The feasibility of biodiesel production at different scales

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Content

- Drivers for liquid biofuel development in the UK
- Key issues affecting the economics of biofuels
- Feasibility of different scales of biodiesel production – Scottish case study
- Conclusions

Factors driving liquid biofuel development

- Environmental issues - reduction in greenhouse gas emissions
  - Transport accounts for a significant, and growing proportion of energy demand
- Strategy - cost and availability of mineral fuel
- Agricultural support
- EU Targets
  - Member States should achieve targets of biofuels as 2% of transport fuels by 2005 and 3.75% by 2010/11
  - Mandatory target of 10% by 2020 proposed

Liquid biofuel types

Renewable energy sources for transport are limited

Main biofuel types currently used:

- Bioethanol - *petrol substitute / additive*
  - from starch/sugar crops, eg cereals, potatoes, sugar beet
- Biodiesel - *diesel substitute / additive*
  - from oil crops (eg oilseed rape, soya, palm), used cooking oil, tallow

Key issues for economic evaluation of biofuels

- Objectives for biofuel production
- Feedstock
  - Crops currently grown
  - Capability for additional production
  - Logistics of supply
- Scale
  - Economies of larger scale
  - Smaller scale offers greater distribution of benefits
- Support
  - Biofuels are generally more expensive than mineral oil fuels, some form of government support is required

Biofuels in Scotland – case study

- Objectives for biofuel production
  - meet EU targets + obtain environmental benefits - important
  - agricultural support - less important
- Feedstocks
  - cereals and oilseed rape (limited used cooking oil and tallow)
- Scale
  - range of scales of interest
- Support
  - limited government support

UK government support for biofuels

- Fuel duty rebate of 20p/l generated little development
- Further support from 2008: Renewable Transport Fuel Obligation
- Fuel suppliers failing to meet biofuel requirement pay buy out price
- Up to 15p/l in 08/09

Bioethanol production potential in Scotland

Feedstock

- Surplus barley gives a feedstock opportunity, but has a poorer conversion rate than wheat feedstock
- Wheat has limited production potential and trades at a premium
- No sugar beet grown, potatoes are for high quality seed

Scale

- Only large scale technology available with high capital requirement

Markets

- Threat of cheap imports could disrupt markets

Conclusion

- The case for bioethanol from wheat/barley in Scotland is poor

Context of biodiesel production from oilseed rape in Scotland

- Oilseed rape production in Scotland
  - approx. 35,000 ha cultivation, third most widely grown crop, after spring barley and wheat
  - highest average yields in Europe
  - high oil content
    - due to northerly latitude and temperate conditions
- Processing
  - currently there is no crusher in Scotland
  - availability of wide range of processing scales
  - Scottish OSR prices lowest in UK

Processing options considered - Scottish context

OSR (tonnes)	Option	Scale	Product	Capital cost (£)
355	1	Farm	Biodiesel	30.4k
15,000	2	Group	Biodiesel	3.86M
60,000	3	Medium	Biodiesel	10.2M
250,000+	4	International	Biodiesel	25M

Production cost elements

- Capital cost
  - cost of plant, storage and installation → annual charge
- Operating costs
  - Labour, power, maintenance, consumables (eg methanol), overheads, interest on working capital
- Income
  - Rapeseed meal, glycerol

On-the-road price for different scales (p/litre)

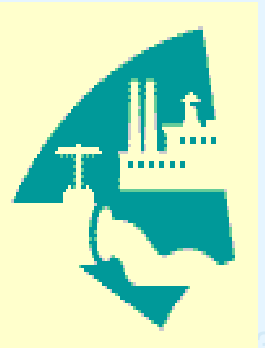
Option	Production cost	Retail margin	Duty	Sub-total	VAT 15%	Total cost
1	0.68	0.02	0.34	1.04	0	1.04
2	0.60	0.10	0.34	1.04	0.16	1.20
3	0.45	0.10	0.34	0.89	0.13	1.02
4	0.41	0.10	0.34	0.85	0.13	0.98

Note – mineral diesel at pump – £1.00 (Aug/09)

Note – RTFO buy-out price effect (£0.15 advantage)

Commercial opportunity for biodiesel in Scotland

- Large scale – lower cost/litre, but need to balance with availability of feedstock
- Medium scale plant (60,000t OSR crushed) (+ 10,000t oil) + esterified - produces 33ML of biodiesel
  - realistic estimate of share of osr production in Scotland vs economies of larger scale
  - 14% return with pay-back by year 6, but considerable inherent risks involved
  - mitigate risk through formation of joint-venture company
    - Farmers⇔Processors⇔Customers



Consider sensitivity of production costs

Budgeted production cost 41p/l

- Utilisation of capacity (+/-10% 2.4p/l)
- Cost of feedstock (+/- £10 1.8p/l)
- Value rapemeal (+/- £10 1.2p/l)
- Grant assistance (+/- £1M 0.9p/l)

- Value of glycerol (+/- £10 0.2p/l)

Small scale production of biodiesel

- Possibility for local fuel production?
- Equipment available and small scale production technically possible
- Opportunity for greater domestic
- Look carefully at costs
- May be worthwhile for some:
  - Ready market for biodiesel
  - Utilise meal on-farm
  - Use existing buildings/labour
  - In area where diesel, feed particularly expensive
- SVO – lower costs of production – more suited to small scale?

Small scale (324 t rapeseed) costs of production (£)

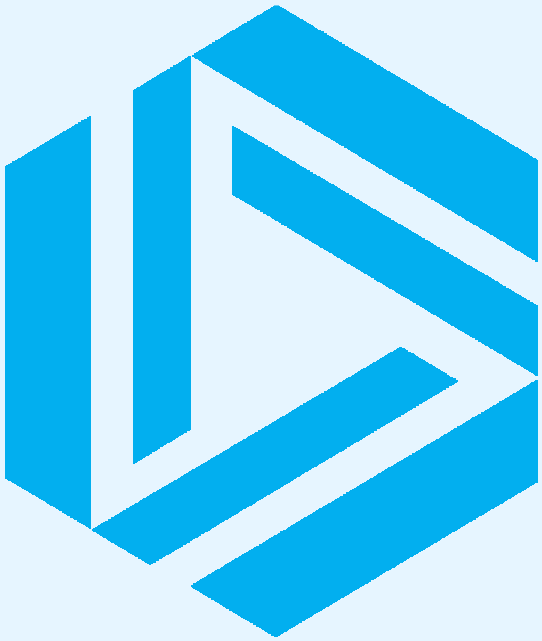
Option	Production cost	Retail margin	Duty	Subtotal	VAT	Total
SVO	0.46	0.02	0.34	0.82	0.12	0.94
Biodiesel	0.67	0.02	0.34	1.03	0.15	1.18

Note – mineral diesel at pump – £1.00 (Aug/09)

Note – RTFO buy-out price effect (£0.15 advantage)

Conclusions

- Biodiesel is more expensive to produce than mineral diesel in Scotland, need continuation of fiscal incentives
- Economies of scale offered by larger processing plants, but less local benefits however with 20p/l fuel duty rebate bigger scales can compete
- Small scale – more expensive, but may suit some circumstances – SVO of interest



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