SHIFTING AWAY FROM LAND-BASED BIOFUELS

Sustainable domestic wastes and residues for the UK transport sector

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Discussion paper

Disclaimer

ActionAid commissioned the Institute for European Environmental Policy (IEEP) to investigate the sustainability or otherwise of domestic wastes and residues for transport biofuels. This briefing is NOT a summary of the IEEP report or its recommendations (an executive summary is supplied with the report which remains entirely independent of ActionAid). Rather this briefing puts the issues from the report – which are clearly referenced – and uses information from other sources, into the context of the current political situation of EU biofuels. In particular the on-going renegotiation of the EU's Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD) and how member states (in this case the UK) could reach the 10% renewable energy transport target.

EXECUTIVE SUMMARY

Land is a precious and finite resource. But great strain is being placed on land through the use of current generation biofuels (wheat, maize etc), biomass for heat and power generation and through other energy crops. Sustainable advanced bioenergy feedstocks from UK sources of wastes and residues on the other hand do not use land directly. In the main, these bioenergy feedstocks are municipal wastes and residues from agricultural activities.

A new report by the Institute for European Environmental Policy (IEEP) estimates that, in the presence of an active programme to promote sustainable and domestic advanced biofuels from wastes and residues, summed together, would create over ten thousand UK jobs; this is more than double existing levels in the current liquid biofuel sector.[1] These same biofuels would also deliver better greenhouse gas (GHG) savings and improve the overall environmental and social performance of the biofuel sector.

The report further suggests that sustainable and domestic wastes and residues could contribute 3.1% of total UK transport energy demand in 2020. This is at the lower-end of estimates. If double counted (see footnote 5) as per the current EU's Renewable Energy Directive (RED), these biofuels would make up 6.2% of the RED's 10% renewable energy transport target.[2]

Recommendations

The UK government should:

- Agree to cap biofuels grown specifically on land at 5%, and to agree a trajectory to 0% by 2021 as part of the current renegotiation of the Renewable Energy (RED) and Fuel Quality Directives (FQD);
- Put in place and implement waste management hierarchies and zero waste strategies, not only to reduce waste but so as not to adversely incentivise wastes and residues;
- Specifically on wastes and residues, and before their use as biofuels, the UK government should:
    - Conduct prior scientific assessments about their merits and their true sustainability, including GHG emissions (and indirect land use change) that arise from wastes and residues over the complete lifecycle;
    - Establish clear definitions;
    - Commission research so as to establish sustainable quantities and extraction rates, to maximise carbon savings and to prioritise end use;
    - Provide investment support to promote new technologies;
    - Impose a series of environmental and social safeguards (and limits to use) to guarantee their sustainability; and to push for these safeguards to be included into the EU sustainability criteria.
- Only those wastes and residues that are deemed sustainable – both in terms of extraction rates and their environmental and social sustainability – should be incentivized. Incentives should be based on their carbon performance and agreed as part of the current renegotiation of the RED and the FQD.

[1] Kretschmer et al, 2013. Op cit. Pages 2 and 48

[2] Kretschmer, B, Allen, B, Kieve, D and Smith, C (2013) *Shifting away from conventional biofuels: Sustainable alternatives for the use of biomass in the UK transport sector*. An IEEP discussion paper produced for ActionAid. Institute for European Environmental Policy (IEEP), London. See pages 2, 31 and 32 http://www.ieep.eu/work-areas/climate-change-and-energy/transport/2013/05/shifting-away-from-conventional-biofuels-sustainable-alternatives-for-the-use-of-biomass-in-the-uk

INTRODUCTION

Land is a precious and finite resource providing not just products but a range of environmental and social services such as habitats, carbon storage and recreation. Yet the UK currently uses over one and a half times its land area to provide the nation with bioenergy but also other products such as food and clothing.[3]

Great strain is being placed on land through the use of current generation biofuels made from wheat, maize, sugar, rapeseed, palm oil and soy. Further additional pressure is being placed on land through the increasing use of biomass (ie from trees) for heat and power generation and the use of energy crops – such as Jatropha. This is all new demand, requiring tens of millions of hectares of new land.

