IMPACT OF BIOFUELS ON DAIRY FEEDING

FINAL REPORT

FEBRUARY 2008

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ACKNOWLEDGEMENTS

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ABBREVIATIONS

BPEX	British Pig Executive
DDGS	Dried Distillers Grains with Solubles
EBLEX	English Beef and Lamb Executive
EC	European Comission
EU	European Union
FAPRI	Food and Agricultural Policy Research Institute
FOB	Free on Board (ship)
GM	Gross Margin
HGCA	Home Grown Cereals Authority
MDC	Milk Development Council
n/a	Not Applicable
NM	Net Margin
OECD	Organisation for Economic Cooperation and Development
ppl	Pence Per Litre
ROCs	Renewables Obligation Certificates
RTFO	Renewable Transport Fuels Obligation
SAC	Scottish Agricultural College
USDA	United States Department for Agriculture

EXECUTIVE SUMMARY

1. The rapid expansion of biofuel production in many regions of the world has coincided with a sharp rise in the price of grains, oilseeds and other feed ingredients. This has the potential to impact on the dairy sector significantly.

2. This study has been commissioned by MDC to investigate the impact of the biofuels industry on dairy feeding and milk production systems on farm. The study has been undertaken by SAC and Biofuels Matters Ltd.

3. This work builds on a previous study commissioned by EBLEX/BPEX and HGCA investigating the opportunities and implications for using biofuel co-products for livestock feed.

4. The first part of the SAC study assessed the impact of the biofuels sector on the feed market; both globally and in the UK. On a global basis the most important impact has been the rapid expansion of US maize usage for ethanol. This has been an important factor supporting global grain and oilseed meal prices. So far the impact of biofuels usage in the EU has been less. While EU demand for biodiesel has lent significant support to rapeseed prices the low level of ethanol production means there has been little impact on grain prices.

5. Both the US and the EU have set strong targets for future biofuel usage which is likely to mean that biofuels continue to have a significant influence on feed costs in the years ahead. However there is considerable uncertainty as to whether these targets will actually be met and a combination of rising feedstocks costs, competition with food use and environmental concerns are likely to hinder the rate of biofuel expansion.

6. In order to assess the current and future impact of biofuels on dairy feeding global price projections from OECD and FAPRI were used for the main grains and feed ingredients relevant to the dairy ration through to 2014. These were then adjusted to generate UK price projections based on transport costs and different UK biofuel scenarios.

7. The projections see wheat prices in the UK remaining firm to 2014 relative to recent history though well below 2007. UK rapemeal and soyameal prices however are expected to decline steadily to below recent historical levels. This would make protein cheaper relative to energy in the feed ration. Market uncertainty requires these estimates be treated with caution.

8. Developments within the UK bio-ethanol industry were assessed in the study. Total DDGS production of the three most promising proposals could result in wheat usage of 3.3mt and DDGS production of around 1.1mt by 2010. However only one plant is under construction and the commercial viability of UK grain ethanol is currently under threat from low cost ethanol imports and rising grain prices.

9. The most important development in the biodiesel sector would be the construction of additional rapeseed crushing capacity releasing additional rapemeal for animal feed. Three different plants are being proposed but it seems likely that only one additional crushing plant might be built utilising 0.25mt of oilseed rape and producing 0.125mt of additional rapemeal.

10. The level of additional feed co-product likely to emerge from the UK biofuel industry appears relatively modest at present and would probably be absorbed within the existing UK and EU feed market without undue disruption or excessive price discounting. Energy markets also offer an alternative market supported by the Government's Renewables Obligation for electricity.

11. The study then examined the nutritive values and feed characteristics of the co-products of biofuels production and identified practical constraints on the use of these feed materials. In general rapemeal and DDGS can be satisfactorily utilised within the dairy ration at moderate to low levels though a number of feeding and milk quality constraints were identified.

12. These nutritional parameters were then combined with projected price levels to assess the impacts on concentrate prices, dairy diet costs and consequences for margins. A representative feed formulation was prepared and then considered for 6,000, 8,000 and 10,000 litre per cow model dairy units.

13. Though not solely attributable to biofuels feed prices rose by around £50/t in 2007 increasing milk production costs by between 1ppl and 2ppl depending on system. The future impact on feed prices of biofuels and other factors is expected to be less than 1ppl as continued relatively high energy prices (cereals) are expected to be offset in part by lower anticipated protein prices (rapemeal, DDGS).

14. Fortuitously for dairy producers, higher milk prices this year have more than offset the impact of sharply rising feed prices. Based on best estimates of forward prices it appears that feed costs will not be sufficiently elevated on their own to justify any marked change in production systems unless milk prices fall back sharply from current levels.

15. Higher relative energy (cereal) costs may lead to lower starch levels in the diet with a potentially negative impact on milk protein levels and hence milk price. These impacts can be minimised through careful diet formulation.

16. Another potential threat to the dairy sector is the possibility that producers will cut back cow numbers or move out of dairying all together in order to grow an increased area of cereals. To assess the likely impact of this a detailed sensitivity analysis was conducted to compare the benefits of milk and cereal production. With milk prices of 22ppl all of the dairy production systems would outperform cereals unless grain prices climbed to between £200 and £250/t.

17. The overall conclusion is that the emerging biofuels industry would not seem at present to be a major driver of structural change in the UK dairy industry. However the situation is evolving rapidly and continued assessment is needed.

18. At present levels, feed costs on their own are not a major threat to the UK dairy sector but combined with rises in the cost of other inputs (fertiliser, fuel) the impact is more significant. Any significant decline in milk prices would therefore continue to present a threat to milk profitability and UK milk production levels.

19. Milk producers can seek to reduce feed costs through the use of cheaper feeds and maximising the use of grass through for instance spring calving. Any major change to established systems needs to be carefully assessed however to ensure the gains are not offset by additional costs and losses in output and milk price.

20. The difficulty in making projections of future price levels, whether feed or milk, means that producers should not place too much reliance on forecasts. It is therefore essential that producers fully understand the impact that price changes for milk, feed, or other costs will have on the returns from their dairy system so that they know what price levels they need to protect.

21. The study identified several areas for future work to benefit the industry. This includes advice on balancing diets to make use of biofuel co-products, development of a calculator to compare dairy and alternative enterprises, monitoring of UK biofuel developments and co-products, training for dairy producers in risk management and continued assessment of global biofuel policies and market impacts.

1. INTRODUCTION AND OBJECTIVES

Introduction

1.1 There has been a rapid expansion in biofuel production in recent years in many regions of the world. For example, in the US, the percentage of corn production utilised for ethanol rose from just over 10 per cent in 2002/3 to 18 per cent in 2006/7 (and is forecast to increase considerably as new capacity comes on line). This increased biofuel demand coupled with recent poor harvests has seen both grain and oilseed prices rise strongly. Although higher grain prices are expected to lead to increased global production as idle land comes into production and crop substitution occurs, the pace of current demand global growth in biofuel, human consumption and livestock feed markets is such that higher prices are expected to continue in the short to medium term. This has the potential to have a significant impact on the agricultural sector in general, and the dairy sector, in particular.

1.2 The production process for biofuels results in a number of co-products that are potentially suitable for livestock feeds such as DDGS and rapemeal. Therefore, the growth in biofuels production will lead to increased supply of co-products. This increase in supply might be beneficial to the livestock sector if it results in lower priced feed. However, it is not certain that all biofuel co-products will be utilised for animal feed due to competition with the energy market particularly in areas distant from livestock production.

1.3 Biofuels will affect the dairy cow feed market through their impact on:

- the price of grain and oilseeds
- the price and availability of biofuel feed co-product
- competition for land and other inputs and impacts on other agricultural sectors (for example, reductions in poultry production could lower competition for feed)

1.4 In terms of the price of grains and oilseeds, it is clear that there is a global and a local aspect to the impact of the growth in biofuels demand. However, given the size of the UK market, it is changes on the global market that are the most significant with world wheat prices already rising around £50/t in the last year, in part due to increased biofuel demand. It is possible that in the longer term these higher prices will lead to an increase in global supply as farmers respond and attempt to increase production. This could lead to a return to overproduction and price falls. However, due to increasing competition for land, the short to medium term price impact of increased biofuel demand is likely to be upwards with increased volatility along the way.

1.5 At the domestic level, if the UK sees significant biofuels production capacity built then estimates suggest that local price gains could be in the region of £5/t to £10/t. Given the geographic concentration of the dairy sector in the UK, the location of the biofuels plants and transport costs for the various co-products are likely to play an important part in determining whether they become available for livestock feed. Therefore, there is the potential for marked regional differences in the impacts of biofuels plants.

1.6 Increased biofuel production will lead to higher output of feed co-products. Economic theory might suggest that increased supply will lead to lower prices for co-products. However, the relationship is far from simple. It will depend, amongst other things, on how effectively the co-products can be utilised for animal feed bearing in mind constraints of transport costs, the fact that the by-products can simply be used to produce energy themselves, and the ability to be utilised within existing livestock diets and systems. In fact, it is likely that co-product feed ingredient prices will remain linked to the value of grain and oilseeds for the foreseeable future, and as already noted, these commodities are experiencing strong prices at present. The main price changes are likely to be *relative* with rapemeal seeing a greater price discount to soyameal for instance.

1.7 In addition to the direct effects in terms of higher feed prices and the production of co-products, the dairy feed market is also likely to be affected by increased competition for land and other resources. Consideration also needs to be given to the development of other livestock sectors. Clearly, the pig and poultry sectors are large users of grains, and a reduction in scale of these industries will reduce demand, and perhaps ease some of the pressure on the dairy sector. Also, biofuels are expected to have an impact on the relative price of energy versus protein. This will have an important effect on the overall cost of rations.

1.8 Wheat is in a sense more versatile as a feed source as it may be fed simply as a grain, as a whole crop, or used for some other purpose that generates co-products such as distilling or biofuels. Oilseed rape is to some extent more limited, as animal feed is the co-product of some other process (such as crushing or biofuel production).

1.9 A further factor that needs to be taken into account is the extent that a resurgent agricultural sector may lead to cost inflation in terms of both factors of production (land, labour etc.) and also key inputs such as fertiliser, chemicals etc.

1.10 Therefore, it is clear that the overall impact on the dairy sector will be the result of a complex interaction of a number of factors including: the extent that prices change for both grains and co-products; the extent of substitutability between different feed ingredients and; the ability of farms to adapt their overall farming system (for example, switch from high concentrate use to a complete forage based system) to the new situation.

Objectives

1.11 The following specific objectives have been set for this project:

- o Objective (1) - To understand the market impacts (positive and negative) of the biofuels industry in the dairy cow feed market
- o Objective (2) To appreciate the impact that any changes in supply will have on the economics of dairy cow feeding and cow nutrition
- o Objective (3) To appreciate any foreseeable issues and develop strategies to address these where appropriate in the short, medium and long term
- o Objective (4) To provide recommendations for future work that may be necessary to address these issues and strategies

1.12 The next section outlines the approach adopted to ensure that the objectives are fully met.

Objective (1) - To understand the market impacts (positive and negative) of the biofuels industry in the dairy cow feed market

1.13 The approach adopted to achieve Objective 1 was through a combination of review of existing literature, consultation with key industry figures, economic analysis and expert knowledge.

1.14 The first stage involved a review of the HGCA/BPEX study that completed a preliminary investigation on the potential demands of the biofuels marketplace on existing raw material production. The review and subsequent analysis enabled estimation of the likely overall impact on cereal and oilseed supply and demand and the subsequent prices of any feeds derived from them for the dairy sector.

1.15 Understanding the impact on the dairy sector involved a review of the current and future potential impact of biofuels on global feed prices. It also involved a review of UK biofuel projects that are likely to go ahead, the nature and volume of their co-products and geographical location. Through informed assumptions about transport costs, feed values, value for alternative uses (e.g. energy) the likely availability and cost of co-products to the dairy industry was considered. In particular, it was assessed whether or not availability of co-products could potentially offset some of the negative effects of market price rises arising out of increased competition for grains and oilseeds.

1.16 Successful completion of Objective 1 enabled estimates of changes in supply and demand for alternative feeds and the price impacts to be derived, in addition to a broader view of the economic impacts on the Dairy business. This formed an input into Objective 2 where the economics of dairy cow feeding and cow nutrition were examined.

Objective (2) - To appreciate the impact that any changes in supply will have on the economics of dairy cow feeding and cow nutrition.

1.17 The second objective considered how changes in supply and absolute and relative prices of feed ingredients will impact on dairy cow feeding and cow nutrition. Two stages were undertaken to achieve this overall objective.

1.18 In the first stage, the nutritive values and any constraints on feeding were identified. Five main feed material co-products were identified from biofuel production depending on the raw material and production process. These were:

- DDGS (moist) - following extraction of starch from cereals, particularly wheat, for bio-ethanol
- DDGS (dry) - as above, with drying
- Rapeseed Meal (extracted) - from industrial extraction of oil from oilseeds for bio-diesel
- Rapeseed Meal (expeller) – from farm-scale cold crush extraction of oil from oilseeds for bio-diesel
- Glycerol

1.19 Information on nutritive values and other feeding characteristics with specific reference to dairy cattle was collated for each of these feed materials using relevant published research papers, review reports including the recently completed HGCA/BPEX report, and information gleaned from feed industry contacts. The aspects considered are highlighted in Table 1.1.

Table 1.1: Feeding Characteristics

Nutrients	Other Characteristics
(Dry Matter)	Variability
Energy	Storage Requirements
Protein	Palatability
Protein Degradability	
Oil	
Fibre	
Minerals	

1.20 From this information, constraints on the inclusion of these products in dairy cow rations were identified.

1.21 Having confirmed typical nutritive values and identified the constraints on feeding, the second stage examined the economic impacts of these co-products by formulating a specimen concentrate blend for dairy cattle. The main tool used was the SAC Feedbyte program which incorporates the Feed into Milk (FiM) rationing system. Using prices for the biofuel co-products and other feed materials consistent with conclusions drawn from the market impacts section of the study, and working with the nutritive values and constraints determined, the blend was evaluated for it's nutritional characteristics and total cost. From the latter total costs, the impact on dairy margins was assessed for a range of dairy production systems.

Objective (3) - To appreciate any foreseeable issues and develop strategies to address these where appropriate in the short, medium and long term.

