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ANUCES Roundtable Summary: Development and Impact of Biofuels Policies

Over the last decade, EU biofuels policy has been invested with hope as a central plank of the transition to a low-carbon economy while simultaneously attracting vilification for its alleged adverse impact on, among other things, land use, food prices, and water usage.

On Friday 3 August 2012 the Australian National University's Centre for European Studies held an invitation-only Roundtable for academic experts and policy-makers to discuss the development and impact of biofuels policies in Europe and Australia. Although the main focus of Roundtable discussion was on the possibilities for a sustainable transport policy that reduced greenhouse gas emissions, biofuels and biofuels policies are multi-faceted; contributions ranged widely to include analysis of issues such as the political backlashes against biofuels, the specification of sustainability criteria for biofuels usage, technological change in the bioenergy sector, energy security, agricultural markets and food security.

The participants in the Roundtable were asked to contribute a short summary of their perspectives on biofuels from either a European or Australian policy development. Although in no sense exhausting the list of salient questions in biofuels policy, these contributions reflect main dimensions of the governance challenges ahead for the EU and Australia in renewable energy. The Roundtable was held under the Chatham House Rule. The different contributions below are de-identified in line with this rule except where the contributor has agreed in advance to be revealed.

The Roundtable was stimulated by inputs from two ANUCES Visiting Fellows, who are both leading international biofuels policy experts: Professor Robert Ackrill from Nottingham Trent University in the UK and Professor Karel Janda of Charles University, Prague. Professors Ackrill and Janda each provide distinctive overviews of the topics covered at the end of this briefing paper—of EU biofuels policy and possible lessons for others, such as Australia.

EU Biofuels Policy

Delegation of the European Union to Australia

Biofuels have the potential to deliver a number of benefits to the EU. These include:

- Climate change mitigation: Biofuels can reduce greenhouse gas emissions from transport by displacing fossil fuels. Emissions resulting from transport account for 21% of the total EU emissions of greenhouse gases.
- Ameliorating energy security concerns: The EU currently needs to import over 50% of its energy requirements. There has been a trend of increasing energy import dependency in recent decades. Indigenous biofuel production has the potential to displace fossil fuel imports and biofuel from third countries has the potential to diversify EU suppliers.
- Jobs: Supporting rural industries and competitive advantage through innovation. Biofuel production employs both farmers and those in the processing stages of the value chain. EU research, development and commercialisation have the potential to deliver economic competitive advantage.

Whilst such benefits hold considerable appeal to politicians and policy makers, the spectre of perverse incentives and possibly significant negative externalities generate considerable debate amongst experts and the broader community.

The Renewable Energy Directive (RED) is the legislation underpinning the EU target of achieving 20% of final gross energy consumption from renewable sources by 2020. Each Member State has its own binding target ranging from 10% for Malta to 49% for Sweden. There is a separate binding target for all Member States to achieve 10% renewable energy in the transport sector. Importantly, this target can be achieved through any renewable energy carrier, including hydrogen and electric vehicles, but it is widely anticipated that the bulk of the target will be met through first generation biofuels.

Generally, there is good progress being made towards both the 20% and 10% targets, with the 2010 aggregated EU27 figures at 12.5% and 4.7% respectively. However, Member States do vary widely in their progress towards their individual 10% renewable energy in transport targets, with a range from 0.17% to 7.85%. The development of this artificially created market also presents opportunities for Australian producers of biofuel feedstock. This is notably the case for canola initially and has led to significant increases in exports of canola to the EU in recent years. Under RED, to be able to count towards the EU's renewable energy targets, the biofuels—including the feedstock—must demonstrate that they meet EU sustainability criteria. These criteria are related to greenhouse gas savings, land with high biodiversity value, land with high carbon stock and agro-environmental practices. They are intended to ensure that the biofuels contribute positively towards environmental and social goals and take into account both direct and indirect land use changes and other externalities. One means of doing this is being certified under a recognised ‘voluntary scheme’, which is the approach being used in Australia. Not being certified does not mean trade in the product is prohibited, just that it is not counted towards the EU's renewable energy targets.

