Sustainable Bioenergy Feedstock

The major political and social issues surrounding bioenergy or biofuels relate to three key areas:

- The impacts of Feedstock Production
- Calculation of Greenhouse Gas (GHG) savings
- The social cost of promoting bioenergy, including balance of jobs

This paper deals with the issues surrounding Feedstock Production. It demonstrates that bioenergy feedstock production can be and is sustainable, and then addresses criticisms.

Displacing high carbon fossil feedstock with low carbon renewable feedstock

Low carbon biomass feedstock can be produced sustainably in Europe with many positive and few negative impacts. This **contrasts with fossil fuel feedstock**, which is a non-renewable extractive industry with a record of major environmental and social disruption.

In addition to bringing **social and economic benefits**, such as rural development, low carbon ethanol and other forms of bioenergy produced from sustainable feedstock displace high carbon fossil fuels. Biofuel's co-product, **protein feed for animals**, displaces imports of animal feed.

The most viable location for biorefineries is close to the farms that grow feedstock. These would be sustainable industries supplied locally, adding value with local processing, creating regional employment and boosting **rural economic development**. Regional biomass supply contracts would boost farm income and, crucially, **incentivize farmers to invest** in improving farming practices.

The two principal pathways to the most sustainable feedstock, those that don't cause indirect land use change (iLUC), are sustainable intensification of crop production and utilisation of abandoned land.

The objective should be to maximise benefits to Europe by growing sustainable feedstock within Europe and subject to EU standards. To achieve this, the **EU must adopt enabling policies**.

Sustainable intensification enhances cropland management

Under-yielding land reflects missed opportunities, is economically wasteful, is socially degrading and is environmentally suboptimal. Improving cropland management brings **benefits to farm families, the climate and the environment, food security and rural development**. Techniques for sustainable intensification are now proven and are being successfully applied.

Sustainable intensification enables **higher crop output with lower inputs** on the same amount of land and is key to increasing crop output to feed a growing world population. Much more food, feed, fibre and energy crops can be produced on the same amount of efficiently managed land while the impact on the environment is not increased. Energy crops may also be at the forefront in developing sustainable intensive crop management systems and improving resource efficiency.

Average annual increases of 2.5% per ha of land in Western Europe have been achieved in the production of arable crops since the late 1990s. Consequently, each year an average increase of 2.7m tonnes of biomass is realized from the same crop area. Since 2000 an additional biomass output of 122m tonnes has been generated[1]. Europe has significant potential for sustainable intensification, more than most other developed parts of the world. **Additional biomass** can be produced in two principal ways, crop yield improvement and double cropping, by using resource

[1] Langeveld et al. (2014) Biofuel cropping systems: Carbon, Land and Food. Earthscan, pp.271.

efficient and technologically smart practices. A recent Utrecht University study[2] investigating only three European countries showed that 1.3% of the total energy use (or 13% of the renewable energy use) in road transport in the EU in 2020 could be met by such biomass for both first generation and advanced biofuels without causing any ILUC.

Crop yield improvement:

Crop yields in Western Europe are the highest in the world, while those in Eastern Europe are low. There is a large "yield gap" in many European countries to be closed. Yield gaps show the difference between actual yield and potential crop yield. The yield gaps in Central and Eastern Europe and neighbouring countries are particularly large (may be over 10 tonnes per hectare), and yield contest results illustrate that average cereal yields could be at least doubled.

FAO shows that arable crop area in Europe declined from 84m ha in 2000 to 79m ha in 2010. At the same time, increases in cropping intensity have created a "virtual" 4m ha of additional arable land (not requiring area expansion)[3].

Double cropping:

Double cropping occurs where a second crop is harvested on the same plot in the same year, allowing farmers to increase harvest amounts without expanding their farms. Double cropping is a powerful way to make optimal use of land, but double cropping only really works in Europe with non-food energy crops as the second crop.

Use of abandoned and degraded land:

Agricultural land use in Europe has been in continuous decline since 1980. EU agricultural policy (including in large part deals made to admit Eastern European members into the EU) drove large areas of productive land into fallow or set-aside. This was exacerbated by the flight to cities inspired by weak global agricultural demand. In 2010, 6.3m ha of European arable crop area was fallow, with an unknown additional amount in set aside. Abandoned lands are substantial mostly in Eastern, Balkan and Mediterranean countries. Some scenarios[4] predicted that 4.2% of the farmland covering the EU Member States would be abandoned by 2040.