1.22 Whilst the direct impact of changes in feed prices can be determined as above, it is evident that rather than simply accept the consequences where these are increased, the producer may be able to take steps to mitigate these through changes to feeding systems, production systems and enterprise mix on the farm. The potential to make changes to existing systems and the consequences arising will depend on many factors including what system is presently being operated, the potential of the land, and location. This component of the study aimed to identify and examine the physical and financial outcomes for a number of possible scenarios.

1.23 However, on the basic assumption that arable margins increase and feed prices rise as a result of crops being diverted to biofuel production rather than animal feed, the possible options considered included:

- Cutting back purchased feed use
- Replacing compounds with cheaper feed materials / blends
- Marketing existing arable crops rather than using them as home-grown forage or concentrates, resulting in less starch in rations
- Changing calving pattern to low input, grass-based spring calving
- Revising the enterprise mix to more arable / less dairy

1.24 Clearly, some of these options are more short term whilst others can only be achieved in the medium to longer term. The opportunities for these were considered separately for dairy producers who operate grass-only systems with no potential for arable cropping, those with potential for arable cropping, and those presently with arable crops being used for the dairy enterprise.

1.25 Outcome considerations would include the potential impacts on milk yield per cow, milk constituent quality, seasonality, cow numbers, overall farm outputs and gross margins. It is proposed to utilise the MDC What-if? package to model the scenarios. Such an approach will not only illustrate the strategies that are likely to be most appropriate for business profitability and on-going sustainability, but will also demonstrate the methodology that individual producers can use for their own circumstances.

Objective (4) - To provide recommendations for future work that may be necessary to address these issues and strategies

1.26 Through undertaking the tasks to achieve Objectives 1 to 3, research required to enable farms to adapt fully to the envisaged changes were identified. Potential research topics considered included:

i) Impacts on national milk production - This study will speculate on whether there will likely be any changes to total milk production, seasonality and geographic location resulting from the growth in biofuels, however any forecasts may become more refined over time as the industry and markets reach a more settled level and producer intentions can be surveyed.

ii) Protein quality - The risk of supplying excessive amounts of rumen degradable protein is a potential limiting factor on rates of inclusion for feed material co-products. The potential to use feed technologies to allow a greater degree of rumen protection will be examined briefly, however, this aspect may warrant a more detailed costed evaluation.

iii) Enterprise Mix Tool - To develop a simple tool to optimise the enterprise mix on farms with potential for dairy and arable production.

2. MARKET IMPACTS OF THE BIOFUELS INDUSTRY

Introduction

2.1. This chapter attempts to understand the main market impacts of the biofuels industry on the dairy cow feed market

2.2. The chapter begins with a review of the previous study of the impact of biofuels on livestock feeds conducted for HGCA and BPEX[1]. It then goes onto assess the impact that biofuels (and other factors) are having and are projected to have on the price of feed ingredients. These global projections are then translated into representative UK price projections. An update is given of current UK biofuel plant proposals and their implications for UK biofuel co-product supply and price. A number of UK feed commodity price scenarios are then prepared covering the main feed ingredients; wheat, barley, soyameal, rapemeal and DDGS.

Review of HGCA/BPEX study

2.3. The study presented UK forecasts of potential supply and demand for biofuel co-products based on assumptions about likely UK plant construction. Based on recent slower than expected progress and high feedstock prices these forecasts now appear either over optimistic or will take longer to develop. A key area that the study did not tackle in detail was the issue of pricing. Without prices it is not possible to formulate feed rations so this has been a key element of the current study.

Feed cost trends

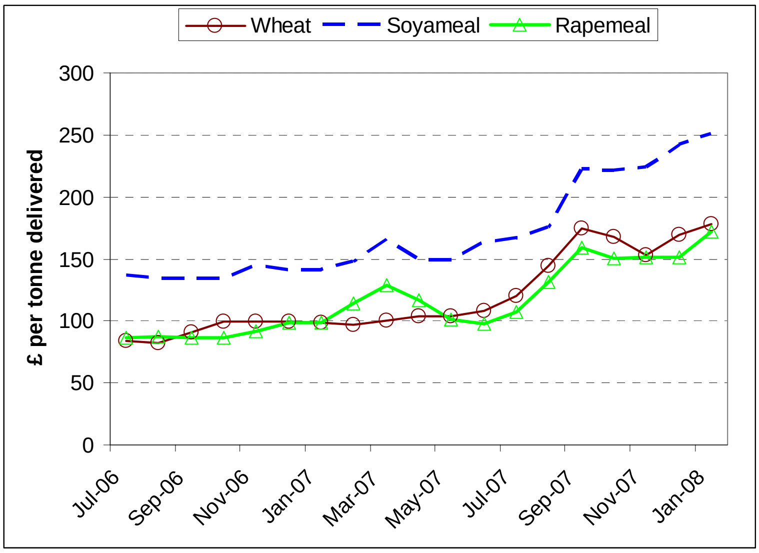
UK feed ingredient prices

2.4. The price of the main raw materials used in animal feed such as cereals and oilseed meals have been rising steadily over the last two years, a trend that has accelerated in the last 6 months boosting UK wheat and oilseed meal prices to record levels. Between July 2007 and January 2008 the following price changes have been witnessed in the UK delivered feed market;

- Wheat up 48% – rising £58/t to £178/t
- Soyameal up 51% – rising £85/t to £251/t
- Rapemeal up 61% – rising £65/t to £172/t

[1] Opportunities and implications of using the co-products from biofuel production as feeds for livestock

Figure 2.1 - UK wheat and protein prices at record highs



Source: MDC & HGCA

Raw materials usage in animal feed

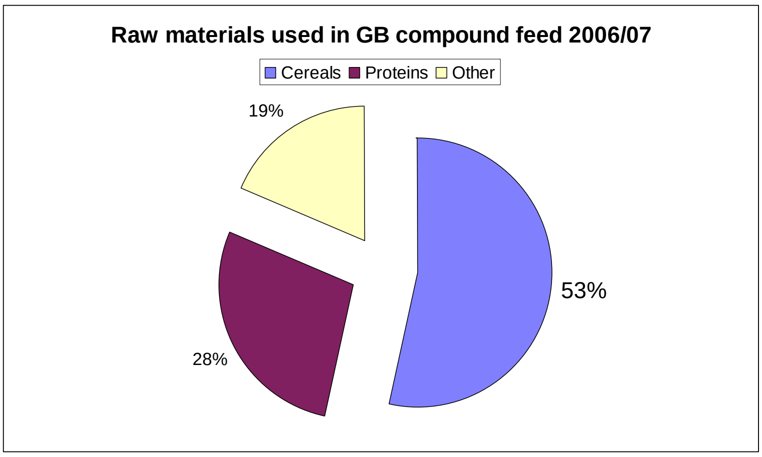
2.5. To put these price rises in perspective it is useful to understand the importance of the main ingredients used in the different animal feeds. The main source of energy in UK rations is cereals; predominantly wheat followed by barley. The main source of protein is soyameal along with rapemeal, corn gluten and other minor oilseed meals

2.6. In 2006/07 cereals accounted for over half (53%) of total raw material usage in Great Britain (GB) retail compound feed production[2]. Wheat was the largest source of energy and on its own represented over 29% of all raw materials used. Protein meals were the next largest category of raw material used making up 28% of total ingredients[1]. Soya was the largest source of protein and represented over 11% of all raw materials used.

2.7. There are no official figures that give a breakdown of raw materials usage in animal feeds for the different livestock sectors. Dairy and other ruminant rations are generally less reliant on wheat and soyameal and able to utilise a wider range of raw materials. However the pricing of most other feed ingredients remains linked to the price of wheat and soyameal.

[2] DEFRA GB Animal Feed Statistical Notice

Figure 2.2 – Raw materials used in GB compound feed

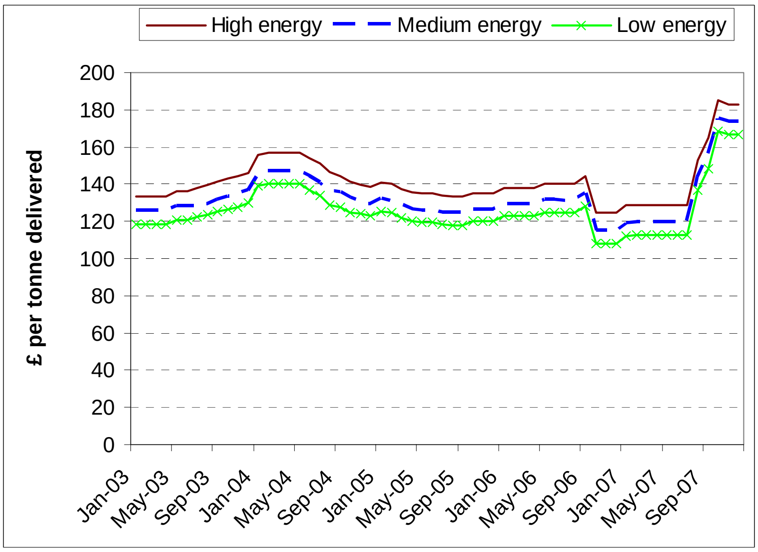


Source: DEFRA

UK dairy compound feed prices

2.8. In light of the sharp rise in raw material costs the cost of manufactured compound feeds has also risen though not quite as quickly. Large scale forward buying at lower prices by feed manufacturers and strong competition has helped slow the rise in the cost of dairy compound rations. In the 6 months from July 2007 dairy compound feed prices rose by an estimated 40 to 50 per cent depending on energy level. However if grain and oilseed meal prices continue at current levels then further rises in the cost of compound feed are inevitable as feed manufacturers move off lower priced contracts

Figure 2.3 - UK dairy compound feed prices rise by up to 50% in six months



Source: MDC

Current market drivers

2.9. Higher grains and oilseed meal prices are helping to drive up the costs of straight and compound rations. For the purpose of this study it is important to consider the role that biofuels have to play in the market and whether higher feed prices are a short term blip or the start of a longer term trend.

2.10. Some key current drivers include;

- Low stocks - world grain stocks are the lowest relative to usage on record leaving little margin for further declines and heightening market volatility.
- Rising demand – world demand for grain has risen ahead of consumption for the past 3 years. Growing population is one factor, but equally increasing wealth in countries such as China is raising world meat consumption and boosting demand for feed grains and protein meals. Biofuel demand has also grown strongly particularly in the US.
- Intense competition for land – record high world wheat prices have only resulted in a 4 percent rise in world wheat sowings for harvest 2008, because world maize and soya prices have also been close to or above record levels maintaining the areas of these other crops.
- Rising production and transport costs – ammonium nitrate fertilizer prices have doubled in the past year, phosphate and potassium prices have risen even faster. Rises in fertilizer prices alone have added around £10/t to grain production costs in the UK and elsewhere. Similarly world oil prices of close to $100/barrel raise production and transport costs. In addition rapid Chinese demand growth for many commodities has resulted in a shortage of sea freight boosting transport charges higher still.
- Restrictive GM policies within the EU – delays to the approval of new GM soya and maize varieties are restricting the sources of soyameal and feed grains available to EU importers. Non GM soya sources are currently trading at £15/t premium at present, this is likely to rise.

2.11. Many factors point towards a continuation of higher prices but commodity markets by their very nature are hard to predict and it is important to be aware of the many factors that could also bring prices lower.

- Higher world plantings – world grain and oilseeds plantings are expected to rise steadily in the next few years. Short term measures have already seen the lowering of EU set aside to 0% which could add another 20mt to EU grain production. Longer term, more land will be brought into cultivation particularly in the Former Soviet Union and South America but it does take time.
- Favourable world weather and good yields – the main driver of market uncertainty is the weather and it is possible that higher plantings coupled to particularly favourable world weather could restore world grain and oilseed markets sooner than expected. In 2004, world wheat production rose by 70mt following the shortage and high prices in 2003.

- Reduced demand from both animal feed and biofuels – most livestock producers have so far been unable to pass on their increased feed costs to the end consumer. As a result margins in pig, poultry and beef production are low or negative in many cases. Consequently demand is already being lost both here in the UK and elsewhere as livestock producers exit. In a similar manner high feedstock costs are also hitting biofuel producer margins and several plants have been mothballed or shelved in the EU and the US

2.12. Current market signals suggest that livestock producers may continue to face relatively high prices for the next 2 to 3 years unless the world enjoys particularly good growing conditions in producing regions. Dairy producers are therefore strongly advised to take steps to limit the impact of any sustained rise in feed prices.

The current role of biofuels

2.13. Current high grain prices have been precipitated largely by adverse global weather and lower than expected world grain production at a time of low world stocks and rising demand. Underlying this however has been a steady increase in global biofuel demand for grains and oilseeds.

2.14. The overwhelming influence has come from a rapid growth in US ethanol production from maize resulting in sharp rises in the maize price and consequent competition with other crops for land, principally soyabeans.

2.15. The next most important driver has been EU demand for biodiesel, supporting prices and production of rapeseed and other oilseed crops.