Under the RED, the Commission is required to report to the Council and Parliament on social sustainability aspects, within and outside the EU, including impacts on the availability and price of foodstuffs. The Commission may also propose corrective actions if required. Robustly assessing indirect land use change impacts from both climate change and biodiversity conservation points of view will be challenging. The European Commission has recently signalled that it is investigating options to address these concerns. Furthermore, the Commission is also required to evaluate the effectiveness of the current sustainability criteria by 2014.

The Expansion of Biofuels and Greenhouse Gas Emissions

Robert Ackrill, Nottingham Trent University

Biofuels policies are motivated by three distinct drivers: **energy security** (diversifying energy supply away from fossil-fuels and from source countries which are limited in number and located in politically-unstable regions of the world), **rural development** (for example by promoting jobs, including high-tech., high productivity opportunities, in rural areas), and **climate change mitigation** (as alternatives are sought to fossil fuels and their greenhouse gas [GHG] emissions).

In the last decade public policies in countries worldwide, but especially in the EU and US, have promoted biofuels (ethanol and biodiesel), resulting in a rapid expansion of production and use. Indeed, the US is now the largest ethanol producer in the world, having overtaken Brazil whose ethanol market is essentially free of supply-promoting policy interventions. As this expansion has occurred, several actual or potential downsides to biofuels have emerged, which represent significant policy challenges to the continued expansion of biofuels markets. This short note outlines issues confronting the climate change mitigation role expected of biofuels.

The presumption that biofuels deliver GHG savings compared with fossil fuels is a simplistic position: every feedstock (input) and technology pathway combination delivers a different GHG performance. Policies have sought, in various ways, to promote first generation biofuels (based on agricultural feedstocks which also have uses as food or animal feed), even though they may generate only modest GHG emissions reductions compared with fossil fuels. They are promoted partly because the technologies already exist to produce such biofuels on a commercial scale, making them a necessary starting-point for the development of biofuels markets. But policies have also recognised the limitations of first generation biofuels because they have sought to promote the development and production of advanced biofuels (which are discussed in more detail in other contributions to this Briefing Paper). Thus first generation is seen as a ‘bridge’ technology, by which a biofuels market can be established, but which is then expanded through expanded production of advanced biofuels.

The use of agricultural commodities as biofuels feedstocks requires land; which, under different circumstances, could be used to grow crops for food/animal feed, or be left uncultivated. Focusing just on emissions-related effects, cultivating previously uncultivated land releases carbon stored in both the soil and the biomass contained therein. This release is worse if the land has first to be cleared of vegetation. These emissions should be included in the calculations of the emissions impact of the resulting biofuels. The development of advanced biofuels will not necessarily reduce this, as some non-food biomass also requires land—although such feedstocks may not require such high quality land as food/feed crops. This is crucial, because the use of food/feed crops for biofuels can impact on the production of food or animal feed, in two distinct ways, both of which would, in turn, impact on a given biofuel’s GHG emissions performance.

First, Direct Land Use Change (DLUC) describes the direct displacement of food production to other land, as a result of expanding production of biofuels feedstocks. Second, there is Indirect Land Use Change (ILUC). If the production of feedstocks for biofuels reduces the supply of commodities for food/feed, the price of the latter could rise. This could induce other farmers elsewhere (including other countries) to expand production of commodities for food/feed. DLUC and ILUC could result in the second-stage activity triggering additional GHG emissions which should also be attributed to the biofuels produced from the first-stage activity. ILUC, however, represents an enormous policy challenge because it cannot be observed, only modelled. And what economists are modelling are overlapping commodity markets, possibly in multiple countries, whilst trying to determine whether it is the original production of the biofuels feedstocks or one of multiple other factors which is affecting food prices and thus farmers' production decisions.

