



AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

**Teagasc response to Green Paper  
“Towards a sustainable energy future in Ireland”**

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# **Response to Green Paper**

## **“Towards a sustainable energy future in Ireland”**

### **Background**

Recent developments in the use of biomass as fuel are increasing both the general level of activity and the diversity of the biofuel uses. Projects to produce fuel for transport (pure plant oil, biodiesel and bioethanol), residential heating (pellets, cereal grains), commercial boiler fuel and electricity generation (wood residues, miscanthus, willow) are under way or being actively pursued. These will generate a demand for a range of annual (rape-seed, cereals, possibly hemp) and perennial (willow, miscanthus, possibly reed canary grass) crops as well as residue materials such as straw, beef tallow and recovered vegetable oil.

The growth of energy outlets is likely to have a stabilising effect on crop prices. But substantial investment will be required in the establishment of perennial crops and processing facilities, and excessive competition or unwise investment could lead to expensive failures. Some biofuel imports will be inevitable, but clearly the aim should be to keep them to a minimum.

If we are to avoid misdirected investment and minimise imports, the various sectors of biofuel production should be developed to assure a reasonable profit for farmer and processor and to provide maximum national benefit in terms of supply security, greenhouse gas abatement and compliance with existing and upcoming EU Directives.

In response to the Green Paper, some suggestions are offered here about the lines along which our biofuel industry should develop, and the initiatives needed to stimulate the development of a balanced sustainable biofuel industry

### **Liquid biofuels**

***MOTR and 2% substitution target:*** Filling the current MOTR excise relief scheme from native feed-stocks would require the produce of about 75,000 ha of tillage land, i.e. about 20% of our total tilled area. It is likely that there will be some imports of feedstock or finished product so the target, although significant, could be achieved with little disruption of existing food or feed enterprises.

**Green Paper and 5.75% substitution target:** The follow-up target of 5.75% in the Biofuels Directive is also set as a target for Ireland in the Green Paper. It will be extremely difficult for Ireland to achieve this target from native resources in the medium-term future, almost regardless of policy initiatives, for the following reasons:

- With present technologies, Irish liquid biofuel feedstocks are confined largely to annual arable crops. The short-term prospects are ethanol from cereals or beet and vegetable oil from rape-seed, with a small amount of tallow and waste vegetable oil.
- To achieve the 5.75% target for both diesel (rape-seed oil) and petrol (ethanol from cereals) would require about 180,000 ha of rape-seed, and 75,000 ha of cereals. With rape in a one-in-four year rotation, this would need 720,000 ha of land in tillage, almost twice the present amount. The inclusion of beet for ethanol production would further exacerbate this problem. The extra tillage land would lead to the production of over 1 million tonnes of additional cereals that would have to find a new market. It would also probably bring us above the 10% reduction in permanent pasture specified in the most recent CAP re-negotiation (Department of Agriculture and Food, 2006).
- If the overall substitution target were met by producing more ethanol and less rape-seed, an area of about 115,000 ha of cereals and 40,000 ha of rape-seed would be sufficient. This would be much more attainable from a land use viewpoint, and more realistic in terms of the required tillage increase. Another option would be to transfer some of the rape-seed area to beet for ethanol production. But any option along these lines would require ethanol substitution in petrol of well above 5% on average. At present, an EU Directive restricts the sale of ethanol for use in unmodified engines to 5% blends with petrol (Commission of European Communities, 1985). Higher proportions could be used in flexible fuel vehicles. But with very few FFVs on the road at present, it is difficult to see how higher levels of substitution could be achieved in the short to medium term.
- A recent report by the European Environment Agency questions the availability of any land in Ireland on which to produce biofuel crops without increasing pressures on the environment (European Environment Agency, 2006). This report takes no account of the demise of the sugar industry, and is based largely on an unreasonable assumption that no permanent pasture should be replaced by biofuel (tillage) crops. Nevertheless, it is clear from the report that any Irish biofuel programme that involved a substantial expansion of the current tillage area would be examined critically by environmental bodies.

