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Economic Evaluation of Biodiesel Production from Oilseed Rape grown in North and East Scotland

Executive Summary

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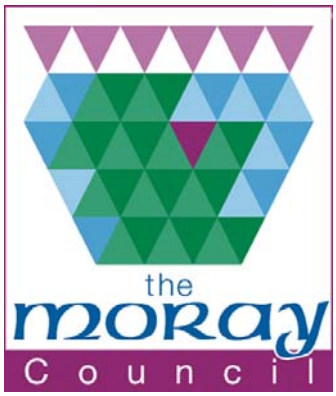

Glossary and Acronyms

Biodiesel	A biofuel produced from a fatty acid methyl-ester using vegetable or animal oil. Used as a diesel replacement or substitute
Bioethanol	A biofuel produced from the fermentation of sugar from a variety of crops. Used as a petrol replacement or substitute
CAP	Common Agricultural Policy (EU)
Crude oil	Mineral oil consisting of a mixture of hydrocarbons of natural origins
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
Esterification	Chemical process for converting vegetable oils into biodiesel using methanol to remove the gylcerine.
Feedstock	Materials used for processing into biofuel
Ha	Hectare (area land = 2.471 acres)
HGCA	Home Grown Cereals Authority
IRR	Internal Rate of Return. Represents return to investors over project life, when NPV = 0.
L	Litre (volume)
Megawatt (MW)	1,000 kilowatts
M	Million
NGC	New Generation Co-operative
NFUS	National Farmers Union Scotland
NMS	New Member States. 10 new countries who joined EU in May 2005.
NPV	Net Present Value. Used in investment appraisal to convert future cashflows into present values.
OSR	Oilseed rape
PBT	Profit before tax
RTFO	Renewable Transport Fuel Obligation
RDR	Rural Development Regulations. EU Policy for development of rural areas
RME	Rape Methyl Ester. An ester derived from Oilseed rape used for biodiesel.
ROC	Renewable Obligation Certificates
SAOS	Scottish Agriculture Organisation Society. Development agency for rural co-operatives
SEERAD	Scottish Executive Environment & Rural Affairs Department
SFP	Single Farm Payment. Introduced Jan 2005 part of CAP Reform, subsidy payment for farmers
SH Funds	Shareholder funds
SME	Small Medium Enterprise.
SRO	Scottish Renewable Orders
t	Tonne (weight)
UCO	Used cooking oil
ULSD	Ultra Low Sulphur Petrol
VAT	Value added tax
$	US Dollars (currency)
€	Euro (currency)

Executive Summary

1. Oilseed rape is well suited to Scottish growing conditions and produces high yields and oil contents. However, no processing facilities exist in Scotland and the crop must either be transported south or to the continent for crushing. The high haulage costs incurred result in lower prices for rapeseed in Scotland, placing Scottish growers of the crop at a disadvantage.

2. Environmental issues are driving the development of liquid biofuels. The EU Renewable Fuels Directive states that biofuels in member states should achieve a 2% share of the mineral transport fuels market by the end of 2005 and 5.75% by 2010. In the UK, the government recommends that carbon dioxide emissions are reduced by 60% from current levels by 2050. In 2005, the UK will only achieve 0.3% of transport fuels from renewable sources.

3. High prices for mineral fuels are also acting as a significant driver. Only liquid biofuels are suitable for use as transport fuels, with biodiesel and bioethanol being the most widely used types.

Study Objectives

4. The study was commissioned by Aberdeenshire Council, Angus Council, Fife Council, Highland Council, Moray Council, Perth and Kinross Council, Highlands and Islands Enterprise and the Scottish Enterprise Energy Team. The aim of the study is to identify the potential to add value to oilseed rape grown in the North and East of Scotland by conversion to biodiesel, and to stimulate economic activity through the establishment of processing facilities and the provision of end products from the process.