The correct carbon accounting for both biofuels and solid virgin biomass (ie from trees) reveals that EU bioenergy policies are not meeting their main objective - to combat climate change. In fact, bioenergy policies are not currently saving any GHG emissions. The acquisition of land is also resulting in social conflicts and localised food insecurity in developing countries, and the use of food-to-fuel (wheat, maize etc) is pushing up global food prices.

The IEEP looked into the sourcing of advanced bioenergy feedstocks from UK sources of wastes and residues; here land is not used directly (there may be some indirect impacts which need to be avoided). In the main, these bioenergy feedstocks are municipal wastes (some of which ends up in landfill) and residues from agricultural activities. As such they can help reduce the environmental and social consequences of UK biofuel consumption and they should reduce GHG emissions compared to other biofuels, including overseas indirect land use change (ILUC) impacts. These advanced feedstocks also differ from the current generation of feedstocks in that they require a different technology and are not sourced from food crops.

The IEEP then assessed how much of these feedstocks could potentially be sustainably extracted and used as biofuels in the transport sector and proposed a series of environmental and social safeguards.

The issue of biofuel feedstocks is currently under discussion between the European parliament and the EU Council of Ministers as part of the renegotiation of the EU's Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD). One proposal under discussion from the European Commission is to cap the amount of food-to-fuel biofuels which can count towards the 10% transport target of the RED at 5%. ActionAid welcomes this initiative, but believes that 5% is far too high.

Therefore, what alternatives are there for the UK to meet its obligation to fill the 10% target of the RED?

Electric vehicles, powered by renewable electricity, are one option. Despite the Committee on Climate Change recommendation that the UK needs something like 1.7 million electric and plug-in hybrid vehicles by 2020 to meet climate goal,[4] the current uptake will not reach this figure.

THE NEXT GENERATION OF BIOFUELS – WASTES AND RESIDUES

The next generation of (advanced) biofuels is another option. But the sustainability of advanced biofuels – both in terms of domestic quantities available and their environmental and social credentials – are not assured (ActionAid is therefore not endorsing any particular advanced biofuel feedstock or technology):

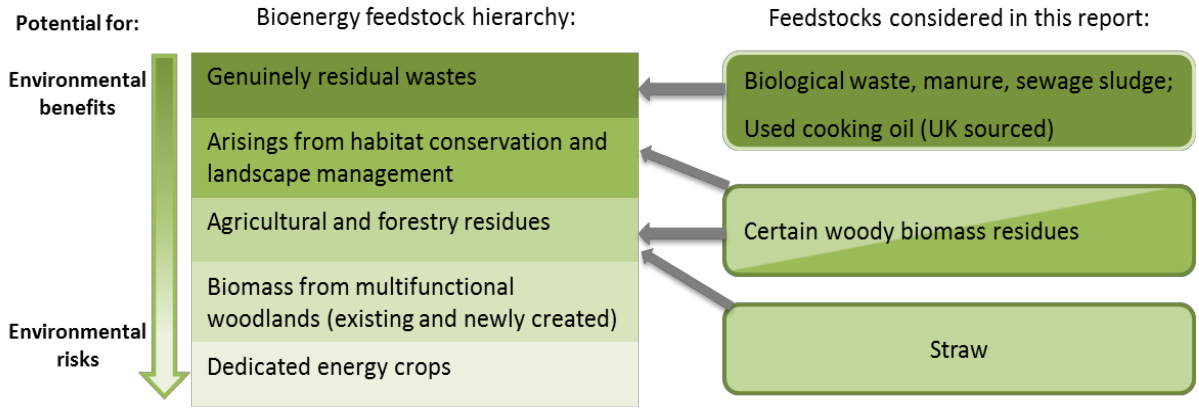
- There needs to be prior scientific assessment about their merits and their true sustainability, including GHG emissions (and ILUC) that arise from wastes and residues over the complete lifecycle;
- Clear definitions need to be established;
- Waste management hierarchies and zero-waste strategies should be in place and implemented not only to reduce waste but so as not to adversely incentivise wastes and residues;
- Their use should maximise carbon savings and be targeted at appropriate established uses wherever possible;

[3] Friends of the Earth [FoE] (2013) *Hidden Impacts: How Europe's resource overconsumption promotes global land conflicts*, http://www.foeeurope.org/sites/default/files/publications/foee_report_-_hidden_impacts_-_070313.pdf.
[4] CCC (2011) *Bioenergy Review*. UK Committee on Climate Change.