Biofuel demand for grain

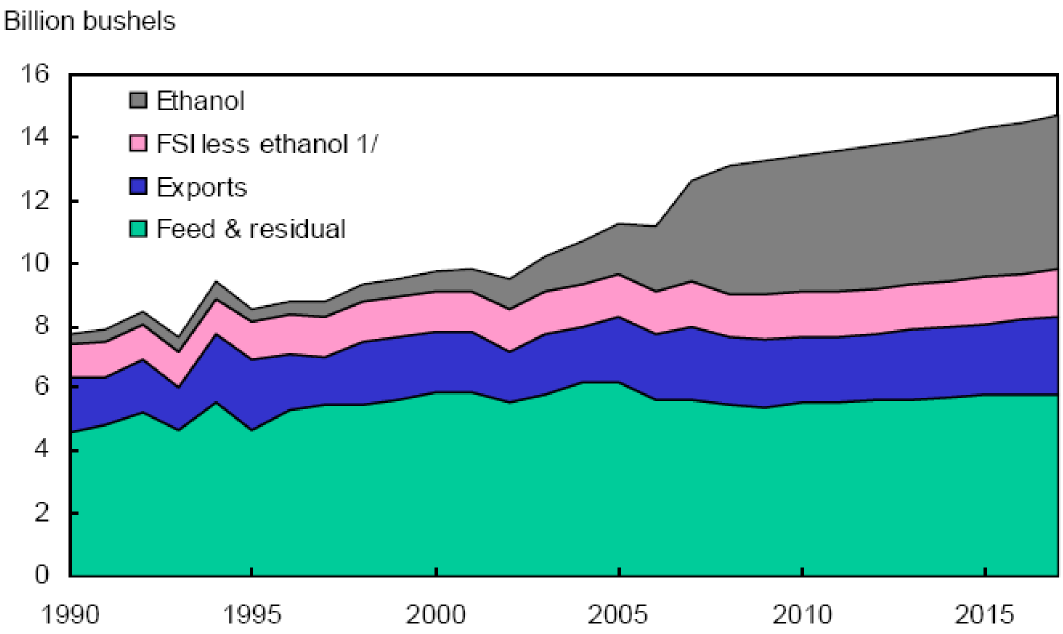
2.16. In 2007 the US is estimated to have used a total of 62 mt of maize for ethanol production compared to an estimated 5.2mt of grain used in the EU[3]. In 2008 US maize usage in ethanol is projected to climb 24mt to 86mt while over the same period EU grain usage is only set to climb 0.6mt to 5.5mt. In terms of grain usage China is the only other major producer of grain based ethanol for fuel production, utilising around 1.5mt of maize annually with only modest future growth expected.

2.17. Looking ahead the US is expected to see maize used for ethanol to climb to between 108mt[2] and 111mt[4] per year by 2010, and account for almost one third of the US maize crop. As Figure 2.4 shows growth in maize usage for ethanol has been most rapid in the period 2006 to 2008 and the future rate of growth is expected to slow. In the EU grain usage for biofuels is estimated to climb to 6.8mt by 2010, according to FAPRI. While these estimates are subject to a considerable degree of uncertainty it is clear that the US is

[3] FAPRI 2007 Agricultural Outlook
[4] USDA Agricultural Projections to 2017

already using around 15 times more grain for biofuel production than the EU and this disparity seems only set to grow. In terms of medium term market impact the US is set to remain the dominant biofuels influence on world grain markets.

Figure 2.4: US maize usage projections



1/ Food, seed, and industrial less ethanol.

2.18. What are the main impacts of US biofuel use of maize so far and into the future;

- Higher US and world maize prices –
    - o although below EU price levels, stronger US maize prices have helped provide underlying support to global grain markets.

- Increased US maize plantings -
    - o leading to a reduction in the planting of other crops, particularly soyabeans in the 2007/08 season resulting in a sharp drawdown in world soyabean stocks and sharply higher soyabean and soyameal prices
    - o contributing to a sharp rise in demand for fertiliser, since maize is a demanding crop, contributing to the more than doubling of world fertiliser prices in 2007/08 with consequences for crop and livestock producers world wide.

- Medium term decline in US maize exports as ethanol demand grows
    - o as the world's largest exporter of feed grains a reduction in US maize exports will support world feed grain prices and stimulate production elsewhere.

- Increased availability of ethanol feed by-products

    - o Rapid expansion in ethanol production is leading to a rise in US distiller's grains production expected to reach around 25mt in 2008/09. This represents a new supply of low grade protein suitable for beef and dairy producers, particularly in the US. However EU controls on non-approved GM varieties mean that exports of US distillers grains have been severely restricted preventing EU livestock sector from benefiting directly.

Biofuel demand for oilseeds

2.19. The world's largest market for biodiesel produced from vegetable oil remains the EU, driven principally by Germany. Within the EU, biodiesel demand now accounts for over 40 per cent of all vegetable oil demand and over 60 per cent of rapeoil demand[5]. Across the world biodiesel demand has accounted for over 40 per cent of annual demand growth for vegetable oil in recent years.

2.20. Biodiesel has been one of the main drivers of demand growth for vegetable oil in the EU and the world helping to raise world vegetable oil and oilseeds prices. Some of the consequences have been -

- Increased global oilseed meal output
  Rising demand for vegetable oil has encouraged increased plantings of oilseed particularly high oil yielding crops such rapeseed in the EU and oil palm in SE Asia. This has helped support oilseed meal production (rapemeal

[5] USDA PSD (Production Supply and Distribution) online database

in Europe, Palm Kernel Meal in SE Asia) and helped moderate oilseed meal prices (until recently).

- <u>Increased oilseeds plantings, particularly in Europe</u>
  EU rapeseed plantings reached a new record in 2007, limiting the production of other crops particularly grain and pulses.

Future biofuel targets

EU biofuel targets

2.21. Current EU usage of biofuels is concentrated on rapeseed and biodiesel with limited usage of grain. Concerns over energy security, climate change and support for agriculture are key drivers behind the EU's energy policies and have led to recent agreements to introduce obligatory biofuel targets.

2.22. The current voluntary biofuels targets were introduced in November 2001 in the Biofuels Directive setting out voluntary targets for the percentage of road fuels to be sourced from renewable fuels. The targets commenced in 2005 at 2% rising to 5.75% by 2010. Few EU states met the targets and, following pressure to make the targets obligatory, the EC made proposals for a new Energy Policy for Europe in January 2007.

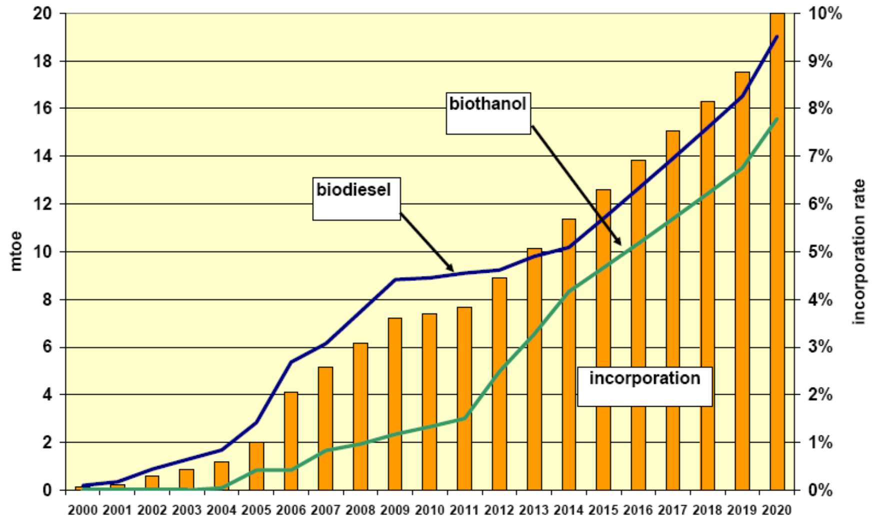
2.23. In February 2007, EU energy ministers agreed to increase the share of biofuels used in transport to 10% by 2020. It has been estimated that without the binding 10% target, the EU would probably only achieve around 4% of biofuel use by 2020.

2.24. In March 2007 EU ministers endorsed a 20% shared of renewable energies in overall EU energy consumption by 2020. Although each member state would be held to the 10% biofuels target, each member state would decide how they contribute to meeting a 20% boost overall in renewable fuel use by 2020.

2.25. In January 2008 the EC introduced strict new sustainability criteria to ensure that domestic and imported biofuels are produced sustainably.

2.26. Based on the 10% target an EC assessment stated that EU production of biofuel could reach 34.6 million tonnes of energy equivalent by 2020, 10.8 million tonnes more than levels would be without the binding biofuel usage target. This would require the usage of 59mt of grain and over 21mt of oilseeds. The successful development of so called 'second generation' biofuel technologies based on cellulosic materials and wastes are also seen as key to meeting the demand.

Figure 2.5: illustrative development of biofuels in the EU until 2010



Source: European Commission[6]

2.27. According to the Commission the impact on agricultural production and prices would be most marked for oilseeds since they expect the EU to have a significant surplus of cereals available for biofuel production. The other key assumption is that the bio-fuel by-products would see a significant fall in prices.

Figure 2.6: Cereal, oilseed and vegetable oil markets in 2020 under a 10% minimum incorporation obligation in the EU-27

	production	total domestic use	of which biofuel feedstock		prices (real)	exports	imports
	mio t	mio t	%-of domestic use	mio t	€/t	mio t	mio t
Cereals	317.3	311.72	19%	58.99	111.7	16.46	10.90
-soft wheat	156.59	138.95	31%	43.06	112.1	22.64	5.00
-maize	69.18	70.18	20%	14.18	103.1	1.50	2.50
Oilseeds	33.41	64.84			237.3	0.30	39.97
-rapeseed	20.67	32.83	65%	21.21	201.4	0.10	12.26
-sunflowerseed	9.28	11.02	12%	1.29	335.2	0.20	1.94
-soybeanseed	3.46	20.99	38%	7.88	189.1	0	17.53
Sugar	16.95	19.07	12%	2.34	412.4	0	2.12
Vegetable oils	18.70	15.13	61%	9.87	922.8	3.84	1.16
-rapeseed oil	11.00	7.76	92%	7.11	729.4	3.33	0.09
-sunflower oil	4.06	4.75	10%	0.48	1764.8	0.00	0.39
-soybean oil	3.64	2.62	52%	1.37	568.3	1.82	0.80
-palmoil	0.00	3.62	10%	0.36	450.0	-	3.62

Source: European Commission[7]

[6] European Commission[6], The impact of a minimum 10% obligation for biofuel use in theEU-27 in 2020 on agricultural markets, April 2007.

2.28. The assessment also estimated that the area of EU land given over to biofuel production could rise to 17.5 million ha - the equivalent to 15% of all utilised agricultural land - compared to just 3% now. About one third of this could come from set-aside land, if the Commission gets the green light for its plans to permanently remove the current obligation on farmers to set-aside 10% of their land. As well as set aside land, the EU crop area would need to be expanded and land currently used for cereal production would need to be converted.

2.29. The direct impact of these targets may be limited in the next 2 to 3 years however they highlight the growing political will to develop alternative energy sources and to reduce the environmental impact of energy production. This will increase the resolve of governments within the EU to ensure that new and existing incentives are effective in moving towards these long term commitments.

2.30 Many of the assumptions made by the EC have come under criticism particularly the assertion that a large increase in demand for grain and oilseeds will not lead to significantly higher feed prices. At the same time there is also considerable uncertainty that these targets will be met particularly if a conflict with food production arises. Biofuels are also coming under criticism over environmental concerns over the real carbon saving potential and the potential for loss of natural habitat in developing countries.

2.31 The livestock sector is right to be concerned over the impact of these EU targets if they are successfully implemented. However a number of doubts remain as to whether EU biofuels usage will meet the target levels.

US biofuel targets

2.32 One of most important driver of future US biofuels demand is expected to be the Energy Independence and Security Act 2007 which sets out national targets for US biofuel usage. The Act sets out targets under the Renewable Fuels Standard of 22Bn US gallons of bioethanol production by 2022 sourced from a combination of maize ethanol and second generation biofuel sources. Some of the implications of this Act[8] include;

- Increased demand and higher prices for maize, soyabeans and wheat.
- Increased supply of soybean meal as crushing for biodiesel increases
- Higher feed prices would lead to further changes in the livestock sector

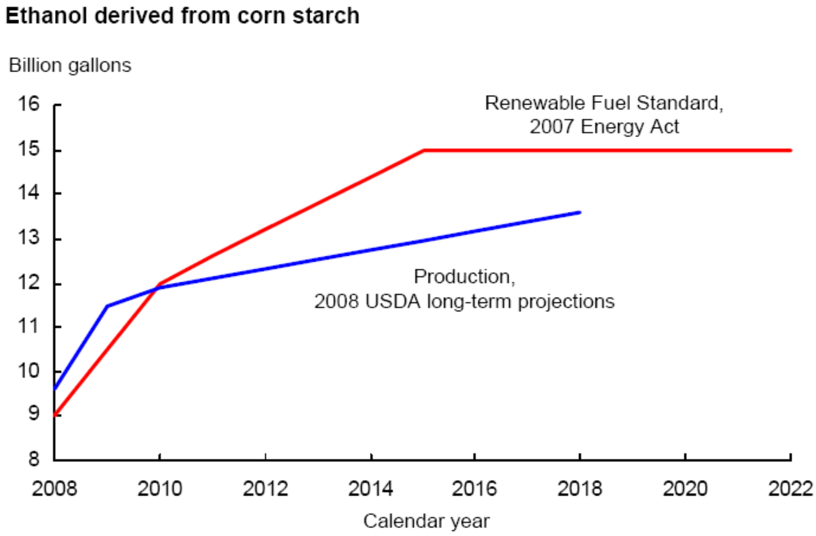
2.33 Again as with the EU biofuel targets, industry analysis suggests that US biofuel production will remain below target levels as the Figure illustrates for ethanol production. Further to this the overall EU biofuel target are again

[7] European Commission[7], The impact of a minimum 10% obligation for biofuel use in theEU-27 in 2020 on agricultural markets, April 2007.

[8] USDA Agricultural Projections to 2017

highly dependent on the development of effective second generation biofuel targets.

Figure 2.7: US ethanol usage scenarios under the Energy Independence and Security act of 2007



Source: USDA

Global price impact

2.34. Biofuels have already contributed to higher grain and oilseed prices and this trend is expected to continue. However several other factors have also been identified as important current and future drivers of price; weather fluctuations, global demand growth for food and animal feed particularly in Asia, and global limits to cropping expansion (water, infrastructure).

2.35. There are also signs that the rate of biofuels expansion has slowed recently in response to high feedstock prices and changes to government support (German biodiesel sales declining, EU ethanol plants mothballed).

2.36. Biofuels have also contributed to grains becoming more expensive relative to protein meals. Biofuel production increases demand for starch and vegetable oil, surplus protein co-products can result. Biodiesel production has increased the rate of oilseed crushing to satisfy demand for vegetable oil. This results in additional supplies of soyameal, rapemeal and other oilseed meals with a potential downward impact on their price. Bioethanol production results in an increase in DDGS output, again potentially leading to a relative drop in price though due to GM restrictions EU livestock producers have not benefited fully (see following section). In the ration energy is therefore expected to become relatively more expensive than protein.