Bioethanol in Scotland

5. Bioethanol can be blended with, or can substitute for petrol, but as a fuel substitute requires engine modification, unlike biodiesel which can be used in unmodified diesel engines. Bioethanol production was considered to be less appropriate in Scotland as compared to biodiesel for several reasons: feedstock available in Scotland is less suited to bioethanol production; relatively inexpensive bioethanol can be imported to the UK; with a petrol over-supply and diesel deficit in Europe better markets exist for biodiesel.

OSR Supplies in Scotland

6. Oilseed rape production in Scotland has expanded since the early 1980s. The highest level of production was seen during the 1990s when up to 70 000 ha and 180 000 t was produced. Aberdeenshire, Angus, Fife, Highland, Moray, Perth and Kinross Council areas account for 76% of the area of the crop grown in Scotland.

7. The UK oilseeds crushing industry is highly concentrated and for economic viability plants are becoming larger. Crushing margins are volatile but have been high recently and it is considered that a new crusher would be subject to considerable competitive pressure.

8. Changes in support through the Common Agricultural Policy, and the removal of area support have reduced crop gross margins considerably, particularly for oilseed rape. Oilseed rape has been shown to give a number of benefits for the crop rotation as a

whole, notably enhancing the yield of following wheat crops, reducing nitrogen requirement of following crops, benefiting soil structure and spreading labour peaks. These benefits provide encouragement to retain the crop.

Use of grower contracts

9. Use of forward contracts in marketing arrangements is currently limited, but increasing. These can provide a number of benefits. A number of specific contracts for the energy crop market are now available. Transport costs to the designated plant will be at the grower's cost and give a significant reduction. For growers in Scotland this will account for £15–20/t, a significant reduction in the gross margin of the crop. Growers for energy crops are also eligible for the EU Energy Crop Initiative, which has a premium payment of 45 euros (£30) per hectare, with merchants retaining a significant portion (up to 50%) of this value to cover finance charges. Retention of a greater proportion of this payment by the grower if a different business structure were established, would give benefits for the overall return from the crop.

10. Production of oilseed rape in Scotland could be stimulated through the establishment of a local crushing plant, which would reduce transport costs ex farm, leaving a larger margin for the farmer in relation to the market price for the crop. Sharing information and potential returns through the local supply chain and establishing a stake in processing by involving a farmer co-operative in crushing biodiesel could all increase the return to farmers from the crop.

Biodiesel production

11. Biodiesel is produced by modifying vegetable oil by mixing with methanol to produce an ester in order to remove the glycerol from the oil. The resulting biodiesel can then be used in unmodified diesel engines. Rapid expansion of biodiesel production and utilisation has occurred in Europe, most notably in Germany, France and Italy, since the 1990s.

12. The use of pure plant oil has generated interest in Ireland and elsewhere. 'Pure' or unaltered oil can be used in diesel engines, providing the engine is first modified. There are several disadvantages to this approach in the UK, a major concern being that engine performance utilising this fuel is technically unproven over longer time periods. **Another important factor is that the use of pure plant oil does not currently qualify for the 20p/l tax rebate in the UK (see Section 10, Option 1, paragraph 10.1).**

13. Used cooking oil offers the potential of a cheaper feedstock but only small quantities are available in Scotland and there is likely to be competition for this from Argent Energy which has already established a biodiesel plant near Motherwell using this feedstock.

14. A further potential development for production of biodiesel involves use of a hydrogenation process to produce diesel standard fuel containing vegetable oil. However this technology is at very early stages of development and production is a number of years away, but progress should be monitored to assess competitive effects.

15. Crushing or pressing the seed for oil consists of several stages and for larger plants solvent extraction is used to maximise extraction of oil. It is of note that no solvent extraction plants with throughput of less than 1000t rapeseed per day are now being built in western Europe. The scale of rapeseed production in Scotland is unlikely to

ever justify a solvent extraction plant and therefore mechanical extraction methods would be used.