- The Irish maritime climate is generally better suited to the production of lignocellulosic (mainly perennial) crops rather than sugar, starch or oil (mainly annual) crops. Eventually it will be feasible to convert lignocellulose to liquid biofuels. Second-generation technologies are emerging for the conversion of materials such as wood, straw or miscanthus either to ethanol or to other petrol or diesel substitutes. However, it will be many years before these technologies reach commercial reality. From an Irish perspective, there is also a concern that the scale required to make these plants viable may be beyond our feedstock production capacity. Finally, it remains to be seen whether the price that could be paid for feedstock for these plants would be attractive to an Irish producer. For the present, we can only await developments.

In the meantime, would it not be better for Ireland to settle for a transport biofuel substitution target not much over 2%, and focus more attention on the use of ligno-cellulose materials for heat/electricity production as detailed below? If the European Commission does not accept this approach, then it is almost inevitable that to meet its Biofuels Directive targets Ireland will be forced to import large quantities of either liquid biofuel feedstocks or processed biofuels. In that case the same cost of excise relief will be incurred, but with no benefit to agriculture and limited effect on fuel supply security. French and German studies have shown that excise relief based on home-produced feed-stocks is largely recouped by the exchequer as additional VAT, income tax etc generated by the additional economic activity. Relief on imported feed-stock or biofuel would cost about €8M per annum per 1% substitution, virtually none of which would be recouped.

***Home-produced vs imported biofuels:*** While it would not be permissible to discriminate against biofuel imports from other member states in the MOTR or similar schemes, projects with short transport distances between feedstock source, process plant and end user should be favoured on the basis of reduction in road traffic and associated road congestion and vehicle emissions. Biofuel imports from within or outside the EU should be carefully monitored to ensure that every aspect of their production is environmentally sustainable.

***Excise relief vs. inclusion obligations:*** For the promotion of transport biofuels, a variety of mechanisms could be considered (Sustainable Energy Ireland, 2005). Most of the leading EU member states are now beginning to move the emphasis from excise relief to blending obligations, i.e. obliging oil companies to include a certain proportion of biofuels in their annual sales. Eventually a similar move may have to be considered for Ireland. But obligations create a very inelastic market. They would need to be closely matched to native biofuel production capacity; otherwise they will lead to big fluctuations in biofuel prices and stimulate imports. This could seriously

damage Irish biofuel production at its present fledgling stage, and might be better deferred until the industry is more mature.

***Biofuel quality:*** The current MOTR scheme rightly puts great emphasis on fuel quality assurance. The growth of a fledgling industry would be seriously damaged by the marketing of low-quality biofuel leading to engine problems. Every producer needs to ensure that all their production meets the appropriate standard (EN 14214 for biodiesel, DIN 51605 for pure plant oil, and in the absence of an agreed EU standard for bio-ethanol, either prEN 15376, ASTM D 5798, ASTM D 4806 or the Swedish Sekab standard). All future support schemes should maintain this quality emphasis.

***Biofuel technologies and feedstocks:*** Subject to the quality requirements listed above, biofuel incentives should not discriminate between biofuel feedstocks or technologies. Actions by other member states to disincentivise the use of pure plant oil in modified engines or the use of tallow as a biodiesel feedstock should not be followed. Possible Commission moves to exclude the use of tallow for biodiesel production should be discouraged.

## **Solid biofuels**

The Bioheat and Greener Homes schemes have generated huge interest in biomass heating fuels; at present this interest is concentrated mainly in three areas:

***Commercial heat:*** The total energy demand of the commercial/public sector in 2005 was 1.8 million tonnes of oil equivalent (Sustainable Energy Ireland, 2006). Heat from oil, gas and coal accounted for over 1 million tonnes of this demand. The most likely biomass substitution in this market is wood chips as boiler fuel. The chips could come initially from forest and sawmill residues and forest thinnings. COFORD have estimated the availability of sawmill and forest residues at about 0.5 million tonnes at present, increasing to 1.3 million tonnes by 2015 (COFORD, 2002). However, as Coillte's timber is subject to long-term agreements, Teagasc figures show that the biggest long-term source of energy wood is first thinnings in farm forests (Table 1).

