

Alternatives to Biofuels

Renewable energy in transport without crop based biofuels

Discussion paper¹

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tim.rice@actionaid.org

Summary

The UK could meet its 10% transport obligations under the EU Renewable Energy Directive (RED) without the use of current land-based biofuels, or indeed any land-based crops or trees. This is partly due to new proposals for the RED that would incentivise the use of sustainable advanced generation biofuels from wastes and residues, the use of other 'genuine wastes' that would otherwise be disposed of, and electric vehicles from renewable sources.

That said, the UK will find it difficult to meet the RED 10% target or its climate change obligations until it stops and then reverses the growth in energy use in the transport sector. In terms of greenhouse gas (GHG) emissions, the Government watchdog Committee on Climate Change (CCC) suggested in June 2012 that a 15% reduction in transport CO₂ could be made by 2020 through such measures as greater fuel efficiency in vehicles and campaigns to get people walking/cycling/using public transport more².

In real terms, to meet the 10% target, 25% of the renewable energy in transport fuel could come from the use of existing domestic wastes such as used cooking oil and tallow, 35% from electric vehicles powered by renewable electricity and the balance from other domestic wastes (ie food waste to biomethane) and sustainable advanced biofuels. But this would entail the UK government introducing measures to incentivise such an approach and to ensure that all feedstocks are assessed so as to ensure 1) they deliver genuine GHG savings including indirect effects and 2) that feedstocks are targeted at the sector(s) and uses that deliver the greatest GHG savings or at uses that deliver other environmental benefits. In many cases, wastes and residues create greater GHG savings if they are used in heat or power generation rather than transport.

¹ Written and researched by Danny Chivers and Tim Rice

² Meeting the Carbon Budgets - 2012 Progress Report to Parliament, Chapter 5, pages 176-187.

<http://www.theccc.org.uk/reports/2012-progress-report>

Benefits for the Government

- Demand reduction, the use of sustainable wastes and the renewable electric vehicle policies would move us in the right direction on climate change, and would have positive economic and social effects in other areas such as congestion and air pollution
- There would be a boost for UK jobs and the rural economy with the development of the electric vehicle sector and the use of fuels made from wastes and residues.
- Increased energy security through a reduction in imported fuels – both biofuels and fossil fuels.

Benefits for consumers

- Saving money through more fuel efficient vehicles and avoiding expensive and unsustainable biofuels that also cause hunger and climate change

Benefits for developing countries

- Sustainable bioenergy, sourced from within the UK, would stop the current land-grab taking place in the developing countries, who themselves want to secure energy for their own use. The move away from food based biofuels will also ease pressure on global food prices.

Recommendations

- Cap all land-based biofuels at 0%, not 5% (i.e. land based biofuels cannot be used)
- Ensure that all energy used to meet the RED comes from truly sustainable and domestic sources i.e.
 - All bioenergy feedstocks – biofuels from waste and residues and advanced biofuels – be subject to full life cycle analysis by the end of 2013
 - Renewable energy should not be sourced from biomass
 - All member states should have in place strict waste management strategies that prioritises waste reduction and avoidance
- Member states to introduce energy reduction policies in the transport sector to incentivise more fuel efficient vehicles, 'smarter choices', eco-driving and enforcing speed limits.

Introduction

There is now wide recognition that crop-based biofuels – wheat, maize, sugar, palm, soy etc. – often called first or current generation biofuels, are causing serious social and environmental impacts. These include increasing GHG emissions, fuelling hunger by diverting food into fuel and causing land grabs in developing countries.

This issue has now been recognised by the European Commission; "It is wrong to believe that we are pushing food-based biofuels," the commissioners said. "In our upcoming proposal for new legislation, we do exactly the contrary: we limit them to the current consumption level, that is five per cent up to 2020."³ In other words, they are proposing that the amount of food-base biofuels (i.e. sugars, cereals, oil seeds and palm oil) that can count towards the RED 10% target should be capped at 5%. The remaining 5% would have

³ Reuters, 2012. Commissioners Connie Hedegaard and Guenther Oettinger. <http://uk.reuters.com/article/2012/09/17/eu-biofuel-idUKL5E8KHA4120120917>

to come from other renewable sources or advanced generation biofuels. They are also proposing to introduce indirect land use change (ILUC) GHG emission factors⁴.