Co-products reduce land use and feed imports:

Animal feed co-production in biofuel plants saved the equivalent of 3.2m ha of crop production in the EU in 2010[5]. Bioenergy is fundamentally an agricultural industry. Biorefineries produce equal amounts of animal feed and biofuel. This animal feed has a very high protein content and ensures that none of the feed content of crops is lost in the refining process. It also contributes to reducing Europe's considerable animal feed deficit, reducing imports of climate unfriendly feed from deforesting areas (e.g. soy from Brazil) and reducing the amount of land needed to grow animal feed.

Factors contributing to farm underperformance:

A working market and stable policies for environmentally sustainable biomass would create an environment in which farmers would realise more of their production potential. The contributors to underperformance are among other things knowledge systems deficiencies; lack of mechanisation nutrient deficiencies, and lack of enabling environment for investments. Strong and positive policies could encourage farmers to increase investment in improving crop production.

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[2] www.uu.nl/en/research/copernicus-institute-of-sustainable-development/research/research-groups/energy-and-resources/potential-indirect-land-use-change-iluc

[3] Langeveld et al. (2014) Biofuel cropping systems: Carbon, Land and Food. Earthscan, p.271.

[4] Ceaușu, S., et al (2015). Mapping opportunities and challenges for rewilding in Europe. *Conservation Biology*. 29(4): 1017-1027

[5] Langeveld et al. (2014) Biofuel cropping systems: Carbon, Land and Food. Earthscan, p.271.

Issues and concerns about biomass production

Cropping systems in Europe are shaped by agricultural, environmental and energy policies. EU policy justifications for encouraging bioenergy production are: Energy security; GHG emission reduction; Rural development and Import substitution.

However more bioenergy implies increased biomass production and that means changes in conditions for traditional biomass users, including food and feed. Regulators and others have concerns about potential negative impacts of increased biomass feedstock production. These concerns arise under three headings: Land use, Cultivation and input use and Socio/economic issues.

Land Use:

The more politically sensitive impacts of biofuel expansion relate to changes in land cover, in particular conversion of nature areas or deforestation, and agricultural land use, in particular conversion of land used to produce food. Such land use changes may have serious consequences for the living conditions of the local populations, global food security and the conservation of biodiversity as well as carbon stocks.

One of today's major political and social challenges is how to organise food and energy production while curtailing carbon emissions and land use change. Concerns about area expansion or land conversion for renewables feedstock focus primarily on the amount of land used and the impact it can have across a variety of fronts.

Opponents of increased biomass production play on fears that date back to Malthus. **Fears that agriculture may be unable to produce** the crops needed to feed a population that is not only growing but getting wealthier thus is also using more biomass per head each year. The finite pool of natural resources, such as land and water, would no longer be sufficient to cover biomass demand, compounded by competing needs of urbanisation and industrial uses. In addition, climate change threatens crop productivity.

Area expansion however is not the main source of additional biomass. Most increases in crop production in the future are expected to come from **improved land use efficiency**. FAO predicted[6] that higher yields and more intensive use of land will contribute 90% to growth in crop production at world level up to 2050.

The EU has a relatively small share of world arable land at 108m ha. EU ethanol production utilises only 2% of EU grain supply and only 6% of EU sugar substrate. Since the RED was passed, more agricultural land has been removed from productive use than would be needed to supply all of Europe's ethanol plants. No land in Europe has been removed from food production for first generation biofuels.

Cultivation and efficiency of input use:

Cultivation and input use are inextricably linked. There are concerns that conventional farming has a negative impact on the environment. Impacts may stem from the application of (artificial) fertilisers and pesticides, tillage and machinery use, or water use. Emissions of ammonia, N2O and CO2, fine particles as well as pesticide residues may be associated with arable farming, contributing to impacts such as air pollution, eutrophication, soil deterioration, climate change or affecting human health and biodiversity.

[6] Bruinsma, J. 2009. The resource outlook to 2050: By how much do land, water use and crop yields need to increase by 2050? ftp://ftp.fao.org/agl/aglw/docs/ResourceOutlookto2050.pdf

Generally crop cultivation is responsible for nearly half of total biofuel GHG emissions, primarily from fertilizer use, especially in areas where fertilizer application does not accord with best available practices. Cultivation of biomass feedstock conforms to general crop production practices, therefore bioenergy feedstock production may face **similar challenges as arable farming in terms of mitigating its environmental impact**.