Scotland's previous OSR crusher

16. Key lessons to be learned from the failure of the Arbroath crushing plant are that scale is important, quality control is paramount, efficient oil extraction is worthwhile and site selection is crucial.

Environmental aspects of biodiesel production from oilseed rape

17. A review of work investigating the link between allergenic and irritant responses of the oilseed rape crop found that there is no evidence of a causal association between exposure to the crop and allergic symptoms. Many of the symptoms attributed to oilseed rape can be explained in terms of allergy to pollen other than oilseed rape.

18. Cultivation of the oilseed rape crop has been shown to provide biodiversity benefits. A number of farmland birds favour the crop for nesting and feeding. In particular, oilseed rape is credited with helping to slow the decline in population of the linnet species.

19. Use of energy balance techniques assesses the amount of energy used in production of a biofuel compared to the amount of energy produced. Energy balance of biodiesel from rapeseed is positive and varies according to the range of by-products included in the energy output and the production system used. For typical situations the energy balance is in the region of 2 – 4 units of energy gained for each unit of input. Energy balance can be improved by the utilisation of the straw and with increased interest for use of biomass for co-firing in electricity generators there may be potential for development.

Environment regulations

20. For environmental regulation, a small to moderate crushing plant will be subject to Part B regulations concerning emissions to air. An esterification plant will be subject to Part A, more stringent regulations applying to air, water and land. This requires a higher cost for the permit and more costly measures to implement requirements.

UK Transport fuel market

21. The current record high mineral oil prices are closing the production cost differential between mineral oil and renewable biofuels. In the past renewable fuels were at least two times as expensive to produce.

22. A review was conducted of the UK transport fuel market. It showed the UK has the 4th largest refinery capacity in Europe with 9 major refineries. The entry of the multiple supermarkets over the last 10 years into fuel retailing has made a major impact. Supermarket fuel sales now account for 34% of the UK petrol market and 24% of the diesel market. Their entry has made the whole fuel market very competitive as their market share continually grows. The number of retail filling stations has fallen dramatically over the last 15 years from 22,000 to 10,300 (2004). Around 700 filling stations are closing every year due to competition. The independent filling stations are found mostly in rural areas and have low volumes.

23. Although the demand for road transport is growing and is expected to increase, the total consumption of road fuels has been virtually static since 1997. This is due to a

combination of more efficient engines and an increased proportion of diesel vehicles. The latest figures from the Energy Institute show that UK petrol consumption for 2004 was 19,068,020 tonnes, with diesel at 18,930,061 tonnes for the same period. One trend is that petrol sales have been falling since the peak in 1990, whilst diesel sales have been increasing. At present too much petrol spirit is produced whilst there is a shortage of diesel.

24. Fuel distributors play an important role in the whole supply chain of transport fuels. It is a fragmented sector with many local companies located throughout the country. Normally wholesale fuel products move from the refinery to port terminals by coastal tankers. Power in the market lies with the major refineries who control supplies. Margins for fuel distributors are falling with intense competition. The market for fuel distributors can be segmented into 5 main customers, which are:

- Commercial businesses
- Haulage
- Agricultural
- Marine
- Domestic consumers

Rebate of fuel levy

25. The UK Government provides a 20p/l rebate on the fuel duty for biofuels. This is only guaranteed on a 3-year rolling basis. Most analysts regarded the 20p/l rebate insufficient for biodiesel to compete with conventional diesel on the open market. At the time of its introduction in 2002, an additional 10-15p/litre (depending on scale of production) was required to make biodiesel competitive. Intense lobbying took place to try and get the rebate raised. However, analysis carried out for the DfT showed that the benefit of biofuels in terms of their contribution to carbon reduction was only worth the equivalent of 20p/litre. It is very unlikely therefore that Government will move from this stance.

UK Government and the RTFO

26. The major driver for the biodiesel industry is the EU Directive on Renewable Transport Fuel Obligation (RTFO). At present this is only indicative and not compulsory although this is likely to change in the future. It is unclear at present how quickly the UK Government will respond to the RTFO, but the general view is that an announcement relating to its introduction will be made this autumn. It is anticipated that any legislation would not come into place until 2007.