Table 1: The potential output from thinning from private forests based on 50% of stands being thinned over the period 2006 - 2015

First thinning age	First thinning volume (ktonnes*)	Second thinning volume (ktonnes*)	Cumulative volume output (ktonnes*)
2006	876**		876
2007	194		1070
2008	195		1265
2009	273		1538
2010	369		1906
2011	352	1226	3485
2012	225	272	3981
2013	213	273	4466
2014	250	382	5099
2015	302	516	5917
Total	3248	2669	

\* Weight of freshly felled timber

\*\*Analysis assumes that this volume is removed from forests currently aged 15 – 26 in 2006 and 2011.

To meet a market beyond this level, short-rotation willow and miscanthus are among the more likely possibilities. The main problems would be:

- 1) *The cost of willow production:* An establishment grant will be essential to stimulate development of these crops. It costs approx €2,800/ha to establish miscanthus and €2400/ha for willow. The payback period for these crops is 7–10 years at an assumed price of €60/tonne. Farmers could not be advised to plant either crop in the absence of establishment grants.
- 2) *Support services:* There is no equipment on farms or with local contractors either for planting willows or miscanthus or for harvesting willows. Farmers or contractors will need some incentive to invest in such equipment to allow an industry to grow to a commercial level.
- 3) *Drying of willow chips:* Willow chips need to be dried from a moisture content of over 50% at harvest to below 30% for safe storage and efficient combustion. Current Oak Park trials with simple low-cost ventilation systems are expected to provide an answer to this problem.
- 4) *VAT exemption for planting material:* An exemption is needed from VAT on the purchase of miscanthus rhizomes and willow cuttings. This would reduce the establishment cost of both crops by over €200/ha, a very significant cost reduction.
- 5) *Miscanthus boiler:* Many wood-burning boilers would not be suitable for burning miscanthus; a suitable boiler would have to be selected. One such boiler is currently being commissioned at Oak Park; it is bigger and more expensive, but more fuel-flexible than the standard wood-chip boiler.

These fuels are bulky and expensive to transport, so the initial target market sector should be buildings outside urban areas with a big, continuous heat demand, such as hotels or hospitals. Short distances between fuel source and user will be important, so distribution will be very much on a local basis. The development of reliable local supply chains will be a key to success, if heat users are to be persuaded that they can safely change to biomass fuel. Start-up aid should be provided towards co-operative groups setting up supply chains. A comprehensive support mechanism along the lines of the DEFRA Bio-Energy infrastructure Scheme should be put in place (Department for Environment, Food and Rural Affairs, 2006). Local authorities should be encouraged to do business with local supply chains to heat swimming pools, government buildings etc.

**Residential heat:** The Irish total residential energy demand was almost 3 million tonnes of oil equivalent in 2005 (Sustainable Energy Ireland, 2006). At least 2 million tonnes of this demand is heat from fossil oil, gas and coal. The most likely alternative to these fuels is biomass pellets used in stoves and small boilers. Demand for pellets has exploded since the advent of the Greener Homes Scheme, and this demand is being met mainly by imports.

Sawdust is the first choice material for pelleting. National production of sawdust has been estimated at about 200,000 tonnes (COFORD, 2002), but some of this is already used for energy, e.g. for on-site heating or in CHP units at sawmills, or in the existing pellet plant in Enniskillen. When sawdust supplies are exhausted, wood residues, cereal and rape straw and energy crops such as willow or miscanthus would be other possibilities as feedstocks for pellet production. The high bulk density of pellets reduces transport costs, which will facilitate imports from countries with low-cost raw materials and large production scale. Even allowing for transport costs, home pellet production will need to be very efficient to compete with these imports. Capital grants will be needed to allow a number of projects of a suitable scale to get under way before imported produce establishes a firm hold on the Irish market.

In rural areas, an alternative boiler fuel for heating farm homes is cereal grains. While the heat value of grain is close to that of wood, ignition difficulties, higher ash content and clinker formation present more challenges to the boiler. We need to clarify the relative merits of the various grain species and the maximum moisture contents for satisfactory combustion. Teagasc is currently commissioning one such boiler; others have already been sold to tillage farmers, and any teething problems will be quickly sorted out. Current or new grant schemes for domestic boilers should apply to those burning grain as well as other biomass fuels.

With the Greener Homes grant scheme to alleviate the higher costs of biomass boilers, at present oil and gas prices a change to biomass looks attractive. Substitution of 10%

of residential oil-gas-coal use would require at least 200,000 tonnes of oil equivalent, or roughly 0.5 million tonnes of biomass. The achievement of this target would require as much sawdust as can be collected as well as other wood and crop residues and some energy crops.

