Meeting the Renewable Transport Fuel Obligation

A Biofuels Case Study from Seed to Forecourt

A team comprised of 14 different businesses involved in a North-East ‘virtual’ biodiesel supply chain identified critical success factors for this emerging industry following the application of a Cereals Industry Forum (CIF) Value Chain Analysis.

The critical success factors are:

- The need to standardise and transfer best farming practices more widely;
- Breeding specific varieties for biofuels;
- Continuity of supply into the crusher with crop storage adjacent to the crusher; and
- Carbon reporting from seed to tank.

“The VCA project was a very valuable exercise and I firmly believe it is a great help as a pointer and a base against which our supply chain members can measure improvements in the coming years. These improvements will be very necessary in a competitive world, where the consumer will demand both cost competitiveness at the pump and a product which helps to combat Global Warming.”

John Reynolds, North East BioFuels Chairman

Background

In 2005 the Government introduced the Renewable Transport Fuel Obligation (RTFO) which will require transport fuel suppliers to ensure that, by 2010, 5% of all road vehicle fuel is supplied from renewable sources.
There are three main types of biofuel:

- **Biodiesel** which can be used neat, but is generally used as a blend in conventional diesel. It can be produced from a number of sources, including recycled waste vegetable oil and oil crops such as rapeseed and palm.
- **Bioethanol** which can be blended into petrol and can be produced from a number of crops including sugar beet and wheat.
- **Biogas** can be used instead of compressed natural gas to power gas vehicles.

In mid-2005 biofuel made up 0.25% of overall road fuel sales and around 50% of it was imported.

If the 2010 target is achieved and if this was produced entirely in the UK from crops like oilseed rape then around 1.5 million hectares of land will be required which is equal to about 25% of UK arable land.

The RTFO also requires businesses to report on the greenhouse gas savings of their fuels using a carbon calculator that is currently under development in Government.

As a result of these changes domestic farmers are looking to supply this market and assess the economic and environmental outcomes.

**Mapping the Chain**

Our project mapped a 'virtual' oilseed rape supply chain from seed through to the vehicle tank shown in the following diagram. We did not set out to assess the economic or environmental impact of this chain, rather our objective was to investigate the developing supply chain relations and identify how these could be improved in order to help the business partners produce in the most efficient way possible.
Due to the length of the chain and for practical reasons, our work was split between an upstream and a downstream focus group. Each team carried out detailed mapping of their respective part of the chain and then the two maps were put together to develop an overview of the whole system.

There are different possible routes to market and different potential suppliers / supplied products at various stages of the chain. Since the crusher plant is still under development the following analysis represents potential activities and relationships based on realistic design and operating data provided by the team.

The oilseed rape element of the value stream which is delineated in this case study is a local chain with the fertilizer manufacturing, growing, central storage, crushing, esterification and blending located in the North East of England.

**Upstream**

The detailed mapping of the upstream chain showed that the total lead-time from basic seed to crusher is about 920 days out of which 365 days is in multiplication of basic seed, 365 growing on the farm and 180 days on average in central silo.
The total mileage from fertilizer manufacturing plant to the crusher is about 250 miles.

The following map provides a detailed overview of the upstream chain.

A number of issues and opportunities were identified in the upstream chain:

- 5% of the farmers achieve 4.5 T/Ha yield while the national average is about 3.3 T/Ha (Monsanto). This gap can be indicative of lack of standardisation of best farming practices.

- If too much nitrogen fertiliser is applied there is a big risk of it not being used efficiently and ultimately some being wasted. This is also important because about half of the greenhouse gas emissions from biodiesel are down to the use of nitrogen fertilisers during cultivation. Good nitrogen application practices are economically and environmentally desirable.
There are several quality checkpoints along the chain – sometimes performing the same tests on the same batch of oilseed rape. Rationalisation of the quality inspection points and regime along the chain could prevent unnecessary waste.

The delivery tickets into the central store are sometimes not accurate and require more attention from the farmers and hauliers to reduce the number of errors. These errors add time to the intake process at GrainCo.

Communication along the chain needs to be improved. For example by improving the information flows between the farmer, the haulier and the central store the delivery performances can be improved.

The information flows between the farmers and Farmway in relation to the seed variety order need attention: currently 25%-50% of the orders are received at the last minute at Farmway which means that Farmway keep just-in-case seed inventory and return the excess back to the seed supplier at the end of the season. Although there is no direct cost to Farmway for returning seed, ultimately this adds cost to the whole system. Moreover, last minute orders mean that sometimes the farmers don’t receive the desired varieties due to unavailability.