What will the major oil companies do?

27. A major threat for any UK biodiesel producer is the action taken by the multinational oil companies who currently operate refineries in the UK. The 'hydrogenation' process could potentially undermine the ability of biodiesel to compete if it is adopted by the oil refiners. The UK is unique in considering introduction of hydrogenation for this application at present. Hydrogenation would allow crude vegetable oil to be mixed with mineral oil at the refining stage and qualify for the rebate on the tax levy. From the UK's perspective this route does have attractions in that it uses existing distribution channels, ensuring continuity of supplies, and guarantees the quality of product. It would address the issue of 'backstreet' blending of biodiesel with the associated risks for quality that the oil companies have previously indicated as a potential problem. However, it should be stressed that this process is at the very early stages of development, with only a small-scale trial having been carried out in

Germany. Much further experimentation and development of the taxation system is required before its introduction.

By-products – rapeseed meal and glycerine

28. There are two principal by-products from the processing of OSR: rapeseed meal (from the crushing stage) and glycerine (from the esterification stage). Rapeseed meal is used by the animal feed manufacturers as a protein supplement for livestock rations. The price is set against the industry benchmark of soyabean meal. The inclusion rate of rapeseed meal is limited to 10-30% due to nutritional factors. The annual demand for rapeseed meal in Scotland is estimated at 30-40,000 tonnes. At present prices ex-mill are £90 /tonne. The trade expect prices to fall in the future due to increased supplies from an expansion in European OSR crushing capacity. Due to the large volume produced, rapemeal prices make an important contribution to the overall economic viability of a plant.

Glycerine is a by-product of biodiesel production and can be used in a wide range of existing markets, having over 1,500 end uses. Crude glycerine is 70% pure and is usually refined to further points of purity up to 99%. Supply in Europe has significantly increased since the mid 1990s and this has been strongly influenced by an increase in biodiesel production. Currently it is valued at just over £110/t but prices have become increasingly volatile. The volume of glycerine produced is relatively low so its value has a relatively low impact on economic viability.

Possible sites

29. An initial review of potential medium scale processing plant sites was undertaken. It was considered necessary to locate at a port to facilitate the movement of imports/ exports. If a Scottish plant could be supplied using solely domestic feedstock then a port location would not be so important. Port Authorities may view any processing developments as a threat as currently over 60% of the Scottish OSR crop is moved through ports. Seven ports in the North-East and East of Scotland were identified and evaluated using a matrix over a range of variables. Further detailed work to identify suitable sites would be required once a decision on the scale and type of development is taken.

Economic evaluation

30. The economic viability of a range of OSR processing options was assessed. The overall aim was to create a business which would provide benefits to the agricultural and wider rural community, add value, meet a market demand and provide a return to investors. To facilitate the analysis, five options were examined which represent a range of scales and different business structures to determine if a viable opportunity exists

Option	Description
Option 1A	Farm Scale –a farmer converting his own OSR (190t) into crude rape oil for own use.
Option 1B	Farm Scale –a farmer converting his own OSR (355t) into biodiesel for own use.
Option 2	Small Group –small group of farmers processing 1,030t OSR producing crude vegetable oil
Option 3	Group Scale – Large group of farmers (15,000t OSR) producing biodiesel
Option 4	Medium Scale – 60,000 tonnes OSR with 30,000 tonnes esterification plant producing biodiesel
Option 5	Large Scale – The benchmark for international competitiveness

The following table attempts to summarise the results from the evaluation of the five options and provide key comments across a range of variables.