ActionAid welcomes this move by the Commission. It is explicit recognition that the food versus fuel issue is real; that land grabs do occur; and that many biofuels will not reduce GHG emissions once ILUC is included. However, we would like them to go further, by excluding all land-based biofuels. As ActionAid will show below, the UK government could still fill the 10% without land-based biofuels and thereby avoid all the social and negative impacts associated with biofuels.

Context

In terms of renewable energy, climate change and biofuels, the key legislative targets are:

- The EU has a target to reduce greenhouse gas (GHG) emissions from transport to 60% below 1990 levels by 2050, according to its Low-Carbon Roadmap.
- In order to achieve this, the EU has a sub-target (as laid out in its 2011 Transport White Paper) of cutting the GHG from surface transport by 20% by 2030.
- The Renewable Energy Directive (RED) was introduced as a mechanism to help achieve these wider goals. It requires all member states to source 10% of their surface transport fuel from “renewable” sources by 2020 (often referred to as the 10% target or mandate). It was introduced with first-generation biofuels very much in mind as the main way this target would be reached.
- Whilst the RED sets out a timetable for targets of renewable energy in transport, alongside the RED is the Fuel Quality Directive (FQD). This requires suppliers of transport fuels to reduce their GHG intensity from their operations by 6% by 2020. They can do this through a number of means;
- The UK planned to comply with the RED almost entirely using biofuels (94%). The Renewable Transport Fuel Obligation (RTFO) was introduced to achieve this. This currently requires fossil fuel suppliers to source a percentage of their fuel from biofuels – this is currently set at 5% by April 2013/4. The original idea was for this to be gradually ramped up to meet the RED, but this is now under review.

The 10% RED target was developed with the best will in the world, but the facts have changed. The mandate encourages a headlong rush into fuels that are the most technologically developed, most profitable and fit easily within the existing infrastructure and vehicle engines – i.e., liquid biofuels. This provides little incentive towards other fuels, vehicle efficiency or changes in transport modes. The RED essentially panders to the oil companies and vehicle manufacturers when it would make sense to pursue a strategy of demand reduction while carefully developing genuinely sustainable alternatives, like electric cars powered by clean renewable energy (sun, wind and tidal power).

Meanwhile, there is now wide recognition that crop-based biofuels are destructive, with regards to hunger, land grabs and to climate change. Sustainable second/advanced generation biofuels might be developed at some point, but they aren't ready at the moment and therefore are unlikely to play more than a minor role by 2020. We need to shift away from crop-based biofuels – and the European Commission clearly recognises this by proposing a cap on food-based biofuels and further incentivising waste fuels by allowing them to count four times towards the 10% target.

To meet GHG reductions from transport fuel, reducing our total fuel use is the quickest and probably the cheapest option. The Committee on Climate change (CCC) 2012 recommendations would be a good start (see below). At the same time, the UK should also start developing workable alternatives, like better public

⁴ Draft EC proposal to amend Directives 98/70/EC and 2009/28/EC, leaked on the 10th September 2012

transport, electric vehicle networks, and some carefully selected liquid fuels from wastes, including agricultural wastes. This would also be good for the UK economy, including the rural economy. These changes would also put us well on the way to meeting the longer-term EU target to reduce greenhouse gases from transport by 20% by 2030.⁵

It should be noted that this broader target (a 20% reduction in transport emissions by 2030) is not considered to be sufficient by many climate scientists and environmental groups in order to give us a decent chance of avoiding catastrophic climate change. This briefing explains how the UK could meet the existing EU targets without using crop-based fuels, but we hope this would be seen as just a first step, intended to meet the UK's legal commitments in Europe. Further measures to cut car use, improve public transport, boost clean renewables, electrify trains, cars and buses, shift freight from road to rail etc. would be needed on top of the policies outlined here in order to set the UK's transport onto a genuinely sustainable path.

Current biofuel and transport demand

According to the Department for Energy and Climate Change (DECC), the UK currently uses a total of 2,300 PJ of transport energy⁶ per year⁷. This is 97% fossil fuel, 2.3% biofuel, just over half a per cent of fossil/nuclear electricity, and 0.05% renewable electricity (mostly in trains, and half of it from biomass). Note that biofuel makes up 3.5% of UK vehicle fuel by *volume*, but only 2.3% by *energy*, because it contains less energy per litre than fossil fuels.

