel
			21	Sawn timber	Fuel	Paper & card	Paper & card	Fuel	Fuel
			23	Sawn timber	MDF	Paper & card	Paper & card	Fuel	Fuel
6	- 7	-7	01	Fuel		Fuel		Fuel	Fuel

Question 3. Does the use of harvested wood exclusively for bioenergy lead to higher emissions than use of fossil fuel for energy generation?

The research carried out by Forest Research and North Energy Associates, shows that the use of harvested wood from UK managed forests exclusively for bioenergy (replacing fossil fuels) has higher relative GHG emissions than leaving the trees unharvested in the forest. This means that on the basis of GHG emissions, there is not a strong case to produce bioenergy in this way. However, such a scenario is very unlikely in the UK.

The Carbon Impacts Analysis undertaken for DECC by Forest Research and North Energy Associates did not consider certain specialised forest types and management regimes dedicated exclusively for the production of bioenergy from harvested wood (e.g. short rotation forestry, short rotation coppice). Such practices are uncommon in the UK but occur to some extent outside of the UK and are based on particular tree species, management approaches and rotation periods, which are different to those employed in harvesting trees mainly for construction products. It is therefore inappropriate to apply the estimates presented in the Forest Research and North Energy Associates biomass carbon impacts study to this kind of forestry system.

As stated in the Bioenergy Strategy, given the complexity of issues associated with bioenergy, there is significant uncertainty about the future impacts of increased demand for bioenergy. It is, therefore, important to continue to monitor impacts and review policies and measures periodically in the light of information gained from, amongst other things the outputs of continuing research. As a specific response to this uncertainty, DECC is currently undertaking new research to fully account for the GHG emissions associated with a wide range of bioenergy pathways, including bioenergy from short rotation forestry (SRF), short rotation coppice (SRC) and other energy crops. As with the Forest Research and North Energy Associates research described above, all GHG emissions will be considered, including the foregone carbon sequestration associated with leaving the land to accumulate carbon. The results will be in the form of a calculator that will help inform discussions in this area. DECC is engaging stakeholders in peer-review and evidence-gathering while developing the calculator. DECC aims to publish the calculator on the DECC website in 2013.

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