Summary matrix showing economic evaluation of biodiesel production from oilseed rape grown in north and east Scotland

Option	Technology	Ease of supply	Capital cost	Planning/ Development difficulty	Production cost (p/L)	Key factors	Retail price (p/L)	Markets	Rural economy impact	Current examples
1A. Farm oil (190t)	Crush Pure plant oil	Good	£7.3K	Easy	57.9 p/l Oil	Low operating cost	107p/l	On farm	Good if lots	All
1B. Farm biodiesel (355t)	Crush Biodiesel	Good	£30.4K	Easy	61.3 p/l Biodiesel	Low operating cost	90.4 p/l	On farm	Good if lots	All
2. Small Group (1,030t)	Crush Pure plant oil	Good	£81.2K	Easy	39.6 p/l Oil	Engine mod' not included	107.75 p/l	On farm	Good if lots	Ireland
3. Group (15,000t)	Crush Biodiesel	Good	£3.86M	Envirn. Impact Required	55.2 p/l Biodiesel	Capital cost vrs. Output	108.45 p/l	Road fuel market, but small volume	Good if several	
4. Medium (60,000t)	Crush Biodiesel	Possible Scot crop 140,000t	£10.2M	Major industrial development	41.3 p/l Biodiesel	Scale benefits	92.12 p/l	Major local player.	Regional, not many direct jobs	Austria Germany
5. Large	Hexane Biodiesel	Difficult UK scale	Only multi-national	Major industrial development	38 p/l (Hexane = 4p/l cost benefit)	Scale and process benefits	88.24 p/l	Link to Nationals. Blend	Not rural	France

31. Sensitivity analysis was carried out to determine the impact of key variable on production costs. If the plant is to be successful it needs to be competitive in the market. Sensitivity analysis will also provide a better understanding of the key issues and the critical success factors for a successful OSR processing plant. The variables considered were:

- Raw material costs
- Plant utilisation
- Value of by-products
- Capital cost
- Grant assistance
- Market demand

The costs of feedstock and the plant utilisation were shown to be key variables having a major impact on production costs.

Competitors – UK Biodiesel plants

32. At present there are four biodiesel plants in the UK, which are either recently established, currently being constructed, or at a well advanced planning stage. The following table presents an overview of key factors.

Name	Location	Plant Size	Feedstock	Investment	Status
Argent	Motherwell	50ML	UCO Tallow	£15M	Operational
Northeast Biofuels, Biofuels Corporation	Teeside	284ML	Palm Soya OSR	£46M	In construction
Greenergy Fuels Ltd	Immingham	113ML	Palm Soya OSR	£12 – 15M	Late Planning
Global Commodities	Norfolk	30ML	UCO, rapeseed	Over £10M	Early planning

Key: UCO - used cooking oil

There are several biodiesel developments in operation or planned. If all go to fruition, combined they will produce over 470 M litres of biodiesel. Comprising only 2.75% of the UK's consumption of diesel, this still leaves ample scope for further development.

How can farmers get involved – co-operative investment

33. One of the main issues for a new venture such as oilseed rape processing is building an effective structure. In this case a joint venture involving a variety of potential partners would seem appropriate. This has the advantage of sharing risk, pooling resources and expertise. The conclusion is that any oilseed processing business is likely to be more successful if it is formed from a broad Joint Venture of interests. A New Generation Co-operative (NGC) would be the best vehicle to get farmers involved in a processing company.

Fiscal support for biodiesel production

34. There are two main reasons why biodiesel production is so well developed in the rest of Europe
- Many European countries receive full fuel tax rebate. (See following table for rates of excise duty levied on diesel. This demonstrates the high rate of duty levied in the UK compared to other European countries.)
- Plants in these countries enjoy economies of scale giving very competitive unit costs.

EU rates of excise duty on diesel, 2003 (€/L diesel)

Austria	0.282
France	0.390
Germany	0.486
Ireland	0.379
Italy	0.403
UK	0.826

Exchange rate, December 2003, 1€ = $1.25 (US)

35. The market is driven by the Renewable Transport Fuel Obligation (RTFO). At present, large scale biodiesel production plants (eg at least 60 000t rapeseed equivalent) could compete with mineral diesel based on crude oil values of more the $60/barrel, even without such legislation. However, should crude oil decline in value, biodiesel at the 20p/litre tax rebate would struggle to compete with mineral diesel. At present, Government seems unlikely to be receptive to calls for a higher level of rebate, due to the belief that 20p/L represents the carbon saving value of biodiesel and that biodiesel is currently viable through market forces.