However, the RTFO and RED targets are based on the percentage of renewable energy in surface transport fuels, not of total transport. The same DECC data shows that the UK currently uses 1,700 PJ of surface transport energy per year, of which 96% is fossil fuels, 3% is biofuels, 0.8% is fossil/nuclear electricity and 0.1% is renewable electricity⁸.

Split down by energy content, that 3% biofuel consists of approximately 35% crop-based biodiesel, 33% crop-based bioethanol, 29% used cooking oil⁹ and 6% tallow (biomethane is only 0.04%).

DECC also publish projections of future energy use¹⁰. In 2020, they expect that UK transport will use 1,825 PJ of surface transport energy – a 7% increase – and that 8% of it would be biofuel. This is the “Business as Usual” (BAU) scenario.

The RED target requires that 10% of surface transport energy must come from renewable sources in 2020. However, some forms of fuel count extra towards the target to incentivise their use. Biofuels from wastes, residues, non-food cellulosic material, and lignocellulosic material are allowed to count twice. Renewable electricity used in electric and plug-in hybrid road (but not rail) vehicles is allowed to count two and a half times.

⁵ European Commission. 2011. Transport White Paper.

⁶ One Petajoule = 1,000,000,000 MJ, or the amount of petrol required to drive a Toyota Prius around the world 13,300 times.

⁷ <http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx>

⁸ Any biofuels used in aviation and shipping do count towards the 10%, however. This is because progress against the target is measured by adding up all the renewable fuels going into transport – whether they're going into cars, buses, ships or planes. Then this figure is compared with the figure for total fuel use in road transport *only*, i.e. currently 1700 PJ.

⁹ The quantity of UCO until April 2012 is high because of the 20p duty differential (ie reduction) it enjoys against diesel; other biofuels do not get this benefit.

¹⁰ http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx

A new policy outlook - how could the UK fill the 10% without land-based biofuels ?

Demand Reduction

The UK will find it difficult to meet the RED 10% target or its climate change obligations until it stops and then reverses energy growth in the transport sector. The Government watchdog Committee on Climate Change (CCC) suggested in June 2012 that the following reductions in transport CO₂ could be made by 2020¹¹, in comparison with “Business As Usual”¹²:

- 9% from **more efficient vehicles** (the CO₂ intensity of new fossil-fuelled cars and vans – ie excluding electric vehicles – falls to 110 g/km and 169 g/km respectively, while new HGVs become 6-9% more efficient). This could be delivered through “financial incentives, such as further differentiation in Vehicle Excise Duty (VED), increased VED and higher fuel duty may be required in future if progress in reducing car emissions is to be sustained.”
- 3% from “**Smarter Choices**” (a Government campaign to get people walking/cycling/ using public transport more, living closer to work, working from home, etc., leading to a 5% reduction in car travel). This could be delivered through “Smarter Choices initiatives [which] should be rolled out across all urban areas in the UK by 2020...However, the funding is only sufficient to roll out Smarter Choices to around 25% of the UK by 2015. This implies the need for further funding, if Smarter Choices is to be fully rolled out and potential emissions reductions of around 3 MtCO₂ in 2020 achieved.”
- 1% from **eco-driving** through the “adoption of more efficient driving techniques such as smooth acceleration and braking, driving at optimal speeds, use of cruise control, engine braking the Government should consider including this as a key element of the practical driving test, and consider options to increase eco-driving training and other opportunities to provide information on fuel consumption and other benefits of eco-driving.”
- 1% from **enforcing existing speed limits**. “DfT statistics indicate that speed limits are exceeded by a high proportion of drivers on motorways (49%) and dual carriageways (42%). This offers an opportunity for reducing emissions through enforcing the current speed limit, given the significant decline in fuel efficiency as car speed increases from 70 to 80 mph. Conversely, if the speed limit were to be increased, fuel efficiency would further decline, increasing emissions...In October 2011 the Government announced their intention to consult on raising the national speed limit on motorways in England and Wales from 70 to 80 mph from 2013...We recommend that the Government should consult on enforcing the existing speed limit, and should provide a full analysis of the costs and benefits that this would entail.”
- 2% from the increased use of **electric cars**, as they use far less energy per km than fossil fuelled vehicles (see below)

These five options would not entail a major change to people’s lifestyles; they will be driving more fuel efficient cars and driving them better – saving money – and obeying the law! Further initiatives could include improvements to public transport or cycling facilities, or even tougher regulations for vehicle manufacturers.