GM issues and the EU

2.37 Rising commodity prices around the world have been exacerbated for livestock producers within the EU by restrictive EU policies which limit the importation of GM grains and processed feeds

2.38 Some implications so far include-

- Reduction in EU imports of US maize gluten
  Delays in the approval of certain US GM varieties of maize have disrupted the normal trade in US maize gluten which traditionally offers a cost effective source of ruminant protein. EU imports of US maize gluten have declined from 4.2mt in 2002 to 2.4mt in 2006[9]. The impact of these restrictions has grown in recent years since they have prevented the EU livestock sector from accessing the large increase in feed co-products resulting from the rapid expansion of the US ethanol industry.

- Restrictions on imports of soyameal
  Due to EU restriction on the importation of certain US GM soyabean varieties, EU importers have become increasingly reliant on exports from South America, particularly Brazil. By reducing the number of origins, EU soyameal prices have increasingly faced a price premium over cheaper US supplies.

- Restrictions on imports of maize
  In a similar manner to soyameal, EU grain importers have been denied access to US maize forcing purchases to be sourced from a restricted number of suppliers, again mainly Brazil resulting in an increase in maize import costs estimated at around £30/t during the 2007/08 season.

[9] FEFAC

Global price projections

2.39 In order to assess the potential impact on dairy feed costs in coming years of biofuels future price projections for the main feed ingredients are required. It is beyond the scope of this study to assess in detail the price and market prospects for the required commodities or to separate out the impact of bio fuels from the wider forces of supply and demand. However, a range of global projections are available which involve extensive modelling of these issues. The study has therefore reviewed the main global agricultural outlook projections.

2.40 A number of organisations generate and publish long range price projections for the main agricultural commodities. The four main agricultural projections which have been considered in this study are detailed below. It is important to realise that these are not s about the future but rather the outcome of conditional, long run scenarios based on a continuation of a set of assumptions about agricultural policy, economics and technological development. Generally this means assuming current support policies, exchange rates, population growth and yield growth patterns will continue over the period. Obviously these projections must be treated with caution but they do offer a useful starting point for analysis of the alternative outcomes for each sector.

- FAPRI 'Agricultural Outlook 2007'
- OECD – FAO 'Agricultural outlook 2007-16'
- 'EU Prospects for agricultural markets and income in the European Union 2007-2014', July 2007
- USDA 'Agricultural baseline outlook to 2016'

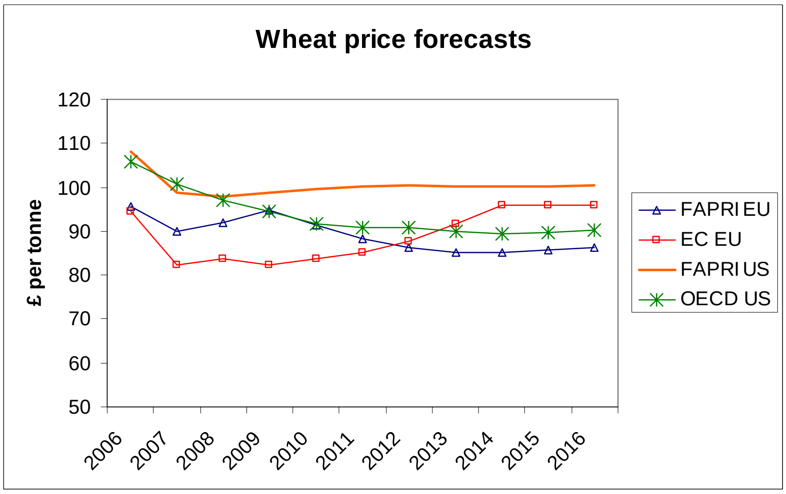
2.41 All of the projections were released before the unexpectedly sharp rise in global grain and oilseeds markets witnessed since July 2007. The projections differ in their results but do share some general points;

- Strong growth in feed and biofuels demand
- The increasing role of biofuel co-products (particularly DDGS in the US) substituting for grain in livestock rations
- Significantly higher wheat prices than seen in the baseline period (2001-2005)
- Significantly lower oilseed meal prices than seen in the baseline period (2001-2005)
- Consequently protein becomes cheaper relative to energy in the livestock diet

Wheat

2.42 All projections see wheat prices in the EU remaining firm relative to recent history with a steady decline in price in the period through to 2016 (Figure 2.8). This excludes the high prices observed in 2007. The exception is the European Commission projection which sees EU wheat prices strengthen steadily through the period.

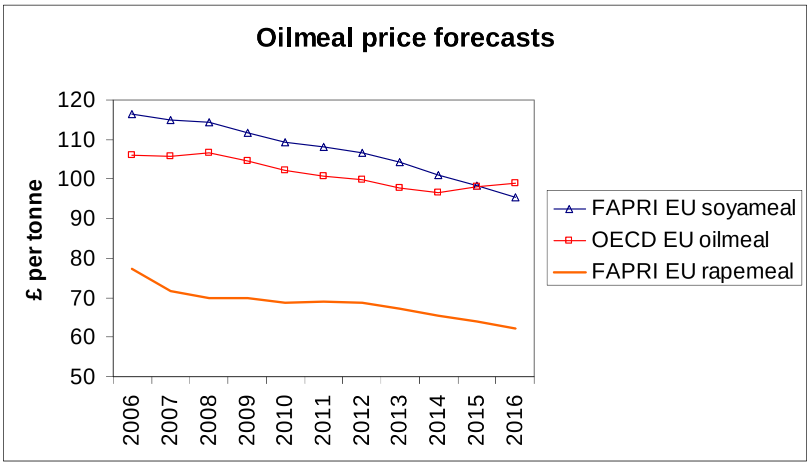
Figure 2.8 Wheat price projections



Oilseed meal

2.43 All projections see oilseed prices in the EU declining steadily in price in the period through to 2016 (Figure 1.2). This again excludes the high prices observed in 2007.

Figure 2.9 Oilseed meal price projections



2.44 Of the four projections it was decided to use commodity estimates from the OECD; EU oilseed meal and FAPRI; wheat and rapeseed, because they were the most up to date and gave the most detail regarding relevant EU commodities and prices.

UK price projections

2.45 The global estimates were then used to derive UK values taking into account relative transport costs and potential future shifts in UK supply and demand. The principal centre of ruminant feed production and use in the UK is the North West of England and price projections have therefore been determined on a delivered Liverpool basis. Based on estimates of likely levels of UK biofuel estimates were also made for biofuel co-product prices. Price projections were prepared for the two principal ration components; energy (wheat) and protein (soyameal). Projections for the other feed ingredients were then determined relative to the price of the main energy and protein sources.

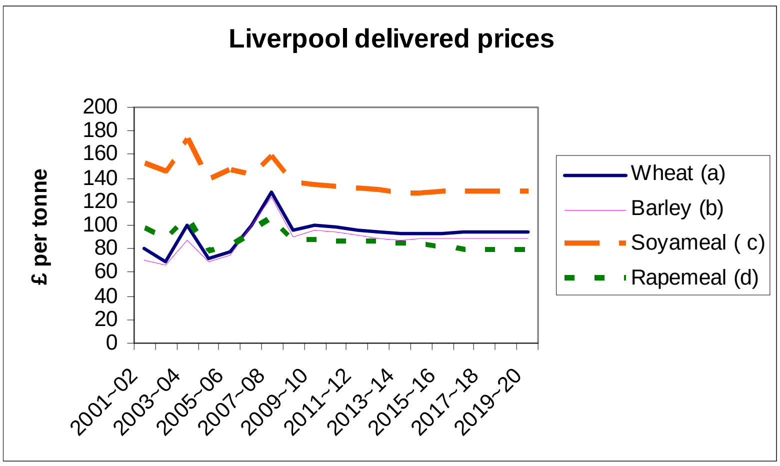
2.46 The FAPRI and OECD projections are based on Continental EU market values which have had to be translated into equivalent UK values (delivered Liverpool). This was achieved using average historical pricing relationships over the 5 year period 2001-05 to determine **historical basis**. In addition the UK is expected to undergo **future basis** shifts in pricing of some commodities relative to the EU and world market. This reflects expected changes in supply and demand in the UK. Adding **historical** and **future** basis estimates together generated a **total** basis figure which was then added to the FAPRI and OECD EU price projections to give UK delivered price estimates.

Three projections have been prepared -

- o Projection 1 – UK feed wheat vs. FAPRI EU wheat
- o Projection 2 – UK soyameal vs. OECD EU oilseed meal
- o Projection 3 – UK rapemeal vs. FAPRI EU rapemeal

All projections follow a similar methodology which is explained in more detail in Appendix I. Based on these price projections have also been prepared for barley and DDGS. Figure 1.3 illustrates the main price trends.

Figure 2.10 UK commodity price projections



UK price scenarios

2.47 Using the price projections as a base, several price scenarios were prepared to allow an assessment of the impact on dairy feeding regimes. These started with historical prices as a base (low grain prices) with current (high grain prices) and future (medium grain prices, relatively lower protein prices) as a comparison (see below). These prices were then used to assess the impacts on dairy feed rations. (see Appendix)

Figure 2.11 UK price scenario descriptions

Scenario	Name	Description
A	BASELINE	Average prices over 5 yr period - 2001/02 to 2005/06
B	2007	Spot prices August 2007
C	2008	Forward prices for November 2008 (in Aug 2007)
D	2010 FAPRI	UK prices in 2010 from FAPRI projections + NO UK biofuels industry
E	2010 FAPRI + UK biofuel1	UK prices in 2010 from FAPRI projections + UK biofuels industry1
F	2014 FAPRI	UK prices in 2014 from FAPRI projections + NO UK biofuels industry
G	2014 FAPRI + UK biofuel2	UK prices in 2014 from FAPRI projections + UK biofuels industry2

2.48 The price projections generated wheat prices between £99/t and £106/t by 2010 and between £93/t and £103/t by 2014 depending on the level of UK bioethanol plant construction that takes place. Feed barley was seen trading at £5/t less than wheat.

2.49 Rapeseed prices were estimated at between £83/t and £86/t in 2010 and between £76/t and £83/t in 2014 depending on the level of UK oilseed rape crush capacity built. Soyameal prices were not expected to be significantly affected by UK biofuel plant developments and were seen at £132/t by 2010 and £126/t by 2014.

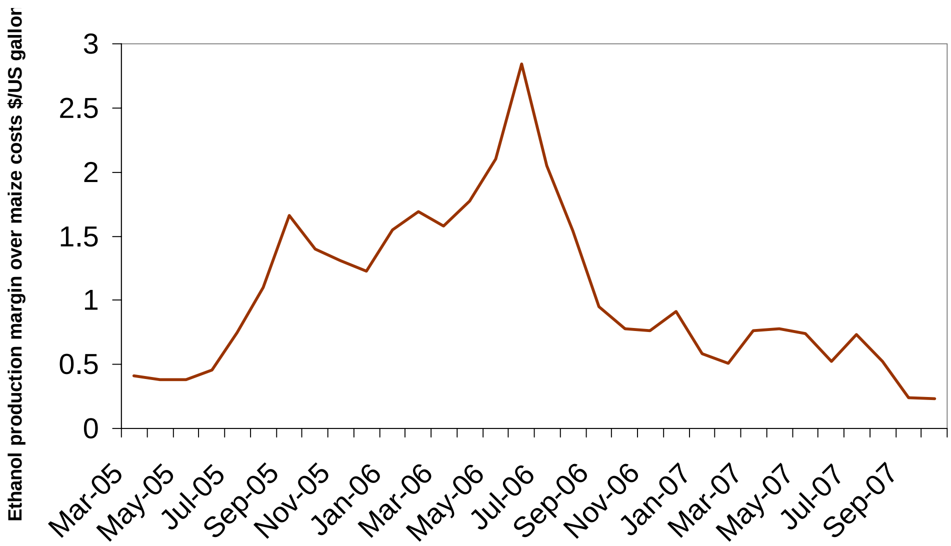
Figure 2.12 UK price scenarios

Scenario	Name	Wheat (a)	Barley (b)	Soyameal (c)	Rapemeal (d)	DDGS (e)
A	**BASELINE**	**79**	**74**	**151**	**91**	**112**
B	2007	180	175	175	140	162
C	2008	135	130	182	122	153
D	2010 FAPRI	99	94	132	86	117
E	2010 FAPRI + UK biofuel1	106	101	132	83	107
F	2014 FAPRI	93	88	126	83	114
G	2014 FAPRI + UK biofuel2	103	98	126	76	99

Impact of UK biofuel expansion

2.50 While several UK biofuel plants may still proceed it seems increasingly likely that the scale of expansion will be towards the lower end of expectation. Since the rise in cereal and oilseed prices that started in September 2006 the prospects for the biofuel industry have taken a significant downward turn. The rising cost of feedstocks, wheat and oilseed rape, and the static price for biofuels have eliminated process margins to such an extent that many of the proposed plants are having significant difficulties in obtaining project funding. Some existing plants in the UK, Europe and the USA have already scaled back production to reduce operating losses. Figure 1.6 illustrates how the processing margins for US ethanol plants have collapsed. The viability of wheat based ethanol plants in the EU and the UK has taken a similar path with additional pressure coming from the high level of low cost Brazilian cane ethanol imports available in the market.