**Electricity generation:** The 30% peat substitution target set out in the Green Paper for the three peat-burning stations would require biomass to replace about 0.9 million tonnes of peat. Assuming net calorific values of 8 and 12 MJ/kg for peat and biomass respectively, about 0.6 million tonnes of biomass would be required. Given that commercial and residential demands will develop for wood residues, it is likely that much of the power station demand will have to be met by energy crops.

The selection of suitable energy crops for this purpose will need to be re-examined with a view to providing a year-round supply of suitable material. The most likely contenders are likely to be miscanthus, willow, hemp and possibly reed canary grass. The environmental impacts (biodiversity, hydrology, visual impact etc) of growing a large amount of energy crop close to the power stations would have to be considered, but should be largely beneficial if the right crop mix, site selection and husbandry practices are followed. The social benefits of providing alternative employment for workers currently engaged in peat harvesting would be substantial.

The present fuel payment system whereby the generating station pays a low price for peat and recoups carbon credits for peat combustion from the PSO levy provides no incentive for the generator to change from the use of peat and does not provide an economic price for the energy crop producer. The price currently paid for peat (€3.50/GJ, or about €42 per tonne of biomass) would not cover the cost of producing energy crops. If the payment system were modified to allow the saving in carbon credits to the electricity producer to be used to top up the raw material price paid to the grower, and an establishment grant scheme and VAT relief on planting were available to the producer, some progress towards the Green Paper target could be expected.

Small grid-connected CHP plants based on either combustion or digestion of biomass have developed in other countries where higher prices are available for renewable electricity. Prices of at least €0.12/kWh for a number of pilot projects are needed to get some development under way in this area.

Small-scale on-site off-grid electricity generation from biomass in CHP plants should also be brought into consideration. New micro-turbine based technologies are beginning to emerge that may prove economic in applications where suitably matched power and heat loads are available for a high number of working hours per year. Grant aid will be needed to get a number of pioneering projects off the ground.

**Biofuel quality:** Just as with liquid biofuels, an effective and stringent solid fuel quality control and monitoring system is required for chipped and pelleted materials to build consumer confidence in a fledgling industry. For wood chips, the most important quality factors are likely to be moisture content, chip size and contaminants. For pellets, moisture content, durability, calorific value and ash content are the main concerns. Facilities for measurement of these and other quality factors need to be available at various levels, and a certification system needs to be put in place.

### **Land use and biofuels**

Taking account of all the foregoing, what should be our targets for the development of the various biofuel sectors? In the short term, the first target should be the achievement of the 2% substitution target, requiring up to 75,000 ha (Table 1). The 5.75% target would require 150-250,000 ha of tillage land. If we were to ignore this and aim instead at 25% of the commercial heat market and 10% of the residential oil/gas market, we would substitute the same amount of fossil energy (450 ktoe). This would require about 45,000 ha of land that is currently in grassland or tillage (Table 1). To make a start on the supply of biomass to power stations, the Green Paper target of 30% substitution of peat would require about 600,000 tonnes of biomass - 60,000 ha if all produced by energy crops (Table 1).

The achievement of these targets would require that the produce of an area of at most 180,000 ha be devoted to fuel crops. Given that some biofuels will be imported and some of the demand will be met from residue materials, the actual area required would be somewhat less than this. So the effect on land use and farming would be significant but not traumatic.

To broaden farmer interest in energy crop production, two further issues will have to be addressed:

1. Under the current REPS rules, farmers who grow energy crops lose their REPS payments. This anomaly is unjustifiable and significantly reduces the pool of farmers who might consider growing energy crops. A total of over 50,000 farmers with 1.85 million ha of land in the REPS scheme would be excluded on this basis.
2. The current EU premium for energy crop production on land other than set-aside is €45/ha. But farmers who convert grassland to energy crops and avail of this payment would have their Compensatory Allowance reduced by €88.88/ha (Department of Agriculture and Food, 2006). To overcome this problem, the energy payment should be increased until it at least matches the Compensatory Allowance.