¹¹ Meeting the Carbon Budgets - 2012 Progress Report to Parliament, Chapter 5, pages 176-187.
<http://www.theccc.org.uk/reports/2012-progress-report>

¹² The CCC’s “Business As Usual” CO₂ figure is based on a transport model from DfT rather than the DECC model. However, DfT do not publish fuel totals as part of their model, which is why we’ve used the DECC model instead. According to a civil servant at DfT, the two models are very similar and this shouldn’t be a problem.

The five scenarios above would result in a CO₂ reduction of 16% compared with BAU. As all of these carbon savings are achieved by burning less fuel, it's fairly safe to assume that this equates to a reduction in transport energy of 16%. To be on the safe side, we have rounded this total down to 15% in our energy calculations.

Biofuels from wastes and by-products

According to the Department for Transport (DfT), these were the amounts of transport biofuel from waste cooking oil, tallow and biomethane (from sewage and other wastes) in 2011. This includes large amounts of imports. The DfT also cite a report by the environmental consultants AEA Technologies about the likely maximum domestic production of used cooking oil and tallow. The table below summarises these figures.¹³

	2011 Domestically produced (PJ)	2011 Imported (PJ)	Estimated maximum domestic production (PJ)
Biofuel from Used Cooking Oil	3.4	11.7	5.3
Biofuel from Tallow ¹⁴	1.6	0.2	8.8
Biofuel from Biomethane ¹⁵	0.02	0	n/a

In the totals below, it is assumed that the levels of imported used cooking oil and tallow are unlikely to be maintained, as there will be increasing demand for these materials within their countries of origin.

Electrified transport

The Committee on Climate Change (CCC) suggest that battery electric and plug-in hybrid cars could, with proper support, reach 1.7 million by 2020. This would be 5% of all cars on the road, and 16% of new cars that year.

This would lead to a 3% reduction in CO₂ – about 0.8% from direct replacement of fossil fuels with renewable electricity,¹⁴ and a further 2% from the fact that electric cars use far less energy per km than fossil fuelled vehicles (this is included in the 15% demand reduction mentioned earlier).

The CCC is upbeat about the Government's current initiatives to promote electric vehicles: the plug-in car grant, the Plugged-In Places pilot charging schemes, and the Electric Charging Strategy. However, they are concerned about the changes that took place in the most recent Budget: "Budget 2012 announced that from 2015/16 zero and ultra-low emission cars will no longer be exempt from Company Car Tax, or from Business Cars First Year Allowance (for leasing firms)...Given the promise of this sector, the need for early take up of electric vehicles, and the very limited revenue generated by the Budget changes, we strongly recommend that the Government should reverse this decision. The Company Car Tax and Business Cars First Year Allowance exemption for electric vehicles should be extended to support the development of the electric vehicle market."

Meanwhile, there doesn't seem to be full support for the CCC's aims across Government; an October 2010 briefing note from the Parliamentary Office for Science and Technology's said, in relation to the 1.7 million target; "Given the length of time new vehicle technologies can take to become established, many

¹³ DfT, 2011. <http://assets.dft.gov.uk/consultations/dft-2011-05/doublecert.doc> (Annex 6) and <http://www.dft.gov.uk/statistics/releases/verified-rtfo-biofuel-statistics-2010-11/>

¹⁴ If Tallow is drawn from existing uses, such as heat generation, this may have unintended consequences such as indirect land use change. To replace tallow in heating, palm oil may be used

¹⁵ UK plans suggest that most biogas/biomethane will be targeted at heat and power generation instead of transport. But there is great potential for the use of biomethane in the transport sector.

stakeholders feel this level of uptake by 2020 is unlikely.” But clearly electric vehicles, powered by sustainable sources of renewable energy, are a genuine alternative and reaching 1.7 million vehicles by 2020 requires concerted and immediate government action.