Figure 2.13 US ethanol 'crush margins'*

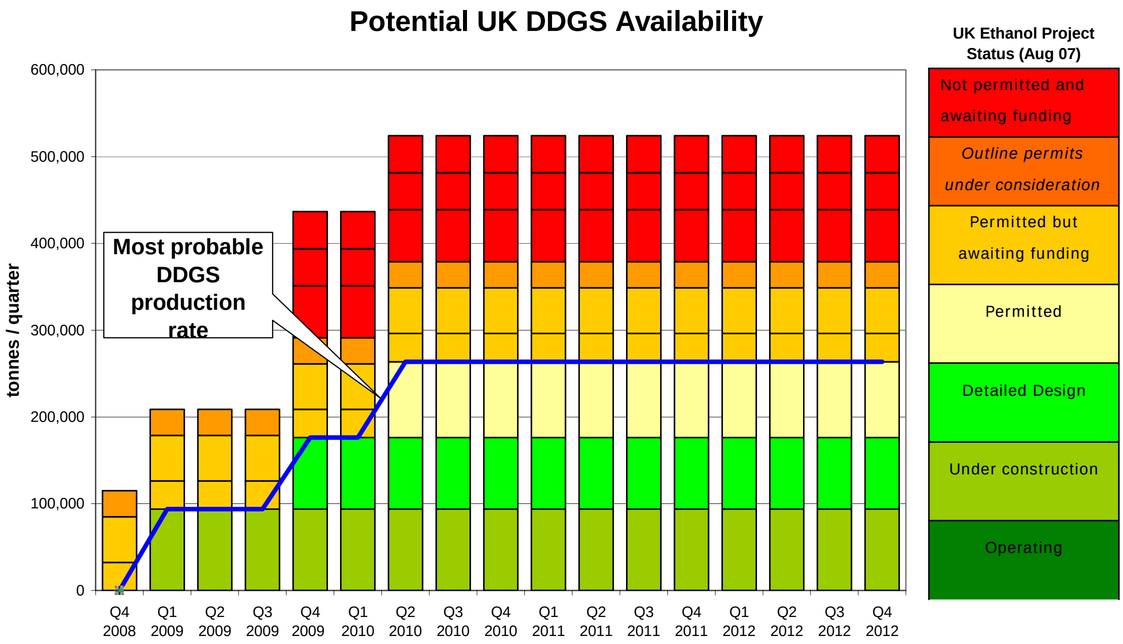


Note* - excludes all processing costs (capital, interest electric, gas, labour) and credits from co-products (Distillers Dark Grains)
Source: SAC

UK bioethanol plants and DDGS availability

2.51 For UK ethanol production, proposals for ten plants with a total wheat demand of 5.2mt were identified. Of these, three large plants appear the most likely to proceed with a potential total annual wheat demand of 3.3mt and DDGS output of 1.1mt. Construction is already underway on the Ensus plant on Teeside. Production is most likely to commence in early 2009 and to use 1.2mt of wheat annually. The coloured bars in the diagram below denote the status of the different projects and potential DDGS production in terms of planning and construction. The line illustrates the most realistic level of DDGS production given the state of project progression to date. Further details of the main proposals are given in Appendix III

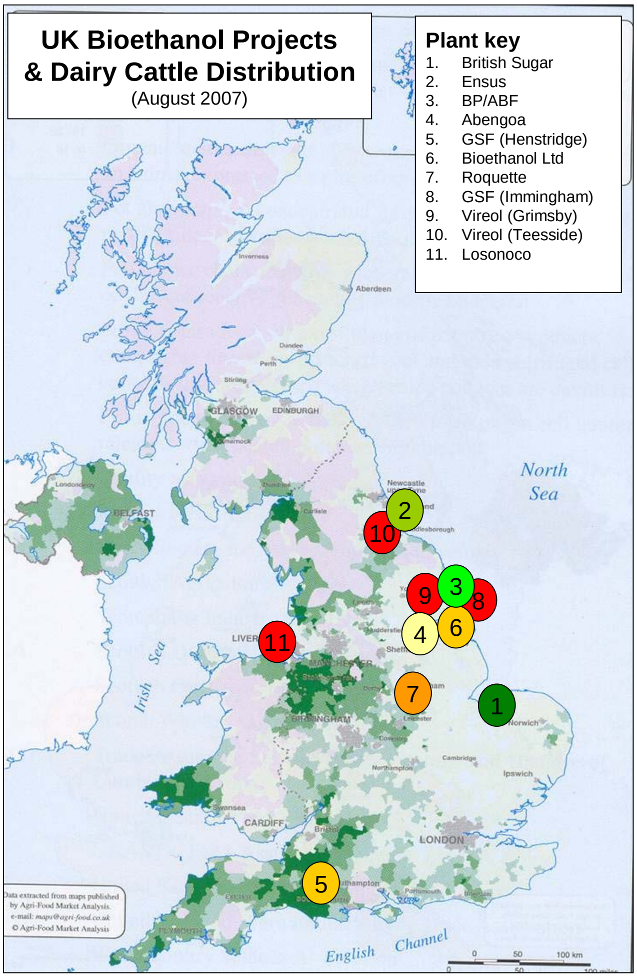
Figure 2.14 Potential UK DDGS availability



Source: Biofuel Matters Ltd

2.52 It is understood that the three most likely candidate ethanol plants intend at this stage to process and market the DDGS for the animal feed market in a pelleted form. While production of moist DDGS remains a possibility feed industry contacts suggest that this would not be commercially viable on the scale of these proposed plants due to difficulties and costs involved in storage and transport. A situation made more difficult by the distance of these plants from the main ruminant and especially dairy producing regions of the country.

Figure 2.15 UK Bioethanol projects and dairy cattle distribution



Source: Biofuel Matters Ltd and Agri-food Market Analysis

New UK rapeseed crushing plants and rapemeal availability

2.53 For the UK dairy industry the most important developments in the biodiesel sector relate to the potential for additional crushing capacity. A total of three new plants with 725kt of capacity are currently being proposed. Of which it seems likely that perhaps only one new plant of 250kt capacity may proceed. Since rapemeal is a more portable raw commodity than moist DDGS, plant location in relation to animal feed demand is less important though producers close to a crushing plant will benefit from savings in transport cost.

2.54 Any increase in the availability of UK produced biofuel co-products is not likely to be so large as to lead to a major reduction in their cost. The overall tonnages likely to become available are expected to be readily consumed within the existing animal feed market.

Figure 2.16 Potential UK biofuel feedstock consumption & co-product production

	2008/09	2009/10	2010/11	2011/12	2012/13
	Million tonnes				
Wheat Consumption for bioethanol	0.600	2.225	3.300	3.300	3.300
New DDGS Production	0.188	0.710	1.055	1.055	1.055
Oilseed Rape Consumption for biodiesel	0.125	0.250	0.250	0.250	0.250
New Rapemeal Production[10]	0.075	0.125	0.125	0.125	0.125

Source: Biofuel Matters Ltd

2.55 There are however likely to be significant regional disparities between biofuel production on the East coast and ruminant demand in the West and North as highlighted earlier with implications for costs and processing options.

2.56 What ever the final level of additional biofuel co-products that is produced, a major unknown is estimating how much of the biofuel co-products might be used to produce renewable energy. Based on current animal feed prices and current whole sale UK natural gas and electricity prices, burning of biofuel co-products cannot be justified purely in energy terms alone. Rapemeal is a more suitable product to use as a tradable fuel source due to higher energy density and low moisture content. However high levels of N, P and K can create difficulties in the areas of combustion and air quality. DDGS is also not an easy fuel to handle and burn due to the high moisture content and also the high levels of ash which can cause clinkering in the boilers and again create difficulties in meeting air quality standards. However, the use of both co-products for energy is being encouraged by government incentives to produce renewable electricity under the Renewables Obligation. Changes to the Renewables Obligation for (banding of ROCS proposals) are likely to have a major impact on how much of the biofuel co-products (and other feed ingredients) are utilised by the energy market and how much is left for animal feed.

2.57 This chapter has considered the likely development of feed markets in light of the future demand and pricing for the main feed products. The next chapter focuses the project by considering the potential implications for dairy feeding and nutrition and the implications for the returns from dairy farming.

[10] Assuming that it is not consumed for energy generation

3. IMPACT ON DAIRY FEEDING AND NUTRITION

3.1 This chapter examines how possible changes in supply and absolute and relative prices of feed ingredients brought about by an expanding biofuels industry will impact on dairy cow feeding and cow nutrition.

3.2 The chapter begins with an examination of the nutritive values and feed characteristics of the co-products of biofuels production. From this, the potential scope and any practical constraints on the use of these feed materials are identified. These parameters, combined with the projected price levels, are then used to assess the economic impacts on concentrate prices and dairy diet costs and consequences for margins.

Validation of Nutritive Values and Feed Characteristics

3.3 Biofuel production is considered to generate five main feed material co-products depending on the raw material and production process. These are:

- DDGS (moist) - following extraction of starch from cereals, particularly wheat, for bio-ethanol
- DDGS (dry) - as above, with drying
- Rapeseed Meal (extracted) - from industrial extraction of oil from oilseeds for bio-diesel
- Rapeseed Meal (expeller) – from farm-scale cold crush extraction of oil from oilseeds for bio-diesel
- Glycerol

3.4 Information on nutritive values and other feeding characteristics with specific reference to dairy cattle was collated for these feed materials using relevant published research papers, earlier reports and information gleaned from feed industry contacts. Where information directly related to biofuels production is limited, the products from similar processing operations, that is starch or oil extractions, for other purposes is also be taken into account.

Wheat DDGS (dried distillers grains and solubles).

3.5 Table 3.1 highlights the nutritive values of DDGS obtained from three sources

Table 3.1. Nutritive value of wheat DDGS, from various sources

	SAC Feedbyte	KW[1]	EcoAgricola
Dry matter (g/kg)	900	900	900
ME (MJ/kg DM)	13.5	14	10.54*
CP (g/kg DM)	340	310	320
NDF (g/kg DM)	346	330	382
Starch (g/kg DM)	44	30	26
Sugar (g/kg DM)	86	30	46
Oil (g/kg DM)	70	70	58 (Ether extract)
Ash (g/kg DM)	52		55
Calcium (g/kg DM)	1.8		
Phosphorus (g/kg DM)	8.8		
Magnesium (g/kg DM)	2.8		
Sodium (g/kg DM)	3.1		
Potassium (g/kg DM)	12.0		
Sulphur (g/kg DM)	4.1		

[1] From KW Alternative Feeds website (http://www.kwalternativefeeds.co.uk)
*Estimated from converting given value of 2520 Kcal/kg, using conversion of 1joule = 0.239calories.

DDGS Feeding rates

3.6 In terms of feeding, KW recommends for dairy cattle, a rate of between one and four kilograms per head per day, although it is theoretically possible to use more. It should be noted that the SAC and KW nutrient specification (highlighted in Table 3.1) is based on DDGS as a co-product of the whisky industry. It is, however, understood that industrial ethanol production will lead to a co-product that is slightly different from this, in particular it is likely to be lower in energy because bioethanol production uses certain enzymes that are not permitted in the whisky industry and can result in more energy being extracted from the grain leaving less in the co-product.

DDGS Metabolisable energy (ME)

3.7 The EBLEX report (April 2007) came to the conclusion that ME from DDGS is higher than official listings, and that it varies between plants. The references quoted show a range of between 14.13 and 15.96 MJ/kg DM. However, the examples they give are from US sources and are therefore likely to be maize DDGS values, which would be expected to be higher than the wheat-based product. The NRC tables (1998) list DDGS as having an ME of 12.69 MJ/kg DM. Therefore, assuming a value of 12.7 MJ/kg DM may be the most practicable option for use when developing rations.

DDGS handling and storage, palatability

3.8 It is anticipated that most of the co-product will be dried on-site, leaving a feedstuff of around 900g/kg dry matter, which can readily be transported around the country. In a dried form, the keeping quality of DDGS is good up to 3 months, but not longer due to the relatively high oil content.

3.9 The palatability of DDGS is good.

Rapeseed meal (extracted)

3.10 Table 3.2 summarises the nutritive values of extracted rapeseed meal

Table 3.2 Nutritive values of extracted rapeseed meal from various sources

	SAC Feedbyte	KW[1]	Feeds Directory[2]
Dry matter g/kg	900	890	880
ME MJ/kg DM	12.0	12.0	12.1
Crude Protein g/kg DM	400	390	385
NDF g/kg DM	248	300	365
Starch g/kg DM	40	60	50
Sugar g/kg DM	105	100	95
Oil g/kg DM	53	30	35
Ash g/kg DM	76		70
Calcium (g/kg DM)	8.4		9
Phosphorus (g/kg DM)	11.3		12
Magnesium (g/kg DM)	4.4		5
Sodium (g/kg DM)	0.4		1
Potassium (g/kg DM)	14.3		n/a
Sulphur (g/kg DM)	16.0		n/a

[1] From KW Alternative Feeds website (http://www.kwalternativefeeds.co.uk)
[2] From The Feeds Directory, W.N Ewing, 1997
n/a not available

Extracted rapeseed meal feeding rates

3.11 In terms of feeding an important factor is that the rapeseed meal is low in anti-nutrients like erucic acid, glucosinolates and tannins. Varieties are now available that are low in these factors. Extracted rapeseed meal is widely used as a protein feed that can partly replace soya bean meal, although it has a higher proportion of degradable protein, and a lower proportion of undegradable protein. For dairy cows, the Feeds Directory recommends a feeding rate of up to 25 per cent of the concentrate part of a ration, which works out at between two and four kilograms per head per day.

Rapeseed handling and storage, palatability

3.12 Rapeseed meal is a free-flowing meal that is easily handled and transported. It is recommended that on-farm storage should be no longer than two months, because of its unsaturated oil content, which would be unpalatable if it oxidises. It should be kept in a cool, dry store, complying with normal feed storage regulations.

3.13 Rapeseed meal is not very palatable, which limits its inclusion in diets.

Rapeseed meal (expeller)

3.14 Table 3.3 highlights the nutritive values of expeller rapeseed meal.

Table 3.3 Nutritive values of expeller rapeseed meal *

Dry matter g/kg	952
ME MJ/kg DM	13.1
Crude Protein g/kg DM	399
Oil g/kg DM	95
Ash g/kg DM	76

Note * Data from a German source (courtesy M Shepherd)

Expeller Feeding rates

3.15 Expeller feeding rates are broadly similar to extracted meal, but as the oil content of expeller meal is higher, then the total oil content of the diet needs to be taken into account when determining the feeding rate. This said, it would be unusual to feed high levels of rapeseed meal for two main reasons. First, due to the issue of palatability. Second, as it will usually be used to balance a ration for protein, neither the extracted nor the expeller product will be needed at a high level.

Expeller Handling and Storage

3.16 It is difficult to get detailed information about the handling characteristics of expeller rapeseed, but it seems reasonable to assume that they will be similar to the extracted meal. The higher oil content of expeller would suggest that it will be storable for a shorter time period than other meal.