It has, for example, been estimated that EU biofuels policy could affect the use of land equivalent to the area of Denmark; or, approximately, 0.09% of global agricultural land. It is unclear what impact this will have—not so much because of the area involved, but because the exact impact will ultimately depend on which land exactly is used, where it is and what it was used for previously. Thus unless the impacts of the many, and uncertain, LUC effects are modelled accurately, the full life-cycle GHG emissions generated by biofuels production cannot be determined precisely. For now, therefore, the ability of many biofuels to deliver GHG emissions reductions compared with fossil fuels remains contested.

Biofuels: An Australian perspective

The Industry

Currently Australia has three first-generation operating ethanol production plants and five first generation operating biodiesel production plants. Australia's ethanol is mainly produced from wheat (including waste from wheat starch and gluten manufacture), sorghum and C-grade molasses. Australia's biodiesel is mainly produced from tallow and processed waste (primarily used cooking oil). In 2010-11, 319 megalitres (ML) of ethanol was produced in Australia and 77 ML of biodiesel was supplied into the market (both through production and imports). Australia has a number of strengths which support the development of an advanced biofuels industry. They include: abundant supply of non-arable land; suitable climate for growing a range of non-food energy crops such as algae; world-class niche scientific expertise in our research organisations; expertise in managing large projects; and a stable policy environment.

Australian Biofuels Policy

The Australian Government supports the development and use of biofuels due to the range of benefits that these fuels may deliver, including a reduction in Australia's reliance on imported oil, fuel security risk mitigation by diversifying supply as well as regional development benefits. The Australian Government recognises the complexity of issues facing the alternative fuels industry and has developed a Strategic Framework for Alternative Transport Fuels (the

Framework) as part of the development of a draft Energy White Paper. The Framework, which was released on 13 December 2011, establishes a long term approach to the market led adoption of alternative transport fuels in Australia and includes 20 actions for industry, Government and other stakeholders to implement to address identified barriers to uptake.

It should be noted that existing biofuels policies in Australia is not considered by the Government to contribute to global food security concerns or impact significantly on food prices. The rationale for this position is that the Australian industry is small scale and utilises wastes for a significant amount of production. However, it is recognised that there are limits to the amount of biofuels which can be derived using existing, first generation technologies and feedstocks and that the future focus will need to be on advanced, next generation technologies. Next generation biofuels are characterised as not being derived from food sources and not depleting native forests.

Australian Biofuels: Programs and Initiatives

Renewable fuels, including biofuels, are supported via a concessionary excise regime which effectively makes these fuels excise free. In June 2011, the Government agreed to continue the full excise reimbursement arrangement for biodiesel and domestically produced fuel ethanol until 30 June 2021. On 24 February 2012, the Minister for Resources and Energy, the Hon Martin Ferguson AM MP, launched the Advanced Biofuels Investment Readiness (ABIR) program. The ABIR program aims to progress the commercialisation of advanced biofuels by building the investment case for significant and scalable pre-commercial demonstration projects for the production of high energy, drop-in advance biofuels.

The Australian Government is working with the Biofuels Association of Australia and the International Standards Organisation (ISO) to develop internationally agreed sustainability criteria that can be applied to industry to ensure that support for biofuels does not compromise sustainable production practices and will provide greater impetus for advanced biofuels development. As the ISO process will take several years, a parallel process will be undertaken with Standards Australia to develop an interim biofuels standard for Australia.

Bioenergy research and demonstration: EU strategy

Description of the evolution of the technology over the past 10 years

The bioenergy sector is complex as it covers a very wide spectrum of options, from the biomass feedstock (e.g. crops, wood, municipal and industry waste, residues from agriculture and forestry, animal manure) to the end product (liquid biofuels, electricity, heat and biogas). Along this chain, several conversion processes (thermal: combustion, thermo-chemical: e.g. pyrolysis, gasification and biochemical: e.g. fermentation) and combinations of these processes are available.