It is in the interests of agriculture to see the introduction of the RTFO as it presents firmer opportunities for biodiesel. However, if, as part of the negotiation hydrogenation was included as an acceptable means of achieving targets it could present a risk to biodiesel production. Industry sources indicate technical issues and introduction appears to be some way off.

When the RTFO is adopted, sources of biofuels for blending with transport fuels must be found. Bioethanol is not a direct competitor with biodiesel as it used for blending with petrol, however, as a biofuel it will compete on its overall contribution to any UK RTFO target.

Scenarios to meet Renewable Transport Fuel Obligation (RTFO) in Scotland for diesel

RTFO Rate	Biodiesel ('000t)	OSR Feedstock ('000t)	Area OSR (ha)	% of Scottish OSR crop (2004)
2%	37,900	94,650	27,043	73%
3%	56,800	141,970	40,654	109%
4%	75,700	189,300	54,086	145%
5.75%	94,700	236,620	67,607	182%

Scotland has made a huge commitment to renewable energy. This would be one component in a range of renewable energy sources. The establishment of a biodiesel plant from Scottish OSR fits well with Scottish Executive and Scottish Enterprise's strategy.

Commercial opportunity – hybrid option (medium sized plant)

36. Following analysis of options, the best commercial opportunity for Scotland is the hybrid option. This establishes a medium scale OSR crushing mill (60,000t), however, the benefits of economies of scale and access to lower cost vegetable oils are achieved through having a larger capacity esterification plant. This plant structure fits in with the Scottish conditions and is nearer being internationally competitive - allowing for the cost of importing biodiesel.

37. A 10-year cashflow was prepared for the medium scale option (60,000t OSR). The conclusion of the investment appraisal analysis is that the expected return is in the order of 14% with payback in 5 years. While this is a reasonable return, given the considerable risks involved potential investors may not be attracted unless ways are found to reduce the inherent risks involved.

How competitive would a Scottish plant be?

38. It is believed current Germany biodiesel production prices are approximately 38p/litre. The cost of a tanker from North Germany (Hamburg / Lear) to Aberdeen is £40 per tonne. This would cover all charges (there is no FOB). This translates to an additional shipping cost of 3.5p / litre. The net imported price would then be 38.0p + 3.5p = 41.5p /litre. Based on the assumptions stated, the estimated production cost of a medium sized plant (60,000t) purchasing additional crude vegetable oil (10,000t) to maximise the utilisation of the esterification plant, was 41.3p /litre. This would indicate that the plant could potentially compete with imported biodiesel.

39. The rapemeal from the process represent a good opportunity to replace imported protein supplements. The size of plant proposed would produce 39,600 tonnes of rapemeal at 9% oil. This could compete with imported and domestic protein supplements to the benefit of the livestock sector.

40. The cost of feedstock has a major impact on production costs. There is potential benefit for OSR growers in Scotland and a crushing plant to work together. The crusher must source feedstock at the cheapest price, however, growers benefit from savings in transport costs (£8-£12/t) and being part of the supply chain.

41. Running a successful processing plant will involve a steep learning curve. This could be overcome by involving a partner who has prior experience in operating a biodiesel plant.

Recommendations

The study makes a number of recommendations with action required on two principal fronts, namely;

- Support for the development of a medium scale plant in Scotland
- Support for pilot studies into small scale biodiesel schemes.

Medium-scale plant support

1. Raise awareness of business opportunity

The study shows there are benefits to farmers and the wider Scottish economy if an OSR processing and biodiesel plant was established in Scotland. The economic appraisal demonstrates there is a business opportunity which is commercially viable.