- A series of environmental and social safeguards (even limits to use) should be imposed to guarantee their sustainability.

With all these caveats, multiple counting[5] (or any other support measures) needs to be kept under review in light of continuing research and analysis.

Five potential domestic feedstocks were considered in the IEEP report: biological (ie food) waste, manure and sewage, waste vegetable (ie used cooking) oil,[6] woody residues and agricultural straw:[7]



UK food and biological waste

Food (and other biological) waste, via anaerobic digestion, can be turned into a biogas and then, if required, upgraded to transport bio-methane.[8]

Under a strict zero-waste strategy, there would be considerably less than the 16 million tonnes of post-farm food waste that the UK discards every year.[9]

Box 1: Solid (virgin) biomass and energy crops

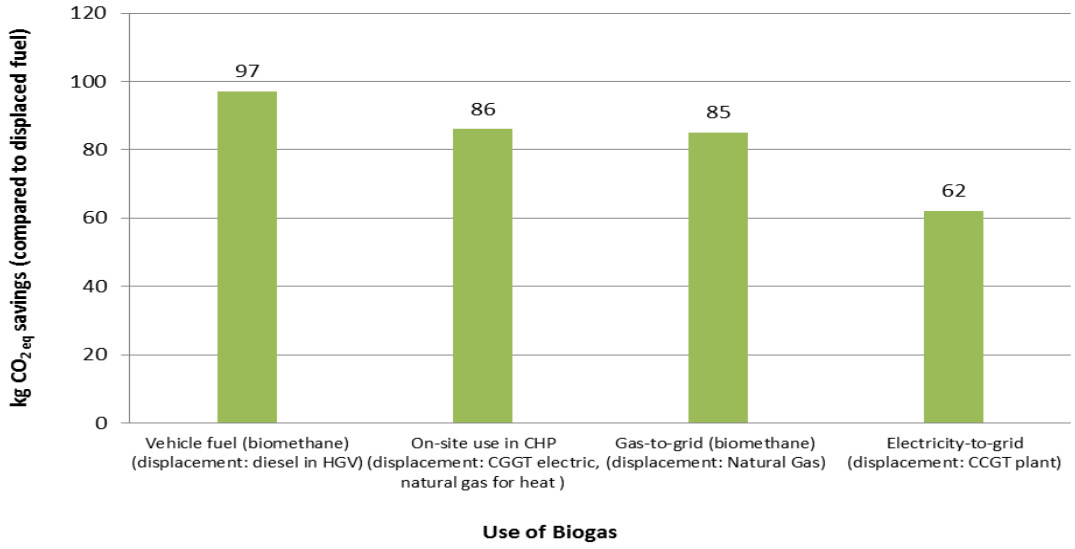
ActionAid advocates that the UK moves away from all large scale land-based bioenergy sources, either for advanced biofuels or for burning in heat and power stations. The latter usually comes in the form of wood pellets and chips. UK wood from trees currently has better established uses such as for timber and paper where the carbon is effectively locked away. The UK has a substantial trade deficit for wood and wood-based products – additional sustainable harvest should benefit the UK wood-processing industries first.[10] Also, the use of round wood for energy purposes is highly controversial as it is unlikely to generate GHG emission savings compared to the fossil fuels replaced over decades or centuries to come – or even not at all – because of carbon debt.[11]

There is a role for limited quantities of UK energy crops – such as small-scale short rotation coppice – as long as they are established on degraded land.