Over the last 10 years, the development and improvement of combined heat and power (CHP) technology enabled to increase the efficiency of biomass energy conversion. Compared to a conventional power station, which has an operating efficiency of 40%, a CHP plant can achieve an overall efficiency of over 75%. First generation of both biodiesel and bioethanol production are mature technologies that have been optimised in terms of energy efficiency, process integration and processing of a broader spectrum of raw material qualities. EU biofuel consumption in 2009 reached 12.1 Mtoe, representing 4% of all road transport fuels (9.6 Mtoe biodiesel and 2.3 Mtoe bioethanol). EU biofuels consumption in 2009 is 18 times higher than biofuels consumption of 2000. The production of advanced biofuels from sustainable biomass is not commercial yet but reached the pilot and demonstration phases for the most advanced technologies. The production of bio-synthetic natural gas has progressed both via the thermo-chemical and the biochemical route and may provide commercial options also for the transport sector. The bioenergy sector faces high costs of biomass feedstocks. Indeed, feedstock costs represent between 60% to 80% of total costs of commercial biofuels. For all technologies, a crucial issue is to increase the supply of sustainable biomass at defined qualities and reasonable prices.

Role of EU projects in the process

Combined heat and power (CHP), and combustion systems have been in the past heavily financed. In FP6,[1] 13.8M€ have been spent on research activities on gasification and feedstock

[1] Sixth Framework Programme (FP6)

optimisation and 31M€ in demonstration activities for poly-generation. All RTD[2] projects on CHP issues were envisaging going to demonstration scale projects as a next step. At the end of FP6 the programme was refocused to research on second generation bio-fuels and on bio-refineries to reflect the energy security challenges of the transport sector. In FP7 the first calls continued to concentrate on advanced bio-fuels using non-food feedstock and on bio-refineries.

As an example, Abengoa's technology for the production of ethanol from agricultural residues such as straw was firstly supported under FP5 with a project achieving a demonstration scale of 5 million litres/year and was further supported under FP7 at a much higher scale (40 million litres/year) in the LED (Large Ethanol Demonstration) contract. After the completion of the LED project, the technology will be mature enough to plan the first commercial plant based on the demonstrated technology.

The bio-refinery is a recent and promising concept based on the processing of sustainable biomass into a spectrum of bio-based products (food, feed, chemicals, materials) and bioenergy (biofuels, power and/or heat). Bio-refineries are at an early stage of "industrial proof of the concept" and are supported under FP7 with 3 large-scale projects covering the whole value-chain and bringing together 69 partners from academia and industry.

Potential of the sector in the EU energy mix in 2020, 2050, and further

Bioenergy will play a key role in the EU long term energy strategy for all applications and especially the transport sector, contributing up to 14 % of the EU energy mix and up to 10 % of energy demand in transport in 2020[3]. It is foreseeable that this EU demand will be dominated by renewable fuels substituting middle distillates for the need of the road, aviation and marine transport sectors.

The potential of the sector in 2050 is rather speculative. The Blue Map Scenario of the IEA estimates a global biofuel consumption of 760 Mtoe representing 27% of transport energy.

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[2] RTD info is a quarterly magazine published by the European Commission presenting a mix of research results and debate on scientific subjects of interest to a wide, non-specialised readership. The common theme is Europe.
[3] Renewable Energy Roadmap — Renewable energies in the 21st century: building a more sustainable future, Communication from the Commission to the European Parliament and the European Council Com (2006) 848, 10 Jan 2007

Is the End in Sight for EU Biofuels Policy?

Robert Ackrill, Nottingham Trent University

Biofuels policies are controversial. There are questions over their ability to deliver GHG emissions reductions compared with fossil fuels and their impact on food prices, to name but two. There have thus been calls from some quarters, including NGOs and international organisations, for biofuels mandates to be abandoned. Thus when, in October 2012, the EU published a proposal to reform the Renewable Energy Directive (RED) and Fuel Quality Directive (FQD), speculation grew about the future of EU biofuels policy. The purpose of this note is to argue that what has been proposed does not mark the beginning of the end of EU biofuels policy. Rather, the changes proposed simply derive from the extant 2009 legislation.