Additional biomass feedstock does not necessarily lead to higher emissions from farming. Sustainable intensification of arable farming allows for the production of additional biomass through yield increase and double-cropping while not increasing the burden on the environment. **Resource efficiency is key**. Output of crop production may be increased while reducing the use of inputs. Recent technologies, such as precision farming or application of drones, enables better planning and utilisation of inputs, tailored to the exact need of each plant, whereby waste and leakage is minimised and therefore emissions are eventually reduced. Higher cropping output does not necessitate higher input use – and this environmental benefit is a crucial tenet of sustainable intensification of cropping systems. It is possible to **produce more with less**, benefiting bioenergy production, farmers and local communities as well as the environment.

<u>Socio/economic impacts:</u>
Some of the more dramatic allegations against biofuels concern socio/economic impacts. The reality is that EU biofuel production fights poverty, combats hunger, supports food production, and promotes conservation of forests and biodiversity.

Deforestation*:* Deforestation and the resulting loss of biodiversity in the tropics caused by EU biofuel policy is one of the most emotional claims made against biofuels. The reality is different. Although deforestation in Indonesia and Malaysia is a real threat, only a small part of this may be used for biofuel production for EU Markets, and the nexus between African or Amazonian deforestation and EU biofuel policy is hardly real. Any such feedstock would of course be for biodiesel production and not ethanol. Ethanol is unrelated to the (palm) oil market, and thus has no link to tropical deforestation. Promotion of feedstock production within the EU would further reduce imports into Europe.

Land Grabbing*:* Land grabbing is also alleged to be encouraged by EU biofuel policy, with Sub-Saharan Africa claimed to be the most heavily favoured region. Again this is not a sustainable claim. The UK Overseas Development Institute found in its 2013 report that „the size of the 'global land grab' may have been exaggerated". Ecofys[7] found a negligible number of land deals possibly involving land grabbing for EU biofuels. Crucially, no biofuel produced in Africa is imported to the EU. Therefore EU biofuel policy cannot be blamed for land grabs in Africa.

Most importantly, the land grab concerns can be put aside by addition to RED sustainability requirements, and this anti-land-grabbing criterion may read as: "*Bioenergy feedstock shall not come from land that in 2008 was the primary source of sustenance for a local community*." Note that the EU biofuels industry has supported this effective legislative response.

Food v Fuel*:* A modern biorefinery uses only the starch (sugar) or oil content of the crop, such as corn or wheat, and the actually valuable nutritional components of the crop are returned to the food chain in the form of high protein animal feed. Note that sugar is the least valuable calorie that exists nutritionally.

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[7] Ecofys, 2013: Land grabs for biofuels

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Food Prices*:* It is alleged that a significant consequence of the EU biofuels policy is that it causes increases in food prices. Data do not support this. Indeed, initial suggestions that biofuels production were to blame for the spike in food prices between 2005 and 2008 have been debunked. Agricultural commodity prices are strongly linked to the oil price. The most recent World Bank report[8] concludes that increases in oil prices, changes in stocks and exchange rates, and not biofuel expansion, were the reasons for agricultural commodity price increases since 2004. It adds that 66% of price increases of biofuel feedstock commodities like wheat and corn over the last decade were due to the oil price, with the contribution of biofuels too small to quantify. In fact, the FAO Food Price Index in July 2015 in real terms was as low as it was in May 2007, while the FAO Cereals Price Index (wheat, maize, rice) is as low as Nov 2006[9]. This is a clear indication for a decoupling of biofuel production growth, which has grown steadily over the past decade, and global food or cereal prices.

Furthermore, generally commodity prices are only small components of final food product prices, and the prices of other components, such as processing, packaging, marketing, distribution are unrelated to farming.

Food distribution inadequacy and food waste, not biofuel feedstock production, are the key causes of global food scarcity problems. The world is producing more than enough food to feed its population. Roughly 30 to 40% of food in both the developed and developing worlds is lost to waste[10].

[8] Baffes and Dennis (2013), Long-term drivers of food prices. World Bank

[9] http://www.fao.org/worldfoodsituation/foodpricesindex/en/

[10] Godfray, H.C.J., et al., (2010) Food security: the challenge of feeding 9 billion people. Science 327, 812–818.