<u>Substitution</u>	<u>Energy demand (ktoe*)</u>	<u>Land needed (ha)</u>
Total national energy demand	• ~16,000	• ~5 million
2% of transport fuel (arable)	• ~80	• ~75,000
5.75% of transport fuel (arable)	• ~265	• ~150-250,000
25% of commercial oil/gas/coal	• ~250	• ~25,000
10% of residential oil/coal/gas	• ~200	• ~20,000
30% of peat in power stations	• ~600	• ~60,000

\*1 ktoe = 1000 tonnes of oil equivalent

**Table 1:** Energy and land needed for various biofuel substitution targets

Longer-term development is difficult to forecast at this stage. Much will depend on the rate of development of second-generation biofuel technologies, especially those aimed at converting cellulosic materials to liquid biofuel. But if we establish the feedstock production and supply chains to achieve the short-term targets, there should be little difficulty in expanding or adapting to meet future targets as opportunities develop. In the meantime, useful studies could be carried out of the feedstock quality requirements of the second-generation technologies, the economies of scale, and the logistics and environmental impacts of growing and assembling the volume of feedstock needed for viability.

## Conclusion

A transfer of some land from food/feed production into energy crops along with the use of forest and crop residues as fuels can bring substantial improvements in energy supply security and greenhouse gas balance; a reduction of food/feed production should also help to stabilise prices for these products. So the Green Paper focus on increasing the use of biomass as fuel is to be welcomed.

Biofuel industries can develop only if they are profitable for raw material supplier and processor, and attractive to investors. At present there is still an over-riding problem that the profitability of producing and processing biofuel crops remains very low. If the industry is to develop to a significant scale, ways of improving profitability must be found. Some of these are suitable subjects for R&D, e.g. finding profitable fuel uses for rape straw, lower-cost perennial crop establishment systems, feasibility of pelleting non-wood materials, use of energy crop sites for effluent disposal etc. Research Stimulus funding in these areas is proving valuable, and should be continued and expanded. But there are also a number of policy and incentive issues that need to be addressed:

- An increase in the Energy Crop Premium would restore the incentive for those in receipt of Compensatory Allowance as well as improving the profitability of arable biofuel crops.
- A change from excise relief on transport biofuels to substitution obligations on oil companies should be deferred for the present and introduced gradually as the biofuel production industry matures.
- To the maximum possible extent, support measures should favour projects involving short transport distances. This should boost home production and greatly reduce the net exchequer cost of the support measures.
- The large investment and long lead-in time required to change land use patterns and establish biofuel processing facilities needs to be recognised. The present MOTR scheme has a life of only five years. A longer-term guarantee of support will be needed to secure commitment from biofuel crop producers and investors in process plant.
- An establishment grant and VAT exemption on planting materials to offset the high initial cost of perennial energy crops such as willow and miscanthus is needed. The area supported by the grant scheme needs to be big enough to be of national significance.
- To stimulate the development of solid biofuel supply chains, support for their establishment similar to the DEFRA Bio-energy Infrastructure Scheme should be introduced.
- For power station use, the payment system for fuel needs to be modified to allow the reduced need for carbon credits when biomass is burned instead of fossil fuel to be passed to the raw material producer.
- The anomaly of excluding REPS participants from energy crop production needs to be eliminated.
- Pilot projects are needed to promote technologies that are being adopted in other countries but have not yet got off the ground, e.g. biogas from crops and wastes and small-scale CHP and power generation. To get such projects moving, an increased price for bio-electricity pilot projects (at least €0.12 per kWh) is needed.
- Studies are needed on the logistical and environmental aspects of energy crop production that is concentrated near power stations or 2<sup>nd</sup> generation liquid biofuel technologies.
- Looking further ahead, the feedstock quality requirements and required scale of the emerging lignocellulose-to-biofuel technologies should be investigated.
- Finally, if the momentum generated by initiatives such as the MOTR, BioHeat and Greener Homes scheme is to be sustained, and if home production of biofuels is to be optimised, decision-making time-scales need to be accelerated and structures streamlined to allow this to happen. Short delays in processing the MOTR and establishment grant schemes can set back planting decisions

by a year or more. Any capital grant aid for pellet production facilities needs to be processed quickly before imports become entrenched in the market. A more coherent, responsive structure for the speedy handling of all these issues is needed.

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