Glycerol

3.17 Glycerol, as well as a by-product from the biodiesel industry, is a natural product of fat digestion, when fat is broken down to tryglycerides and glycerol. In dairy cows, milk lactose is synthesised from the carbohydrates glucose and galactose, itself in turn partly made from glycerol (McDonald et al, 1996). Glycerol can be fed to dairy cows as an energy source (Hutjens, 1996) and has been investigated as a feed to reduce symptoms of ketosis in transition cows (DeFrain et al, 2004). At least one study has found that it can be included in diets for ruminants at up to 10% of diet dry matter (Schröder anad Südekum, 1999). As glycerol is a glucose precursor, it could at least in part replace starch as an energy source. The main drawback to the ex-factory co-product is the question of its purity (see EBLEX report, p52).

Economic Impacts

3.18 The objective of this section of the project is to take the information on nutritive values and projected prices (and the impact these may have on the prices of other feed materials) and consider the likely impact on the costs of dairy rations in future, and in turn how this would impact on margins and profitability.

Method

3.19 The economic impacts are highlighted through use of a *representative* feed formulation upon which various price and cost changes are considered. The formulation considered was a specimen 18 per cent Crude Protein blend which was taken to complement a well fermented grass silage of reasonably good energy (11MJ ME DM) and protein (14 per cent CP DM) contents. The ingredient cost per tonne of this blend was determined using feed prices projected for each of the future scenario previously identified. Prices for other feed materials were not held constant but varied in accordance with their relative feed values against projected barley and rapeseed meal prices. To put the findings into a practical context, the impact of these changes were then considered for three 100 cow dairy herds, producing 6000 litres/cow with a feed rate of 0.20kg/litre (Herd X), 8000 litres at a feed rate of 0.30kg/litre (Herd Y) and 10,000 litres at a feed rate of 0.40kg litre (Herd Z).

Blend

3.20 The specimen blend formulation based on typical dairy feed ingredients is highlighted in Table 3.4.

Table 3.4 Formulation of Dairy Feed Ration

Ingredient	Inclusion Rate	Ingredient	Inclusion Rate
Wheat	250 kg	Rapeseed Meal	75 kg
Distillers Grains	200 kg	Palm Kernel	75 kg
Sugarbeet Pulp	150 kg	Molasses	50 kg
Wheatfeed	100 kg	Min / Vit Supplement	25 kg
Soyabean Meal	75 kg		

3.21 The nutritional specification of the blend was Dry Matter 88 per cent; Metabolisable Energy 12.5 MJ/kg DM; Crude Protein 214g/kg DM (18 per cent CP as fed); NDF 250 g/kg DM and; Starch and Sugar 330 g/kg DM

Model Herds

3.22 The key feed usage details for the three model herds at different levels of production are highlighted in Table 3.5

Table 3.5 Feed Usage Details for Model Herds

Herd	X	Y	Z
Yield/cow (litres)	6,000	8,000	10,000
100 Cow Total (litres)	600,000	800,000	1,000,000
Feed Rate (kg/litre)	0.20	0.30	0.40
Feed Use (tonnes/cow)	1.2	2.4	4.0
100 Cow Total (tonnes)	120	240	400

3.23 Whilst feed is generally the most significant variable cost in a dairy enterprise, gross margins and profitability are determined by a combination of both costs incurred and product prices received. Thus the impact of any changes in feed prices arising from the biofuels industry has the potential to be either exacerbated or mitigated by changes in other factors, such as milk price. Given the significant increases in milk prices that have been seen over recent months, the extra returns from milk prices have been calculated to compare alongside the feed cost increases.

Results

3.24 Formulating the blend using each of the determined price scenarios provided the following ingredient cost per tonne and changes relative to the baseline position.

Table 3.6 Feed Costs (£/tonne)*

Pricing Scenario	Price	Change from Baseline
	(£/tonne)	(£/tonne)
A – Baseline	105	
B	160	+ 55
C	142	+37
D	113	+ 8
E	114	+ 9
F	108	+ 3
G	110	+ 5

* based purely on ingredient prices, i.e. before any processing costs.

3.25 In summary, the most significant increases in feed costs are observed for the next two years when cereal prices in particular are high. In future years, the overall impact on feed prices is relatively small with the higher prices of primarily energy ingredients (i.e. cereals) being offset by the cheaper protein feed ingredients (rapeseed, soya) and biofuel co-products (DDGS).

3.26 The general impact of changes in feed costs per tonne on feed costs per litre is presented in Table 3.7.

Table 3.7 Impact of Feed Costs per tonne on feed costs per litre

Increase in Feed Cost (ppl)		Feed Rate kg / Litre				
		0.20	0.25	0.30	0.35	0.40
Increase Feed Price per Tonne	£20	0.40	0.50	0.60	0.70	0.80
	£30	0.60	0.75	0.90	1.05	1.20
	£40	0.80	1.00	1.20	1.40	1.60
	£50	1.00	1.25	1.50	1.75	2.00
	£75	1.50	1.88	2.25	2.63	3.00
	£100	2.00	2.50	3.00	3.50	4.00

3.27 When considered in the context of the 3 model herds, these impacts can be more clearly observed in Tables 3.8 to 3.10.

Table 3.8 Purchased Feed Cost by Scenario - Herd X (100 cows, 6000 litres/cow, 1.2 tonnes/cow)

Pricing Scenario	Price	Pence per Litre	Change from Baseline	Total Feed Cost	Change from Baseline
	(£/tonne)			£ for 120t	(£/tonne)
A – Baseline	105	2.1		12,600	
B	160	3.2	+ 1.1	19,200	+ 6,600
C	142	2.8	+ 0.7	17,040	+ 4,440
D	113	2.3	+ 0.2	13,560	+ 960
E	114	2.3	+ 0.2	13,680	+ 1,080
F	108	2.2	+ 0.1	12,960	+ 360
G	110	2.2	+ 0.1	13,200	+ 600

For herd X, every £20/tonne increase in feed price will increase feed costs by 0.4ppl.

Table 3.9 Purchased Feed Cost by Scenario - Herd Y (100 cows, 8000 litres/cow, 2.4 tonnes/cow)

Pricing Scenario	Price	Pence per Litre	Change from Baseline	Total Feed Cost	Change from Baseline
	(£/tonne)			£ for 240t	(£/tonne)
A – Baseline	105	3.2		25,200	
B	160	4.8	+ 1.6	38,400	+ 13,200
C	142	4.3	+ 1.1	34,080	+ 8,880
D	113	3.4	+ 0.2	27,120	+ 1,920
E	114	3.4	+ 0.2	27,360	+ 2,160
F	108	3.2	0	25,920	+ 720
G	110	3.3	+ 0.1	26,400	+ 1,200

For herd Y, every £20/tonne increase in feed price will increase feed costs by 0.6ppl.

Table 3.10 Purchased Feed Cost by Scenario - Herd Z (100 cows, 10,000 litres/cow, 4.0 tonnes/cow)

Pricing Scenario	Price	Pence per Litre	Change from Baseline	Total Feed Cost	Change from Baseline
	(£/tonne)			£ for 400t	(£/tonne)
A – Baseline	105	4.2		42,000	
B	160	6.4	+ 2.2	64,000	+ 22,000
C	142	5.7	+ 1.5	56,800	+ 14,800
D	113	4.5	+ 0.3	45,200	+ 3,200
E	114	4.6	+ 0.4	45,600	+ 1,600
F	108	4.3	+ 0.1	43,200	+ 1,200
G	110	4.4	+ 0.2	44,000	+ 2,000

For herd Z, every £20/tonne increase in feed price will increase feed costs by 0.8ppl.

3.28 From these models, in the short term it can be seen that the higher feed costs do represent significant financial sums in real terms. However over time these differences diminish as feed prices drop back.

Milk Prices

3.29 Milk prices have increased dramatically over recent months. The following table works out the additional return for each of the model farms at a range of milk prices against an assumed baseline figure of 18 ppl.

Table 3.11: Extra Milk Income Associated with Higher Milk Prices

Milk Price	Farm X (600,000 litres)	Farm Y (800,000 litres)	Farm Z (1,000,000 litres)
20 ppl	£ 12,000	£ 16,000	£ 20,000
22 ppl	£ 24,000	£ 32,000	£ 40,000
25 ppl	£ 42,000	£ 56,000	£ 70,000
28 ppl	£ 60,000	£ 80,000	£ 100,000

The above figures are before consideration of increases in feed or other costs.

3.30 The additional milk income is generally significantly above the extra feeds costs that are projected to be incurred.

3.31 Feed however, is not the only cost for milk producers. Amongst the others which have increased or are still increasing are fertiliser, fuel and interest charges. These will vary from farm to farm depending on circumstances and system practiced however typically these could easily be of the order of 2ppl.

3.32 The following tables illustrate how margins are impacted upon by feed and milk price changes following an increase of other costs of 2ppl for each of the model herds.

Table 3.12 Impact of Changing Milk / Feed Prices on Margins – Farm X

Farm X - Yield 6,000 litres/cow, feed rate 0.2 kg/litre **After** other costs of 2ppl					
Change in Margin (ppl)		Change in Milk Price (from 18ppl base)			
		+ 2 ppl	+ 4 ppl	+ 7 ppl	+ 10 ppl
Change in Feed Price per Tonne	£20	-0.40	1.60	4.60	7.60
	£30	-0.60	1.40	4.40	7.40
	£40	-0.80	1.20	4.20	7.20
	£50	-1.00	1.00	4.00	7.00
	£75	-1.50	0.50	3.50	6.50
	£100	-2.00	0	3.00	6.00

Table 3.13 Impact of Changing Milk / Feed Prices on Margins – Farm Y

Farm Y - Yield 8,000 litres/cow, feed rate 0.3 kg/litre **After** other costs of 2ppl					
Change in Margin (ppl)		Change in Milk Price (from 18ppl base)			
		+ 2 ppl	+ 4 ppl	+ 7 ppl	+ 10 ppl
Change in Feed Price per Tonne	£20	-0.60	1.40	4.40	7.40
	£30	-0.90	1.10	4.10	7.10
	£40	-1.20	0.80	3.80	6.80
	£50	-1.50	0.50	3.50	6.50
	£75	-2.25	-0.25	2.75	5.75
	£100	-3.00	-1.00	2.00	5.00

Table 3.14 Impact of Changing Milk / Feed Prices on Margins – Farm Z

Farm Z - Yield 10,000 litres/cow, feed rate 0.4 kg/litre **After** other costs of 2ppl					
Change in Margin (ppl)		Change in Milk Price (from 18ppl base)			
		+ 2 ppl	+ 4 ppl	+ 7 ppl	+ 10 ppl
Change in Feed Price per Tonne	£20	-0.80	1.20	4.20	7.20
	£30	-1.20	0.80	3.80	6.80
	£40	-1.60	0.40	3.40	6.40
	£50	-2.00	0	3.00	6.00
	£75	-3.00	-1.00	2.00	5.00
	£100	-4.00	-2.00	1.00	4.00

Even for the higher feed users, a 4ppl increase in milk price from 18ppl to 22ppl is sufficient to cover an increase in feed prices of £50/tonne and other costs of 2ppl.

Discussion and conclusions for economic Impacts

3.33 Although not necessarily driven by the biofuels industry, the escalating cereal prices in 2007, and their impact on other feed material prices, are resulting in very significant increases in concentrate feed price. These increases add to production costs considered on a pence per litre or total pounds per herd basis.

3.34 These higher costs would have resulted in reduced margins had it not been for the significant increases in milk price over the last few months, even since this project was initiated. Consequently although producers are not quite as well off as they would have been with no change in feed prices, they are still better off than previously.

3.35 Starting from the point of negligible or negative profitability in summer 2007, further pressures on feed prices without the increase in milk price would have left more producers making financial losses which were not sustainable giving the choices of either leaving the industry or altering their system significantly. Included within the options for changing the systems would be possibilities for cutting back on feed use, replacing compounds with cheaper feed ingredients or switching to a spring calving system to achieve more milk from grass, though the scope for adopting any of these will vary from farm to farm depending on their current system.

3.36 On the basis of the feed price increases forecast, together with the significant improvement in milk price increase in the second half of 2007, most producers should be attaining increased margins and therefore the impact of biofuels cannot be considered as directly driving changes in production systems. Should biofuels, or some other factor, drive feed prices even higher than forecast or if milk prices were to drop back significantly, then structural changes in the industry would be likely. (The possibilities are discussed in more detail in section 5.0)

3.37 Whilst this situation has been examined and illustrated using one typical specimen feed blend which incorporates feed ingredients of relevance to the biofuels industry, the impacts and therefore conclusions drawn would be similar for any situation involving purchased feeds as the prices of these will move up and down relative to the main energy (cereals) and protein feeds (oilseed meals) that predominate in the feed market

3.38 Feed price increases could be partially mitigated by substituting cereals with other energy feed ingredients. Assuming overall energy and protein contents in the feed are maintained, there may be a slight decline in milk protein contents as a consequence of less starch / sugar in the concentrate. If the nutritional specification is allowed to fall, then any savings in feed price in £/tonne may be lost through poorer performance (reduced milk yield, milk quality, fertility, etc) or as a result of having to feed more to maintain production.

3.39 For 2008, cereals and other feed material prices are forecast to remain relatively high compared with the baseline figures, however their overall impact in driving structural change within the sector is likely to continue to be diminished with continued firm milk prices, albeit probably less than 2007.

3.40 For 2010 and 2014 projections, where there are increases in cereal (energy) prices, there are also decreases in the soya & rapeseed (protein) prices. Consequently, the net impact on concentrate prices is fairly negligible. As such, feed prices alone are not likely to lead to marked changes in the industry, even if milk prices were to fall back closer to prices in the recent past.

3.41 Cereals are relatively more expensive / less available compared with other ingredients, one consequence is that these may be substituted by other energy feed ingredients. The result would be less starch in the diet, potentially leading to reduced milk proteins, which would reduce milk price if the producer is on a constituent based contract. For example on a contract paying 3.5 pence per % protein in the milk, a fall of 0.2 percentage units would equate to an income foregone of 0.7ppl. Milk protein content is not solely determined by starch levels in the diet and impacts on milk protein contents can be minimised even if not absolutely offset be ensuring the diet is well formulated and carefully fed out to ensure overall energy intakes are maintained.

3.42 The main forecasts within this report do not suggest that biofuels will be a significant driver of structural changes in the dairy industry. However, in light of the uncertainty attached to these price forecasts it is essential to consider the implications in case feed prices rise significantly higher than forecast (due to biofuels or other factors) and milk prices fall back to early 2007 levels. Under such a scenario changes are likely and are discussed further in the following section.