[5] To incentivise their uptake, the new EC proposal suggests that advanced biofuels, with the exception of waste cooking oil, would count four times against the transport energy target in the RED. ActionAid believes this is on the high side and should more properly reflect their carbon performance.
[6] UCO is not technically an advanced biofuel because it is in current use but is included here as an important waste source.
[7] Kretschmer et al, 2013. Op cit. Page 16.
[8] Kretschmer et al, 2013. Op cit. Pages 18 to 20.
[9] See Defra (2011) *Government Review of Waste Policy in England 2011*. Department for Environment, Food and Rural Affairs, http://www.defra.gov.uk/publications/files/pb13540-waste-policy-review110614.pdf.
[10] Forestry Commission (2012a) *UK Wood Production and Trade: 2011 Provisional Figures* (release date 17 May 2012). Forestry Commission: Edinburgh, http://www.forestry.gov.uk/pdf/trprod12.pdf/$FILE/trprod12.pdf.
[11] Bowyer, C, Baldock, D, Kretschmer, B and Polakova, J (2012) *The GHG emissions intensity of bioenergy: Does bioenergy have a role to play in reducing GHG emissions of Europe's economy?* Institute for European Environmental Policy (IEEP): London.

Diversion from the waste hierarchy may be appropriate for food waste; it has been demonstrated, for example, that anaerobic digestion of food waste generally is superior to composting in terms of GHG savings and according to a number of reports, the greatest GHG savings can be achieved in the transport sector (see also Fig 1).[12]

Fig1: GHG savings for different uses of biogas in the UK[13]



UK sewage and manure

Both animal manure and sewage sludge can also be turned into bioenergy (biogas) via anaerobic digestion (AD). Currently their main use is as organic fertilisers, with significant benefits to soil organic matter and fertility. However, although beneficial when applied to fields in the correct concentrations and using appropriate techniques, there are situations where the density of livestock production is such that animal manure and slurry are produced in excess. This can be particularly problematic in livestock-dominated areas of the UK and where manure and slurry volumes exceed those which can be applied back to the land without risking water pollution. Traditional manure management should not be diverted to an extent that would lead to a decline in soil organic matter.[14]

The use of AD from both food waste and sewage/manure results in a solid by-product (digestates) that can be liquefied and applied as a fertiliser; reliance on on-farm AD with parallel use of the digestates should be promoted over complete removal of sludge and manure from the farming system.

UK straw

The sustainability of straw as a biofuel feedstock (to produce ethanol) is closely related to the scale and location of its extraction and the extent of diversion from existing uses, which will give use to consequences of their own. Negative impacts of excessive straw diversion towards energy use include (and safeguards need to be put in place):[15]

- Depleted soil functionality, most importantly through a reduction of soil organic (and carbon) matter and therefore nutrients;
- Potential longer term impacts on fauna resulting from modifications to stubble heights and straw management;

[12] Environmental Resources Management [ERM] (2006). *Carbon Balances and Energy Impacts of the Management of UK Wastes*, Final Report for Defra R&D Project WRT 237, http://www.fcrn.org.uk/sites/default/files/ERM_Carbon_balances_and_energy_impacts_of_waste.pdf.

[13] IEEP compilation based on Letsrecycle (2010) Research raises questions over best use of biogas. Letsrecycle.com 17th February 2010. http://www.letsrecycle.com/news/latest-news/compost/research-raises-questions-over-best-use-of-biogas. and Arcadis and Eunomia (2010) *Assessment of the options to improve the management of bio-waste in the European Union*. Study contract Nr 07.0307/2008/517621/ETU/G4 for European Commission DG Environment, http://ec.europa.eu/environment/waste/compost/pdf/ia_biowaste%20-%20final%20report.pdf.

[14] Kretschmer et al, 2013. Op cit. Pages 18 to 20.

[15] Kretschmer et al, 2013.Pages 22 and 23.

- Animal welfare impacts when no suitable alternatives for bedding (such as sawdust or wood chippings) and roughage are readily available.

To ensure the correct carbon accounting for straw, soil carbon must be included in the GHG accounting framework of the RED.