Biofuels from other wastes and residues

“Sustainable” second generation biofuels don’t yet exist on any useful scale but small quantities – particularly from other existing waste streams - may be available by 2020. To meet the 10% target, and assuming the UK carries out all the other measures above and if the quadruple waste counting comes into effect as proposed in the new Commission proposal, an extra 22.7 Petajoules (PJ) of waste energy would be required to get us the rest of the way to the 10% target (see table).

In theory, there’s quite a lot of waste energy out there. Food waste could be anaerobically digested to produce methane although this preferentially should be burnt to produce electricity. According to a 2011 IEEP report¹⁶, the UK could in theory produce 282 PJ from “Genuine residual wastes” (ie landfill and food waste), 46 PJ from “arboricultural arisings” and 114 PJ from “Agricultural and forestry residues”. That’s 442 PJ of energy. However, it’s not quite that simple, because:

- Much of this energy is in the form of wood, energy crops, forestry residues or agricultural straw, which isn’t easy to transform into vehicle fuel and costly to transport;
- Transport fuel is not the most sustainable use for much of this waste – it would be better used for heating, electricity generation, soil improvement, or other purposes entirely (from animal bedding to building materials). That said, small quantities of such biofuels could be targeted at sectors where there are few other low-carbon options such as aviation or shipping;
- There’s a risk that creating demand for waste as a fuel can reduce the incentive to reduce waste in the first place – and reducing waste always saves more energy in the long term. As with all wastes, the primary focus should be on waste avoidance, then recovery, and finally disposal. In the waste management hierarchy, energy-from-waste comes fairly low down. Materials may have other more sustainable uses and have all sorts of unintended knock-on effects. For example, animal manure or straw, in part, maybe also be an important component for reuse and recycling on the farm and forestry residues should either be left in situ to replenish forest soils or the carbon should be locked away, e.g. reused in the board industry.

	PJ					
Surface travel demand cut to 15% below BAU, using CCC recommendations	1551					
Renewable Fuels		Real %	Current Uplift	RED %	New Uplift	RED %
Domestic UCO	5.3	0.3%	2x	0.7%	2x	0.7%
Domestic tallow	8.8	0.6%	2x	1.1%	2x	1.1%
Renewable electricity in cars ¹⁷	11.7	0.8%	2.5x	1.9%	2.5x	1.9%
Renewable electricity in public transport ⁶	6.9	0.4%	1x	0.4%	1x	0.4%
Biofuels from other wastes and residues	22.7	1.5%	2x	3.0%	4x	5.9%
TOTAL				7.1%		10.0%

¹⁶ <http://www.ieep.eu/work-areas/climate-change-and-energy/sustainable-land-use/2011/11/securing-biomass-for-energy-developing-an-environmentally-responsible-industry-for-the-uk-now>

¹⁷ This should be sourced from tidal, wind, geothermal, solar or small scale hydro for example but NOT biomass

That said, it would only need 6% of that 442 PJ to meet the 10% target but with all the caveats noted above. Tough rules will be required on exactly what wastes, by-products and residues are used, with all potential materials being assessed thoroughly through a comprehensive Life Cycle Analysis (LCA) on a case-by-case basis.

Conclusions and recommendations

The UK could meet its 10% transport obligations from the Renewable Energy Directive without the use of land-based biofuels.

- Cap all land-based biofuels at 0%, not 5% (i.e. land based biofuels cannot be used)
- Ensure that all energy used to meet the RED comes from truly sustainable and domestic sources i.e.
 - All bioenergy feedstocks – biofuels from waste and residues and advanced biofuels – be subject to full life cycle analysis by the end of 2013
 - Renewable energy should not be sourced from biomass
 - All member states should have in place strict waste management strategies that prioritises waste reduction and avoidance
- Member states to introduce energy reduction policies in the transport sector to incentivise more fuel efficient vehicles, 'smarter choices', eco-driving and enforcing speed limits.

These measures should be seen as a first step, with the aim of meeting our legal obligations from the EU without the need for crop-based fuels. Further measures to cut car use, improve public transport, boost clean renewables, electrify trains, cars and buses, shift freight from road to rail etc. would be needed on top of the policies outlined here in order to set the UK's transport onto a genuinely sustainable path.