The RED and FQD include a number of elements that recognise concerns over biofuels. For example, they require 10% of transport fuels to come from renewable sources, whereas the proposal called for 10% entirely from biofuels. Even though most will still be biofuels, that was a modest weakening. Moreover, Recital 9 of the Preamble to the RED emphasises the need to promote advanced ("second generation") biofuels, and to monitor the impacts of biofuels on the environment, sustainability, and agricultural food products. The Commission was also charged with bringing forward proposals about how to deal with indirect land use change (ILUC) effects in biofuels' GHG emissions calculations. In 2010, the Commission identified four possible ways in which ILUC could be addressed:

(1) take no action for the time being, while continuing to monitor,
(2) increase the minimum greenhouse gas saving threshold for biofuels,
(3) introduce additional sustainability requirements on certain categories of biofuels,
(4) attribute a quantity of greenhouse gas emissions to biofuels reflecting the estimated indirect land-use impact.

The ILUC element of the October 2012 proposals is, in effect, Option 4 plus something reflecting Option 2. Default ILUC emissions, in grams of CO2 equivalent per megajoule, are estimated for cereals (12), sugars (13) and oilcrops (55). These are not to be used where, for a specific biofuel, direct land use change effects are included in the GHG emissions calculation.

As scientific understanding increases, there is also scope for amending these figures, such as by laying-down ILUC values for individual feedstocks.

The current legislation requires a minimum GHG emissions saving (relative to fossil fuels) of 35% (for production facilities operating before 2008, this applies from 2013), rising to 50% in 2017. From 2018, biofuels produced in facilities built in 2017 or later must deliver GHG emissions savings of at least 60%. In practice, compliance with the higher figures requires either radical improvements in conventional biofuels technology pathways, or the rapid development and deployment of advanced biofuels to displace conventional biofuels.

Reflecting Option 2 above, in the proposals the 60% figure would apply to plants operating from the 1st July 2014. Thus plants built in the four years prior to 2018 would now also have to deliver greater emissions reductions, applying the higher threshold to an additional portion of future biofuels. Countering this, biofuels produced in plants built before the 1st July 2014 can now deliver 35% savings until the end of 2017. There is thus also a portion of biofuels that can deliver the lower figure for an additional year. The net effect on emissions will thus depend on the age of individual plants producing the biofuels.

The proposals also limit the contribution of conventional biofuels to transport fuels, to 5% (i.e. half of the 10% renewables figure); roughly equal to 2011 levels. But is this a u-turn? Not really, for two reasons. First, as noted earlier, the RED called for the ongoing monitoring of the impacts of biofuels. The 5% figure can be seen simply as a response to this. Second, as discussed, the RED already includes measures which increase in future years the required GHG emissions reduction for biofuels to count against the EU mandate. This, inevitably, would anyway disqualify much of the biofuels that count currently, notably biodiesel, unless there are significant and rapid developments in biofuels' technology pathways.

In order still to deliver the 10% figure, on paper at least, the proposal includes multipliers by which advanced biofuels can count towards the target, either 2-times or 4-times. This is purely a paper exercise in terms of volumes. It does, however, also reflect the greater GHG emissions savings potential of biofuels that do not require land in their primary production.

Also proposed is the ending of public subsidies for crop-based biofuels after 2020. This could, potentially, rule out significant portions of EU production. That said, much EU production may have been ruled out anyway by the extant rules on rising GHG emissions thresholds. The same applies to imported biofuels, notably some imported biodiesel.

Thus most of the proposed changes to the RED and FQD have their basis in the existing legislation. The death of EU biofuels policy has most definitely been exaggerated.