UK used cooking oil (UCO)

The UK Sustainable Bio-Diesel Alliance estimates that less than five per cent of the UCO available from domestic households is currently collected. The rest is typically landfilled or disposed of through the drain.[16] Already, UCO from non-household sources represents an important source of biodiesel in the UK. Other uses are in the oleochemicals industry, for energy generation and animal feed.[17] One safeguard would be to ensure virgin oil is not diluted by small quantities of UCO or even heated up solely for the purpose of making it qualify for incentives.[18]

UK wood biomass (forestry) residues

This category includes a wide variety of vegetative material produced by the sustainable management of domestic landscapes, green space and woodlands. And through chemical conversion, could produce a number of fuels.[19]

ActionAid does not expect many biomass residues to end up as transport biofuels. This is because the following needs to be addressed: additional management of forests must be at sustainable levels, including sustainable residue extraction rates (in terms of the maintenance of forest system nutrients, carbon balance and soil fertility); where woody biomass residues are already being put to good use by other industries, such as in the fibre board and paper pulp industries but also in the compost industry and soil mulch processing and for animal bedding (for example as an alternative to straw). Therefore the use in the energy sector should not erode the resource base of appropriate established uses.

As with straw, soil carbon must be included in the GHG accounting framework of the RED.

UK WASTE AND RESIDUES POTENTIAL

With all these caveats, how many wastes and residues may end up in the transport sector as compared with other (bioenergy) end uses? Table 1 gives the lower-end estimates of potential sustainable and domestic wastes and residues – 3.1% or 54.7 petajoules (PJs) – in transport. This potential does not include real world practical constraints to realising advanced biofuels from wastes and residues, such as economic viability, waste collection and segregation.

[16] UK Sustainable Bio-Diesel Alliance (2011) Written evidence submitted to the House of Common's Environmental Audit Committee - Green Economy, 6 December 2011, http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenvaud/1025/1025vw36.htm.
[17] Smith, C (2011) Biomass availability for a UK advanced biofuels facility. In: *Advanced Biofuels: the potential for a UK industry* (Appendix 3). National Non-food Crop Centre (NNFCC): York.
[18] Kretschmer et al, 2013. Op cit. Page 20
[19] Kretschmer et al, 2013. Op cit. See pages 21 and 34.

Table 1: Potential UK sustainable quantities of waste and residues to transport by 2020 (this is at the lower end of IEEP estimates)[20]

Feedstock	PJ
Food and green waste to bioemethane	16.8
Manure to bioemethane	1.6
Sewage sludge to bioemethane	1.3
UCO	7.3
Straw	18.0
Forestry residues	0.8
Arboricultural arisings	4.6
Renewable fraction of solid wastes	4.4
Total PJ	54.7
Share of 2020 total transport energy (1749 PJ)	3.1%

This finding is consistent with previous work which reveals that advanced biofuels could contribute between 1.3 to 2.6% to total UK road and rail transport energy demand in 2020. This study involved looking at a different feedstock mix and reviewed a number of additional restrictions (such as prices of feedstocks). [21]

Assuming double counting, UCO would contribute 7.3 PJs towards the RED transport target (0.8% if double counted) and the other wastes and residues 47.5 PJs (5.4% if double counted) (see Table 2).

Table 2: How would this contribute to UK meeting the RED 10% transport target by 2020?

Renewable Fuels	PJs	Real %	Current multiple counting (see footnote 5)	RED %	Potential (new) multiple counting	RED %
Domestic UCO	7.3	0.4%	2x	0.8%	2x	0.8%
Renewable electricity in cars[22]	c6.9	0.4%	2.5x	1.0%	2.5x	1.0%
Renewable electricity in rail (based on 2011 figures)[23,24]	c10.5	0.6%	1x	0.6%	2.5x	1.5%
Biofuels from other wastes and residues[25]	47.5	2.7%	2x	5.4%	2x	5.4%
TOTAL				**7.8%**		**8.7%**

UK EMPLOYMENT OPPORTUNITIES

It is estimated that, in the presence of an active programme to promote sustainable advanced biofuels from wastes and residues, summed together, over ten thousand UK jobs could be created in the transport related advanced biofuel