Local Authorities and Development Agencies need to raise the awareness of this opportunity amongst farmers and the wider business community. Effort needs to be taken to bring interested parties together. This is a role that the Partner Councils in the study should play.

2. Facilitate businesses to form a joint-venture company

There are significant risks involved for a medium scale plant however these could be considerably reduced through the formation of a joint-venture company. Ideally partners should be drawn representing different sectors in the chain. These could be:

- farmers co-operative - to ensure supplies
- processing business – to operate the crushing and esterification plant
- regional fuel distributor - to handle the blending and distribution
- animal feed compounder – to allow rapemeal to be utilised in Scotland

It is recognised it will be a considerable challenge to bring potential partners together to form a joint-venture company. Any action the Study Partners could take to facilitate this would be desirable.

3. Enlist support of SAOS and NFUS to gain farmer commitment

Securing farmers involvement and commitment will be a major step in levering other companies to invest in the project. SAOS and NFUS could play a key role in convincing farmers of the benefits of the project. The New Generation Co-operative (NGC) model provides a good mechanism to get farmers involved. There are many good examples in the United States, Canada and New Zealand to show the benefits for farmers. Whilst a medium scale plant requires feedstock of 60,000 tonnes of OSR, it is not imperative all this tonnage is provided from a NGC. If a NGC could provide a core, of say 10,000 – 20,000 tonnes, the balance could be sourced on the open market through the trade. Whilst offering considerable support to a Scottish industry, this approach allows the benefits of optimising cost efficiency by allowing some procurement on the open market.

4. Provide firm commitment to source biodiesel from Scottish plant

The attractiveness of the project would be greatly enhanced if all the Local Authorities involved in the study were able to underwrite a firm commitment to

source their diesel requirements from an established biodiesel plant. They would not be expected to pay a premium over market rates but simply guarantee a core demand.

5. The biodiesel produced should be branded.

It would be desirable to differentiate the biodiesel produced by branding it and also blending it at a higher inclusion level (above the market norm of 5%). Both these actions have the advantage of providing something unique to help protect markets from competition. It would also contribute more to the 'green' credentials of the product through lower emissions. If Local Authorities sourced a 10% blend, it has the added advantage of doubling sales and would also provide Local Authorities with a real opportunity to promote their efforts towards improving the environment. One potential obstacle for a 10% blend would be securing vehicle manufacturers acceptance, to ensure engine warranty. This is not believed to be a major obstacle and is already happening in many cases.

6. Approach existing OSR and biodiesel processors

Many regional fuel distributors showed interest in the project and it clearly had a lot to attract this sector. It is not anticipated that it would be difficult to secure a partner to a joint-venture company from fuel distributors. Potentially the most difficult area will be to recruit a partner for the processing side of the business. There are few companies who have experience in this sector. Approaches should be made to existing OSR and biodiesel processors to gauge their level of interest.

Pilot studies into small-scale production.

7. Pilot studies of small-scale biodiesel production

It is recognised that the development of a medium scale biodiesel plant will take time, establishment of a new business and considerable capital investment. In the meantime a few (2-3) small-scale plants could be supported through a series of pilot studies. The financial appraisal showed that small scale production for own use could be economically viable. Further work is required to test and confirm the costings. Pilot plants could be situated at a number of points within the major growing areas of oilseed rape, possibly at existing farmer co-ops and in different Council regions. This would provide huge benefits to the development of biodiesel production in Scotland. It would also provide confidence to potential investors. There is a real need to gain experience and develop a better understanding of the technology, relationships and cost structures in this whole area.

Engineering aspects of running a biodiesel plant will be assessed. To develop confidence in the fuel produced and enable expansion of the market it will be essential that biodiesel produced is of a sufficient quality. A programme to monitor quality of the biodiesel produced from these micro plants will be implemented. These studies could be for a 2-3 year period with lessons learned through a series of regular reports and visits made available. It would be an advantage to involve an equipment manufacturer in the pilot study.