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
<table>
<thead>
<tr>
<th>OSR (tonnes)</th>
<th>Option</th>
<th>Scale</th>
<th>Product</th>
<th>Capital cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>355</td>
<td>1</td>
<td>Farm</td>
<td>Biodiesel</td>
<td>30.4k</td>
</tr>
<tr>
<td>15,000</td>
<td>2</td>
<td>Group</td>
<td>Biodiesel</td>
<td>3.86M</td>
</tr>
<tr>
<td>60,000</td>
<td>3</td>
<td>Medium</td>
<td>Biodiesel</td>
<td>10.2M</td>
</tr>
<tr>
<td>250,000+</td>
<td>4</td>
<td>International</td>
<td>Biodiesel</td>
<td>25M</td>
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</tbody>
</table>
Production cost elements

- **Capital cost**
  - cost of plant, storage and installation → annual charge

- **Operating costs**
  - Labour, power, maintenance, consumables (e.g., methanol), overheads, interest on working capital

- **Income**
  - Rapeseed meal, glycerol
## On-the-road price for different scales (p/litre)

<table>
<thead>
<tr>
<th>Option</th>
<th>Production cost</th>
<th>Retail margin</th>
<th>Duty</th>
<th>Sub-total</th>
<th>VAT 15%</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.68</td>
<td>0.02</td>
<td>0.34</td>
<td>1.04</td>
<td>0</td>
<td>1.04</td>
</tr>
<tr>
<td>2</td>
<td>0.60</td>
<td>0.10</td>
<td>0.34</td>
<td>1.04</td>
<td>0.16</td>
<td>1.20</td>
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<tr>
<td>3</td>
<td>0.45</td>
<td>0.10</td>
<td>0.34</td>
<td>0.89</td>
<td>0.13</td>
<td>1.02</td>
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<tr>
<td>4</td>
<td>0.41</td>
<td>0.10</td>
<td>0.34</td>
<td>0.85</td>
<td>0.13</td>
<td>0.98</td>
</tr>
</tbody>
</table>

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 (£)

<table>
<thead>
<tr>
<th>Option</th>
<th>Production cost</th>
<th>Retail margin</th>
<th>Duty</th>
<th>Subtotal</th>
<th>VAT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVO</td>
<td>0.46</td>
<td>0.02</td>
<td>0.34</td>
<td>0.82</td>
<td>0.12</td>
<td>0.94</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>0.67</td>
<td>0.02</td>
<td>0.34</td>
<td>1.03</td>
<td>0.15</td>
<td>1.18</td>
</tr>
</tbody>
</table>

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