[20] Kretschmer et al, 2013. Op cit. See pages 30 to 32.
[21] Nattrass, L, Smith, C and Evans, G (2011) *Advanced biofuels: The potential for a UK industry*. National Non-food Crop Centre (NNFCC): York.
[22] The CCC report in 2011 (see above) argued that 1.7 million electric and plug-in hybrid cars would be needed on UK roads by 2020 to meet carbon goals (or 0.7% of UK transport energy consumption, or about 11.7 PJs). This is (now) probably unachievable but electric vehicles should play a more important role by 2020. For the purposes of this table, we assume only one million electric and hybrid vehicles by 2020 (see http://www.nationalgrid.com/NR/rdonlyres/DF928C19-9210-4629-AB78-BBAA7AD8B89D/47178/Operatingin2020_finalversion0806_final.pdf). The renewable electricity should be sourced from tidal, wind, geothermal or solar for example but NOT from solid round wood biomass.
[23] See table ENV0102 at https://www.gov.uk/government/statistical-data-sets/env01-fuel-consumption
[24] Assumes current use of >0.3 million tonnes oil equivalent in electric trains in 2011 (0.7 mtoe was diesel). Major electrification programmes are under way so figures should be higher in 2020. ActionAid proposes that electricity in trains, always assuming it is renewable, should count 2.5 times towards the target on the basis that electric vehicles are far more efficient and bringing it equal treatment with electric road vehicles (electric trains are significantly more efficient than fossil fuels in terms of carbon savings see http://downloads.theccc.org.uk.s3.amazonaws.com/4th%20Budget/4th-Budget_Chapter4.pdf.).
[25] We have assumed double counting as per the current RED

sector; this is more than double current levels in the liquid biofuel sector (see Table 3 for a description as to where some of these jobs would be created).[26]

Table 3: UK Employment

Industry	Total Jobs	Timeframe	Comments
Liquid biofuel sector	3,500 – 5,300	Current	Current employment in the UK liquid biofuel sector including indirect employment in related sectors.
Three to six operational gasification plants	4,240 – 8,190	2020	Plant operation, construction and along the supply chain. The majority of jobs (3,000 – 6,000) are in the construction phase. **Not all these jobs will be in the transport sector.**
Anaerobic digestion	Up to 35,000	2020	**Not all of these jobs will be in relation to transport fuels.** Achieving this figure would require a 14 fold increase in employment compared to 2010/11.
Cellulosic ethanol	100-153	Current - 2020	Direct jobs **per plant**. The higher figure includes 88 construction phase jobs in addition to the 65 permanent jobs cited by Abengoa.[27]
UCO related	1,200	2020	**Direct jobs in transport fuels.** There will be other jobs associated with this part of the sector.

IN CONCLUSION

Sustainable quantities of bioenergy from domestic wastes and residues could be available for the transport sector by 2020. It would not only make a sustainable contribution to the RED targets but will also provide employment opportunities.

However, the quantities will always be limited. The best way to reduce our dependence of fossil fuels, and to fight climate change in the transport sector is to reduce energy demand. In the transport sector, the quickest and easiest route is via better fuel efficiency of vehicles.

To move away from land-based biofuels towards domestic wastes and residues, the UK government should:

- Agree to cap biofuels grown specifically on land at 5%, and to agree a trajectory to 0% by 2021 as part of the current renegotiation of the RED and FQD;
- Put in place and implement waste management hierarchies and zero waste strategies, not only to reduce waste but so as not to adversely incentivise wastes and residues;
- Specifically on wastes and residues, and before their use as biofuels, the UK government should:
    - Conduct prior scientific assessments about their merits and their true sustainability, including GHG emissions (and indirect land use change) that arise from wastes and residues over the complete lifecycle;
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    - Provide investment support to promote new technologies;
    - Impose a series of environmental and social safeguards (and limits to use) to guarantee their sustainability; and to push for these safeguards to be included into the EU sustainability criteria.
- Only those wastes and residues that are deemed sustainable – both in terms of extraction rates and their environmental and social sustainability – should be incentivized. Incentives should be based on their carbon performance and agreed as part of the current renegotiation of the RED and the FQD.

[26] Kretschmer et al, 2013. Op cit. See page 48
[27] See Kretschmer et al, 2013. Op cit. Page 46