With existing technology, about 10% of the oilseed rape is lost during harvest. This will be substantially higher if the wrong setup is done on the harvester. Therefore, standardisation of the harvest practices and changeovers will reduce crop loss. Also, alternative harvest techniques could be explored.

**Down Stream**

The detailed mapping of the downstream chain showed that the total lead-time from the crusher to the vehicle tank is more than 60 days (excluding time in the tank-farm due to data not available).

The total transport in the downstream is about 60 miles (excluding miles travelled in pipelines).
The following map provides a detailed overview of the downstream chain.

A number of issues and opportunities were identified in the downstream chain as follows:

- One of the key issues in the chain is continuity of supply of locally grown OSR with consistent quality to the crusher. This requires attention from the farming industry and the right storage points along the chain.

- The downstream chain is effectively an oil & gas chain and very mature from a logistical perspective. However, Petroplus continuously strives for perfection and aspires to bring delivery error ratios and the number of delivery incidents down to very low levels near zero.
Critical Success Factors

Our team ranked the improvement opportunities and identified the following as the key requirements along the chain.

- Standardise best farming practices, disseminate and educate farmers

A significant gap was identified between the best and the poor farmers, for example substantial yield differences due to wrong choice of variety and non-standard husbandry, N-fertilizer loss due to wrong application, harvest loss due to wrong setup and non-standard changeovers. Therefore, the team felt that both cost efficiency and quality of the outputs could be improved through standardisation of the best practices at the farm level and dissemination to the wider industry.

A continuous improvement culture should be institutionalised in the farming industry for the biofuels sector to thrive. Also, sources of variation in farming should be identified and dealt with in a rigorous manner. With regards to the oilseed rape harvest loss (10% on average) new technologies (e.g. application of resin prior to harvest) could be investigated.

“We have established a biodiesel growers network to share experiences and build advice based on farm results and analysis. Grower networks of this kind are a key way of raising farm performance and will become an essential element of the new biodiesel market.”

Dr Colin Merritt, Monsanto UK Ltd
“The importance of bio-fuel crops to farmers has already been demonstrated in the market place in this last nine months, at last we are receiving demand-led energy related prices for our arable crops rather than market clearing prices. With fossil fuels we have been utilising the energy from the sun captured 100 million years ago, bio-fuel crops are the link to capture that energy now, our fields are solar panels.

The VCA report highlights the key points which can deliver the right carbon footprint to improve the credibility of our energy crops in a carbon conscious world. At the farm level the report highlights the importance of nitrogen fertiliser as the main contributor to growers’ carbon emissions suggesting that plant breeders should focus on this problem as well as higher oil yields per hectare”

John Hutchinson, Croxdale Farms

"Agrovista is pleased to have played its part in the Value Chain Analysis project in support of the rapidly-developing biofuels industry on Teesside. We believe that establishing an efficient supply chain for biofuel production will be of tremendous benefit, not just to farmers in the immediate vicinity, but all over the UK. Any project that ensures farmers an expanding end-market for their crops has to be positive and Agrovista looks forward to working with farmers to produce high yielding, high quality feedstock for the biofuels market."

Chris Glover, Agrovista
Breeding specific varieties for biofuels

Currently, there are no oilseed varieties specific for biofuels production. High yield and oil content are key to the success of the whole sector and have a big impact on profitability of biofuels crop production as well as the whole supply chain.

Continuity of supply into the crusher and crops storage adjacent to the crusher

Key to sustainability of this chain is the continuity of supply of high quality locally grown crops into the crusher. The crusher connects the upstream and downstream chains and efficiency of the upstream supply is crucial in terms of competitiveness of the whole industry. Therefore, any unnecessary stocks and double handling should be eliminated before the crusher. The team felt that the ideal scenario is to have oilseed central storage adjacent or close enough to the crusher. This was so that a just-in-time vendor-assured continuous flow can be created from the store into the crusher all year round.

“The emerging renewable transport fuels sector will increasingly exhibit many of the attributes of the oil industry. It will be characterised by very large volumes, moderate to small added value per tonne, a need to manage stocks throughout the supply chain and a zero defect delivery system at the point of usage (quality, timing, price, zero rework and service). To achieve the business objectives there needs to be a detailed understanding of the total supply chain so that it can be efficiently managed. The VCA study has been a milestone in achieving this understanding.”