4. SOME IMPLICATIONS FOR DAIRY SYSTEMS

Potential for changes to the enterprise mix

4.1 Whilst the direct impact of changes in feed prices can be determined as in the previous chapter, rather than simply accept the consequences where these are increased, the producer may be able to take steps to mitigate these through changes to feeding systems, production systems and enterprise mix on the farm. The potential to make changes to existing systems and the consequences arising will depend on many factors including what system is presently being operated, the potential of the land, and location.

4.2 It was originally anticipated that the developing biofuels industry would result in markedly higher feed prices which the financially pressured dairy industry would not be able to cope with at then current milk prices. In such a scenario then producers would indeed have had to examine a range of strategies to determine if returns could be improved by increasing output or reducing costs by changing the system being operated. However with a reasonably positive outlook for dairy product prices together with overall feed prices not anticipated to rise too significantly due to the offsetting of rising energy and reducing protein feed ingredient prices, the long term impact of biofuels on the dairy sector may not be as dramatic as feared. As such, from a dairy feeding perspective, the biofuels industry is not anticipated to be a significant driver to farmers radically changing their system of production.

4.3 However, one way in which the biofuels industry could more directly impact on the dairy sector would be if there were better returns per hectare for growing energy crops as opposed to keeping milking cows. This needs to be considered further both with regard to the relative margins of the enterprises and the potential land areas involved that are 'interchangeable' between grass and cereals.

4.4 The approach taken was to start with the three example farms from Chapter 3 and to change different aspects of their inputs and outputs to demonstrate the resulting financial impacts (Table 4.1). In particular arable versus milk output was compared. The cereal variable costs and yields were taken from the SAC Farm Management Handbook (October 2007), taking the average between spring and winter barley.

Table 4.1. Example of sensitivity adjuster

Farm	X	Y	Z	
Cows	100	100	100	
Yield	6000	8000	10000	Litres
Area Required	60	60	60	Ha
Milk Price	22	22	22	p per litre
Output	132,000	176,000	220,000	£
Feed Rate	0.2	0.3	0.4	kg/l
Purchased feed cost	160	160	160	£ per tonne
Total Feed Cost	19,200	38,400	64,000	£
Other Variable Costs	31,000	31,000	31,000	£
Total Feed Use	120	240	400	tonnes
Gross Margin	81,800	106,600	125,000	£
Cereal Use	50	90	130	Tonnes *
Yield	6.5	6.5	6.5	tonnes per ha
Ha of cereals required	7.7	13.8	20.0	ha
Area Left for cows	52	46	40	ha
New Cow numbers	87	77	67	
New Milk Output	115,077	35,385	46,667	£
New Total Feed Use	52	92	133	tonnes
New Feed Cost	8,369	14,769	21,333	£
New Variable Costs	26,000	23,500	20,000	£
Additional Variable Costs	1,838	3,309	4,780	£
Cereal Variable Costs	239	239	239	£ per ha
New Gross Margin	78,869	93,806	100,553	£
Difference	- 2,931	- 12,794	- 24,447	£

* cereal use is based on replacing 50% of total feed, and using the new cow numbers

4.5 For each of the three farms X (cows yielding 6000 litres), Y (8000 litres) and Z (10000litres), a gross margin was calculated. For all farms, this assumed that the milk price was 22ppl and that purchased feed cost was £160/Tonne. The assumed area required for each farm was 60 ha. If cereals were to be grown, to replace 50 per cent of the purchased concentrate at an assumed yield of

6.5 tonnes per hectare, 7.7 ha would be needed by Farm X, 13.8 ha by Farm Y and 20 ha by Farm Z.

4.6 If these areas of cereals are grown, the area remaining for forage reduces as the herd yield rises, leaving least area for forage on Farm Z. Therefore the number of cows must also be reduced. However, feed costs and variable costs both reduce, and a revised gross margin can be calculated. The sensitivity spreadsheet suggests that it is more attractive to stay in milk production than to grow cereals, at 22 ppl for all farms.

4.7 If the milk price dropped to 17.85 ppl, Farm X would be better to grow cereals, but at a milk price of 22ppl, Farm X's feed costs would have to rise to £209/tonne before it would be worth growing cereals. For Farm Y, if the milk price dropped to 14.85 ppl, it would be better off growing cereals, but should stay in milk production at 22 ppl until the feed price rises above £253/tonne. For Farm Z, it is better to stay in milk production unless either the milk price falls below 14.4 ppl, or the price of feed rises above £258/tonne.

4.8 The scenarios can be changed by inputting different variable costs, feed prices or milk prices, to suit each farm's particular circumstances.

Potential changes under more extreme scenarios

4.9 The main forecasts within this report do not suggest that biofuels will be a significant driver of structural changes in the dairy industry. However, in light of the uncertainty attached to these price forecasts it is essential to consider the implications in case feed prices rise significantly higher than forecast (due to biofuels or other factors) and milk prices fall back to early 2007 levels. Under such a scenario changes are likely and are discussed briefly below.

4.10 Cutting back on feed use will give a direct saving on costs however there will be an inevitable detrimental consequence in milk yield and possibly milk quality, and ultimately margins and profitability. The scope and likely impact of such an approach will vary depending on current levels of feed use. For example the benefits of this for model Farm X, typical of a low-input farm, could only have a limited impact at best because the feed use is already very low. For Farm Y (medium input) and Farm Z (high input), there may be some scope to see if any efficiencies in feed use can be introduced through the feeding system or exploiting the full value from home-grown forage, however this will only be beneficial financially to the business if yields, milk quality and other aspects of performance such as cow fertility and health are not significantly adversely affected.

4.11 Replacing compound feeds with cheaper feed ingredients is an option that can be considered by all if they have not already done this, with the impact potentially more significant for the larger feed user. A small benefit may be attained by replacing a compound with a blended feed provided the nutritional specification and performance is maintained. The most potential benefit is likely when feeding more straights, however this does require sufficient storage, handling equipment, labour, suitable feeding arrangements and possibly capital. In some circumstances, the direct savings in feed cost per tonne may not actually cover the costs of any significant capital investments required to accommodate such a system. This could certainly be the case with farms such as Farm X using relatively small volumes of feed to spread these costs over. Whilst the benefits could be there for a larger feed user such as Farm Z, in practice, given the significant financial pressures that the sector has been under for a number of years now, many will have already gone down this route where feasible in order to survive.

4.12 Moving to spring calving is essentially a means of being able to cut back on feed use as discussed above, whilst mitigating some of the yield impacts by fully utilising the potential of grass. Model Farm X is quite typical of a farm already adopting such a system hence there may be little opportunity for further change in this regard. At the other end of the scale, for Farm Z, this would represent a very large change and would require very careful consideration to ensure the performance impacts on yield, milk quality and fertility did not outweigh the benefits in reduced feed costs. For Farm Y, the degree of shift would be less making it a more feasible proposition if managed well. However, before making such a move, it should be carefully evaluated. As well as the more obvious elements of milk output and feed cost savings, consideration must be given to elements such as impacts on milk price from seasonality / level supply bonuses; labour; grass/forage growing potential of the farm, management skills, labour and the costs of transition which will vary depending on the starting point.

5. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

Impacts on National Milk Production

1. On the basis of earlier findings, in particular that increases in energy feed prices may be offset by lower protein feed prices leading to small increases in overall feed prices; that these feed prices increase are being more than covered by the milk prices increases; and that milking cows still appears a better option than changing enterprise to growing cereals, then it would be concluded that the emerging biofuels industry would not seem at present to be a major driver to structural change in the dairy industry.

Protein Quality

2. Feeding excessive levels of rumen degradable protein, such as might arise from feeding high levels of rapeseed meal, can be detrimental to production. This is because excess ammonia levels in the rumen may inhibit fibre digestion by the rumen microbes, there is an energy cost to excreting excess nitrogen from the cow, and fertility may be adversely impacted. There could even be environmental impacts if the nitrogen content of slurry and manure was increased. Producers therefore need to be kept aware of the need to maintain appropriately balanced rations and that performance should not be unduly compromised just to make use of what appears to be a relatively cheap co-product.

Enterprise Tool Mix

3. This study has used a spreadsheet model based on gross margins from the SAC Farm Management Handbook to consider whether it is better for a dairy farmer to switch some of his land away from a milk production enterprise to growing cereals. Whilst this was not attractive on current average figure, such figures will vary from farm to farm and therefore a simple calculator that will allow producers to input figures directly relevant to their business and circumstances would be beneficial to producers who will be asking questions of this nature. Such a calculator for producers could be readily developed from the model used in this study.

Feed Evaluation

4. This study has examined what information is published on nutritive values and characteristics for biofuel co-products. However it is also noted that the technologies for extracting the starch and oil energy fractions is developing and becoming more efficient. This will in turn reduce the nutritive value of the co-product and possibly even the scope for their use in dairy rations. As UK biofuel plants become fully functional it will be important to establish the nature and consistency of the specific co-products produced from each plant.

Managing future commodity price fluctuations

5. In this study projections were used about possible price levels in the future. Due to the unpredictable nature of global commodity markets such projections should be used with caution. This applies equally to feed, milk and input costs such as fuel and fertiliser. Dairy producers should therefore concentrate on protecting margins through forward contracting and other available measures. The first step is to fully understand costs of production so that producers know what costs and prices they need to protect to stay in business. The second step is to develop strategies to protect margins when prices move the wrong way. Developing practical case studies and training resources would help dairy producers develop the new knowledge and skills they will need to manage these price risks in the future.

Future impact of biofuels

6. In this report available information suggests that the biofuels industry may only have a limited impact on the UK dairy industry at this present time. However many uncertainties remain over the impact of future government polices and the market's reaction. The impact of future policy measures such as the EU targets to meet 10 percent of road fuel needs with biofuels should therefore continue to be assessed on a regular basis. Within the study it was identified that protein prices were likely to weaken as the biofuel industry develops helping offset any increase in grain price. However in late 2007 soyameal prices rose sharply reflecting the large loss of soyabean area in the US due to rising US demand for maize in ethanol production. This assumption will therefore need careful reassessment as the situation develops.

6. KEY FARMER MESSAGES

- **Higher feed prices on their own do not justify a switch out of milk production at present** - at a milk price of 22ppl and purchased feed price around £160/t, it is better to stay in milk production than switch to another farm activity.

- **Further rises in the costs of feed and other inputs will remain a threat unless higher milk prices are maintained** - if feed price rise to over £200/t, or milk price drops significantly below 20ppl, it may be worth considering options like increasing the area under cereal cropping. Work through the possible business scenarios with your adviser to gauge the likely cost/benefit of doing this, using something like the spreadsheet tool.

- **Be careful to avoid major changes in dairy system in response to short term market fluctuations** - a major change in system, such as a shift to more home-grown feeds, or spring calving to produce most milk from grass, should only be done if the long-term price structure for the proposed system is forecast to be stable.

- **Any move from compounds to lower cost feeds must be carefully assessed** – the greatest cost savings can come from increased use of straights, less so from blends. Any cost savings are dependent on maintaining nutritional specification and performance. Additional costs in storage, handling and labour must also be fully considered.

- **Spring calving can allow reduced feed use and savings in overall feed costs** – but care must be taken to ensure that this does not lead to poorer performance and excessive transitional costs.

- **Make full use of biofuel co-products** – these do provide another option in the range of feedstuffs available for dairy rations, but it should be noted that there is a ceiling on how much can be fed in a balanced ration. Also, for DDGS, the energy contribution may not be as high as for traditional distillery-produced dried grains.

- **Feed prices are likely to remain higher and less predictable for some time to come** - take steps to limit the impact of further feed price rises where possible. Forward grain prices for harvest 2008 and 2009 are currently lower than the spot market. Securing a proportion of next year's feed requirements at a fixed price will moderate price risk. At the same time livestock producers should be aware that feed prices could fall given favourable world weather and a down turn in demand.

- **Understand the impact of biofuels on your business** - global biofuel developments have far reaching effects on the price of feed, fertiliser and competing livestock products. Irrespective of UK and EU biofuel developments, UK dairy producers will continue to be affected by the global biofuels industry and it is essential that they keep up with developments and understand the implications for their business.

- **Use market projections to aid business planning but beware of the risks** – global commodity markets have always been unpredictable but the advent of biofuels has added yet another uncertainty to the market. Do not place too much emphasis of future market projections but invest time instead in developing a flexible and effective strategy to manage unexpected risks.

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APPENDIX I. COMMODITY PRICE PROJECTIONS

Price projections

Methodology

Example

Projection 1 – UK feed wheat vs. FAPRI EU wheat

Average prices 2001-2005
UK feed wheat delivered Liverpool = £79.61/t
EU wheat French FOB Rouen = £79.79/t
HISTORICAL BASIS = -£0.18/t

FUTURE basis
For wheat the UK basis is expected to strengthen as the UK moves to export parity if domestic ethanol production increases as planned. In Liverpool the local market is already deficit which means that the total price gain there would be less than say in East Anglia and is assumed in this example to be +£8/t by 2010.

TOTAL basis = -£0.18+ £8/t = +£7.82

2010 Projection
FAPRI EU wheat price projection = £91.28
PLUS UK TOTAL basis = £7.82
Final UK delivered Liverpool price = £99.10/t

This is of course a major simplification of the many issues that could affect the pricing relationship between UK and EU wheat prices

For soyameal the oilseed meal price projections from OECD were used which are based on a weighted average oilseed price at European port which includes soya, rapemeal, sunflower meal.

For barley historical values were obtained from the HGCA delivered survey while for future projections a £5 discount to wheat was used.

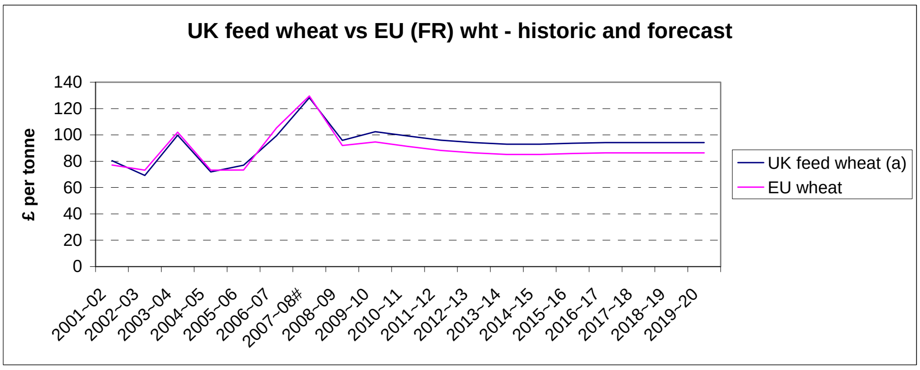
For rapemeal historical figures were taken from HGCA's feed ingredient survey based on Erith values as Liverpool values were not available.