Some environmental considerations related to biofuels

Karel Janda, Charles University

While the carbon emissions and reduction of GHG are the leading environmental considerations related to biofuels, there are a number of other environmental concerns. Change from the existing agricultural crops into a biofuel feedstock or development of new biofuel acreage may lead to increased soil erosion and deforestation. An increase of an acreage devoted to biofuels may lead to the decrease in biodiversity. The extensive production and the use of biofuels may increase the hazard of air pollution both during the growth of biofuel feedstock and during the burning of biofuel when it is actually used. All of these possible detrimental effects are very much dependent on particular geographical, climate, and technological details of any considered biofuels production, processing and utilization project. In some cases, biofuels may actually improve or be neutral with respect to any of the environmental concerns mentioned in this paragraph.

Their effect on water supplies is also a very important environmental aspect of biofuels. While an increased use of biofuels may lead to a higher demand for water resources both during the production of biofuel feedstock and during their processing, there is also a question of water pollution. Here, a danger of small scale water pollution from biofuel feedstock may be compared with a danger of a large scale or an accident-related water pollution caused by the production of fossil fuels. While the water-pollution-related hazards of conventional oil drilling are well understood and publicized, there are also important water-pollution hazards connected with new technologies of fracking or tar sands mining. According to Glassman, Wucker, Isaacman and Champilou (2011), petroleum from the Canadian tar sands extracted via surface mining techniques can consume 20 times more water than conventional oil drilling. Hydraulic fracking, which is considered to be the most important North American energy development in recent decades according to Glassman, Wucker, Isaacman and Champilou (2011), is a technique that pumps liquids under high pressure to create fractures in rocks that previously could not release their natural gas. This method of natural gas extraction leads to a significant pollution of local water resources in some cases.

Very important environmental feature of biofuels is their role in the development of the relevant biotechnologies, especially genetically modified crops. The advances in the biofuel feedstock relevant biotechnology are an important technological factor determining a successful development of biofuel sector. Rajagopal, Sexton, Roland-Holst, and Zilberman (2007) consider a possibility that agricultural biotechnology may be used to target improvements in the photosynthetic efficiency and content of cellulose, hemi cellulose and lignin in the biofuel feedstock. They raise the idea that it may be possible to engineer plants to allocate greater quantities of carbon to stem growth as opposed to height growth and in this way to enhance biomass production. While this conceptual idea is related primarily to the second generation biofuels, the agricultural biotechnologies (especially genetic engineering) are highly relevant already for the first generation biofuel feedstock. Currently, three out of four main genetically modified crops (cotton, corn, soybeans, and rapeseed) are major biofuel feedstocks. In their simulation analysis based on the econometric estimation, Sexton and Zilberman (2012) show that at the height of the 2008 global food crisis, the additional output generated by genetically engineered crops yield gains significantly mitigated price increases. They argue that already the first generation genetically engineered crops permit the intensification of agriculture, which effectively frees land for production of biofuel, or at least diminishes the demand for new cropland induced by rising food and fuel needs.

The increase of biofuel feedstock productivity therefore serves as a mitigating factor in the food versus fuel dilemma. While the conversion of land and other agricultural resources into the biofuel feedstock production naturally increases food prices, the increased productivity may offset this price-increase pressure. Successful biotechnology provides a clear way toward increased productivity which may resolve food versus fuel dilemma at the level of commercial use of both the first and the second generation biofuels.

Since biofuels convert energy that was originally captured from solar energy via photosynthesis, there is an obvious possibility of comparison between biofuels and a direct use of solar energy. Reijnders and Huijbregts (2007, 2009) provide a comparison of the efficiency of solar energy conversion for automotive purposes. They show that conversion of lignocellulosic biomass into electricity to power an electric vehicle may do substantially better than the use of the most energy efficient first generation biofuel (ethanol from sugarcane) in converting solar energy to automotive power. And the conversion of solar energy into automotive power based on solar cell is even more efficient.

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