James Emerson, Nepic
Carbon reporting from seed to tank

The carbon footprint and the environmental impact of the end-to-end supply chain (seed to tank) must be constantly monitored to ensure that the promised carbon reduction is met. Currently the RTFO is not directly linked to carbon saving however this is expected to evolve to provide more incentive to best environmental practices. Moreover, an obligatory carbon reporting mechanism should be put in place which requires companies along the chain to report against their carbon track.

Using a life-cycle approach and data published by Government, our team compiled the table below showing that a substantial savings can be obtained by displacing ultra low sulphur diesel from crude oil by biodiesel from oilseed rape.

Total GHG Emissions – Comparison between Conventional Ultra Low Sulphur Diesel (ULSD) and Biodiesel from a Supply Chain in the Northeast of England

<table>
<thead>
<tr>
<th>Type of fuel</th>
<th>Kg CO2-equivalent / Kg of product</th>
<th>Kg CO2-equivalent / MJ</th>
<th>% net savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional diesel</td>
<td>---</td>
<td>0.087</td>
<td>0%</td>
</tr>
<tr>
<td>Biodiesel (UK average estimated by Defra)</td>
<td>1,516</td>
<td>0.038</td>
<td>53%</td>
</tr>
<tr>
<td>Biodiesel (existing chain)</td>
<td>1,398</td>
<td>0.041</td>
<td>57%</td>
</tr>
</tbody>
</table>

Source: DEFRA/Sheffield Hallam University

“The VCA is a valuable project which helps supply chain stakeholders to build better and longer-term relationships. The VCA project looked at opportunities for improving operations and also the logistics in the supply chain. This sector is very mature and the logistical opportunities are limited. However, one of the key findings was the need for transparent and rigorous carbon reporting along the life-cycle of biofuels. This includes all aspects of delivery from grain to fully blended biofuels to the retail outlet.”

Iain Grime, Petroplus Business Development Manager
“The potential for Teesside bio fuel industries has never been better. Using new projects, the Tees Valley could be producing up to 800 million litres of biodiesel and the same of bioethanol. Massive investment and thousands of jobs in construction, process and supply chain would be generated and Tees Valley would play a pivotal role in achieving the Government’s Renewable Transport Fuel Obligation (RTFO). This VCA was a powerful tool to analyse the state of the industry at an early stage and contributed to helping this region achieve its long-term objectives.”

Dermot Roddy, CEO, Renew Tees Valley Ltd

Value Chain Team

The table below identifies the team that undertook this project with a few of them posing for the camera.
<table>
<thead>
<tr>
<th>Company</th>
<th>Activity</th>
<th>Representative(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terra</td>
<td>Fertilizer production</td>
<td>Andy Yates</td>
</tr>
<tr>
<td>Monsanto</td>
<td>Seed breeding</td>
<td>Colin Merritt</td>
</tr>
<tr>
<td>Agrovista</td>
<td>Agri-chemicals supplier</td>
<td>Chris Glover</td>
</tr>
<tr>
<td>Farmway</td>
<td>Buying group (Farmer Controlled Business)</td>
<td>Tony Simpson</td>
</tr>
<tr>
<td>Hutchinson Farm</td>
<td>OSR grower</td>
<td>John Hutchinson</td>
</tr>
<tr>
<td>Grain Co.</td>
<td>Central storage</td>
<td>Jonathon Pearse</td>
</tr>
<tr>
<td>North East Biofuels</td>
<td>Crusher</td>
<td>John Reynolds, James Emerson, Ian Waller</td>
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<tr>
<td>Biofuels Corporation</td>
<td>Esterification plant</td>
<td>Aylia Atherley</td>
</tr>
<tr>
<td>Simon Storage</td>
<td>Tank farm</td>
<td>Mike McIntyre</td>
</tr>
<tr>
<td>PetroPlus</td>
<td>Refinery and diesel blending</td>
<td>Iain Grime, Karen King</td>
</tr>
<tr>
<td>JET</td>
<td>Forecourt</td>
<td>Linda Greenhalgh</td>
</tr>
<tr>
<td>Renew Tees Valley</td>
<td>Economic Regeneration</td>
<td>Dermot Roddy</td>
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<tr>
<td>HGCA</td>
<td>Cereals industry levy body</td>
<td>Chris Barnes, Mairi Black</td>
</tr>
<tr>
<td>Cardiff Business School</td>
<td>VCA facilitator</td>
<td>David Simons, Keivan Zokaei</td>
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