FORECAST 1 - UK feed wheat vs EU wheat FAPRI

		£ per tonne UK feed wheat (a)	HISTORIC basis	FUTURE basis	TOTAL BASIS	£ per tonne EU wheat
ACTUAL	2001~02	80.41	3.25			77.16
	2002~03	69.09	-4.13			73.23
	2003~04	99.74	-2.32			102.06
	2004~05	71.83	-1.33			73.16
	2005~06	77.00	3.63			73.37
	2006~07	99.34	-5.99			105.33
	2007~08#	128.33	-1.20			129.53
FORECAST	2008~09	95.81	-0.18	4	3.82	91.99
	2009~10	102.54	-0.18	8	7.82	94.72
	2010~11	99.10	-0.18	8	7.82	91.28
	2011~12	96.02	-0.18	8	7.82	88.20
	2012~13	94.17	-0.18	8	7.82	86.35
	2013~14	93.00	-0.18	8	7.82	85.18
	2014~15	93.05	-0.18	8	7.82	85.23
	2015~16	93.66	-0.18	8	7.82	85.84
	2016~17	94.11	-0.18	8	7.82	86.29
	2017~18	94.11	-0.18	8	7.82	86.29
	2018~19	94.11	-0.18	8	7.82	86.29
	2019~20	94.11	-0.18	8	7.82	86.29

(a) Delivered Liverpool, HGCA
(b) FOB Rouen

HISTORIC BASIS claculations			
5 yr average (2001-2005)	79.61	-0.18	79.79

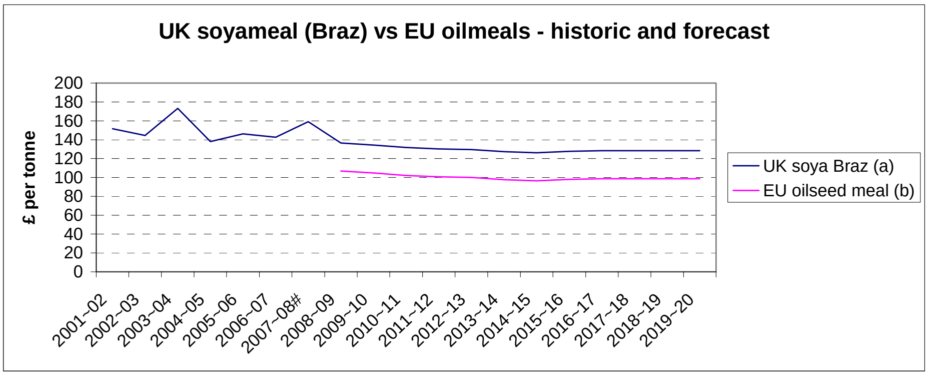


FORECAST 2 - UK soyameal vs EU oilseed meal OECD

		£ per tonne UK soya Braz (a)	HISTORIC basis	FUTURE basis	TOTAL BASIS	£ per tonne EU oilseed meal (b)
ACTUAL	2001~02	151.48				
	2002~03	144.63				
	2003~04	173.30				
	2004~05	138.01				
	2005~06	146.29				
	2006~07	142.58				
	2007~08#	159.00				
FORECAST	2008~09	136.43	29.66		29.66	106.76
	2009~10	134.36	29.66		29.66	104.70
	2010~11	131.75	29.66		29.66	102.09
	2011~12	130.33	29.66		29.66	100.66
	2012~13	129.59	29.66		29.66	99.93
	2013~14	127.28	29.66		29.66	97.61
	2014~15	126.24	29.66		29.66	96.58
	2015~16	127.62	29.66		29.66	97.96
	2016~17	128.46	29.66		29.66	98.79
	2017~18	128.46	29.66		29.66	98.79
	2018~19	128.46	29.66		29.66	98.79
	2019~20	128.46	29.66		29.66	98.79

(a) Delivered Liverpool, HGCA
(b) CIF EU, OECD

HISTORIC BASIS claculations			
5 yr average (2001-2005)	149.38	29.66	119.72



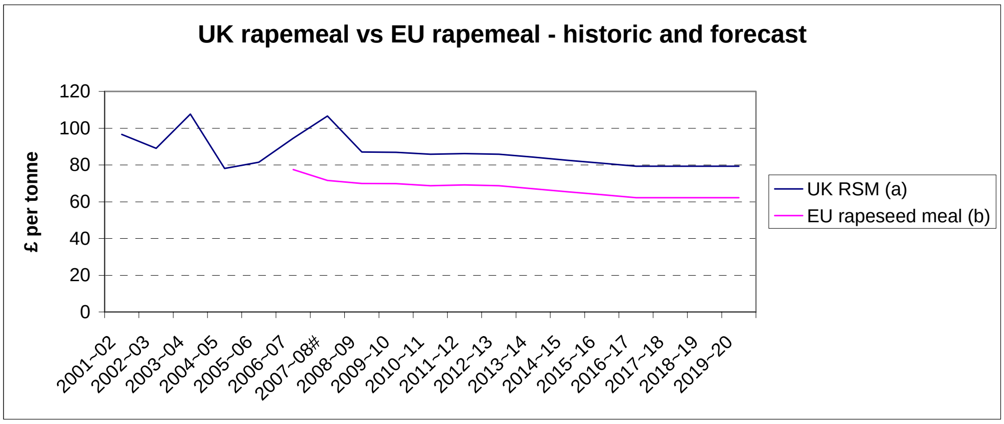
FORECAST 3 - UK rapeseed meal vs EU rapeseed meal FAPRI

		£ per tonne UK RSM (a)	HISTORIC basis	FUTURE basis	TOTAL BASIS	£ per tonne EU rapeseed meal (
ACTUAL	2001~02	96.6				
	2002~03	89.03				
	2003~04	107.68				
	2004~05	78.03				
	2005~06	81.51				
	2006~07	94.56				77.43
	2007~08#	106.62				71.51
FORECAST	2008~09	87.01	17.13		17.13	69.88
	2009~10	86.95	17.13		17.13	69.82
	2010~11	85.85	17.13		17.13	68.72
	2011~12	86.19	17.13		17.13	69.06
	2012~13	85.83	17.13		17.13	68.70
	2013~14	84.25	17.13		17.13	67.12
	2014~15	82.54	17.13		17.13	65.41
	2015~16	81.00	17.13		17.13	63.87
	2016~17	79.29	17.13		17.13	62.17
	2017~18	79.29	17.13		17.13	62.17
	2018~19	79.29	17.13		17.13	62.17
	2019~20	79.29	17.13		17.13	62.17

(a) Delivered Liverpool, HGCA
(b) CIF EU, OECD

HISTORIC BASIS claculations

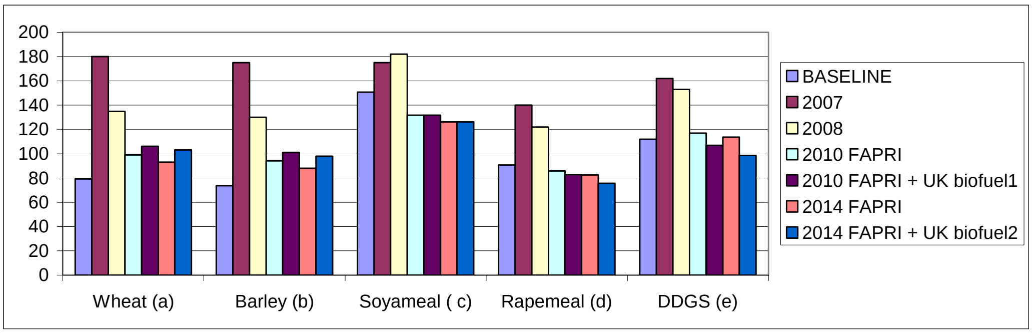
5 yr average (2001-2005)	149.38	17.13	119.72



APPENDIX II. FUTURE PRICE SCENARIOS

Price scenarios

Scenario	Name	Wheat (a)	Barley (b)	Soyameal (c)	Rapemeal (d)	DDGS (e)
A	**BASELINE**	**79**	**74**	**151**	**91**	**112**
B	2007	180	175	175	140	162
C	2008	135	130	182	122	153
D	2010 FAPRI	99	94	132	86	117
E	2010 FAPRI + UK biofuel1	106	101	132	83	107
F	2014 FAPRI	93	88	126	83	114
G	2014 FAPRI + UK biofuel2	103	98	126	76	99



All prices basis - delivered Liverpool

Scenario	Name	Description
A	BASELINE	Average prices over 5 yr period - 2001/02 to 2005/06
B	2007	Spot prices August 2007
C	2008	Forward prices for November 2008 (in Aug 2007)
D	2010 FAPRI	UK prices in 2010 from FAPRI projections + NO UK biofuels industry
E	2010 FAPRI + UK biofuel1	UK prices in 2010 from FAPRI projections + UK biofuels industry1
F	2014 FAPRI	UK prices in 2014 from FAPRI projections + NO UK biofuels industry
G	2014 FAPRI + UK biofuel2	UK prices in 2014 from FAPRI projections + UK biofuels industry2

UK biofuels scenarios

UK biofuels (1) assumes UK bioethanol capacity of 1Mt wheat + UK rapeseed crush of 2Mt
Prices vs FAPRI = UK wheat +£7/t, rapeseed -£3/t and DDGS -£10/t

UK biofuels (2) assumes UK bioethanol capacity of 2Mt wheat + UK rapeseed crush of 2.5Mt
Prices vs FAPRI = UK wheat +£10/t, rapeseed -£7/t and DDGS -£15/t

APPENDIX III. UK BIOFUEL PROPOSALS

UK biodiesel plant capacity projections

UK Biodiesel Production Plants (annual capacities)

Commencement	Company	Status	Location	Biodiesel Capacity (tonnes)	Rapeseed Consumption (tonnes)
1998	ESL	Operating	Cheshire	200,000	0
2005	Argent	Operating	Motherwell	45,000	0
2006	Biofuel Corp	Operating	Seal Sands, Teesside	250,000	0
2006	D1 Oils	Operating	Middlesborogh	42,000	0
2006	Greenergy	Operating	Immingham (1)	100,000	0
2007	Greenergy	Construction	Immingham (2)	100,000	0
2007	DMF	Permitted and awaiting funding	Rosyth	100,000	250,000
2008	Ineos	Construction	Grangemouth	500,000	0
Q3 2008	ABS	Planning Process and awaiting funding	Bristol	225,000	?
Q4 2008	Petrotech	Not known	South East	100,000	0
H1 2009	Tees Valley	Permitted, has necessary equity and now finalising project finance	Teesside	200,000	250,000
2009	Flex Fuels	Planning permission for crushing but awaiting decision on biodiesel plant	Cardiff		225,000
Totals				1,325,000	725,000

UK Biodiesel Production Plants (annual capacities)

Commencement	**Company**	**Status**	**Location**	**Biodiesel Capacity (tonnes)**	**Rapeseed Consumption (tonnes)**
1998	ESL	Operating	Cheshire	200,000	0
2005	Argent	Operating	Motherwell	45,000	0
2006	Biofuel Corp	Operating	Seal Sands, Teesside	250,000	0
2006	D1 Oils	Operating	Middlesborogh	42,000	0
2006	Greenergy	Operating	Immingham (1)	100,000	0
2007	Greenergy	Construction	Immingham (2)	100,000	0
2007	DMF	Permitted and awaiting funding	Rosyth	100,000	250,000
2008	Ineos	Construction	Grangemouth	500,000	0
Q3 2008	ABS	Planning Process and awaiting funding	Bristol	225,000	?
Q4 2008	Petrotech	Not known	South East	100,000	0
H1 2009	Tees Valley	Permitted, has necessary equity and now finalising project finance	Teesside	200,000	250,000
2009	Flex Fuels	Planning permission for crushing but awaiting decision on biodiesel plant	Cardiff		225,000
Totals				1,325,000	725,000

Source: Biofuel Matters Ltd

UK bioethanol plant proposals

UNITED KINGDOM					Feedstock				Co-products		
Status	Commencement	Company	Location	Bioethanol (tonnes)	Sugar Beet	Wheat	Wine	Biomass	Wheat DDGS		Comments
Operating	Q3 2007	British Sugar	Wissington, Norfolk	55,000	650,000						This will NOT put any additional animal feed onto the market because it is not an increase in crop, it replaces the so called "C" quota sugar that was previously exported until WTO rules changed this. Therefore sugar beet feed volumes remain unchanged.
Under construction	Q1 2009	Ensus plc	Wilton, Teesside	320,000		1,200,000			375,000		
Design phase	Q4 2009	BP/ABF/Dupont	Saltend, Hull	330,000		1,000,000			330,000		DDGS may be sold in a moist or dry pelleted form.
Permitted	Q2 2010	Abengoa Bioenergy UK	Immingham	320,000		1,100,000	100,000		350,000		All DDGS will be dried and pelleted (8mm)
Permitted but awaiting funding	Q4 2008	Green Spirit Fuels	Henstridge, Somerset	105,000		350,000			*130,000*		All DDGS will be dried and pelleted
	2008	Bioethanol Ltd	Immingham	200,000		650,000			210,000		
Outline permits under consideration	*2008*	Roquette	Corby, Northamptonshire	96,000		*320,000*			*120,000*		
Not permitted and awaiting funding	*2009*	Green Spirit Fuels	Immingham	200,000		650,000			*240,000*		*GSF have stated that they are considering combustion of the fermentation residues for power and heat generation*
	2009	Vireol	Grimsby	150,000		*500,000*			171,000		
	2010	Vireol	Teesside	150,000		*500,000*			171,000		
	2010	Losonoco	Merseyside	*66,000*				*330,000*	0		

Source: Biofuel Matters Ltd