

**An Integrated Regional Supply Chain
for a
BioMass and Energy Strategy**

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Client: The North East Process Industry Cluster (NEPIC)



The **North East Process Industry Cluster (NEPIC)** is an organisation that represents in excess of 500 Pharmaceutical, Biotechnology, Speciality, Polymer & Rubber, Petrochemical & Commodity Chemical companies based in the North East of England and was established by industry to develop the long term future and improve competitiveness of these sectors and region.

Furthermore, there are at least an equal number of companies in the supply chain of these industries based in the region making this a major economic cluster. NEPIC companies have a significant presence in all sub regions of North East England – Northumberland, Tyne & Wear, Durham and Teesside and the combined economic power of NEPIC companies and their importance to the region and the UK cannot be over emphasised.

Lead by senior industrialists, NEPIC has a reputation for delivery of projects that enhance sustainability of the Process Industry Sector. These projects are identified, developed and delivered through a series of Thrust Teams set up by the industry. The process sector is the largest industrial sector in North East England, and is vital to its future prosperity.



PCF Solutions Limited (PCF) is a specialist professional services provider based in the North East of England, which was formed in 2007 to offer a wide range of Financial, Human Resources, Information Technology and Management Consultancy solutions, based upon the extensive experience of the management team.

PCF has carried out a number of assignments in the renewable and waste to energy sectors for clients in the UK and the US, ranging from strategic investment reviews, financial and operating model development, project and financial due diligence, corporate structuring and restructuring, mergers and acquisition negotiation and post integration management, as well as, fund raising activities.

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1.0 Executive Summary

The move towards renewable and waste to energy solutions, as part of an overall UK strategy to achieve a lower carbon economy, is being driven by government policy and incentives in the form of the Road Transport Fuel Obligation (RTFO), Renewable Obligation Certificates (ROC's) and Feed in Tariffs (FIT's) for electricity generated from sustainable sources. The UK Government is also seeking to incentivise the capture and generation of heat from renewable sources through the renewable heat incentive (RHI) during 2011.

Ultimately, the behaviour of consumers will determine the success or otherwise of such policies and in that respect, it would appear that the tide is turning in the right direction, however, there remains a long way to go if the UK government is to meet its objectives over the coming years.

Education regarding the ultimate benefits of a lower carbon economy can help to continue increasing consumer acceptance. However, the biggest challenge that remains during the current financial climate, is what impact the move towards a lower carbon economy will have on the consumers themselves in terms of cost (via the fuel pump, the National Grid and taxes), combined with the deliverability of government policies, which requires the support of financial markets and strategic investors to secure the capital and intellectual investment required to achieve its objectives.

The global renewable energy sector is an emerging industry which almost inevitably has been through a particularly turbulent period over the past 5 years. This is now creating a further potential challenge to the sector being able to convince the capital markets that "this time it will be different".

On the other hand, the North East of England as a region has also had its share of successes over the same period, which is a testament to the work that NEPIC has carried out in building on the following factors:

- Established process industry, training and skills base, looking to achieve continuous improvement in operations and efficiencies;
- The establishment of a technology base in the form of the Centre for Process and Innovation to encourage SME's to invest and develop new technologies;
- Strong existing and scalable infrastructure to facilitate expansion, logistics, transportation and storage capability;
- A strong University research base;
- A strong and well established training and skills base.

The sector must learn from the experiences of the past by adopting a more integrated approach to its development, understanding and managing the risks associated with a capital intensive programme, combined with volatile commodity and financial markets.

The importance of managing logistics, transportation and storage costs will become more important to the fundamental economics of the supply chain in a higher oil price environment.

An opportunity therefore exists for a business or a combination of businesses to create an integrated regional supply chain built around a core waste biomass to energy strategy in the North East of England.

Many of the key elements exist within the region, however, there are some gaps in the supply chain, which would facilitate a more coherent and integrated approach such as:

- A dedicated Rapeseed Crushing Facility of a size and nature to service a growing market and act as a conduit to provide recycled waste oils for processing;
- An Oil Processing and Refining Plant to create different grades of product suitable as a feedstock for BioFuels production, liquid biomass per generation and anaerobic digestion;
- A Liquid Biomass Production facility for the production of renewable energy;

There are also spin off opportunities for further integration of feedstocks, co-products and waste products for incremental aerobic/anaerobic digestion, biogas generation and downstream gas to liquids for transport fuels and chemicals, which would naturally follow, depending upon the availability of capital and economic drivers.

Due to the complexities of a number of businesses being involved in the supply chain, an opportunity exists to form centralised back office, risk management services, logistics and transportation services around the core strategy which will lead to a number of benefits for the participants such as:

- Lower operating costs;
- More efficient operations and product management;
- Risk management which is for the greater good rather than the region potentially having winners and losers in the supply chain.

There will be a clear benefit to the region in terms of generating direct and indirect jobs as a result of adopting the integrated supply chain strategy.

The investment requirement needs to be established and structured based upon the way in which, the integrated supply chain strategy is adopted.

2.0 Introduction

Tees Valley business leaders, local authorities and MP's united behind the **NEPIC Ten Point Plan** in November 2009, charting a path towards a more prosperous future for the chemicals and renewable waste to energy industry.

Some of the ten points include:

- Innovation;
- Energy Efficiency;
- Supply Chain Development;
- Feedstocks;
- Partnership working.

NEPIC has created a world-wide interest in biomass and renewable waste activities in the North East of England, a location which now has several biofuel biomass and waste to energy projects in full scale operation, in part due to NEPIC's promotion of the potential of its members and its local infrastructure capabilities.

It is recognised that reinvestment in existing assets and investment in new assets is required. It is also recognised that issues, some key, need to be addressed and overcome for the UK to meet its renewable energy targets under the **Renewable Energy Directive (RED)**.

Some of these factors include:

- The sustainability of such material;
- The choice of technology;
- Logistics for the storage and distribution of materials and feedstocks, intermediate products, primary products and co-product;
- Proven processes based on fully developed technology.

Additionally, for all investments a robust and long term supply chain (including availability of materials and feedstock) must be in place for a sustained period of time to guarantee profitability.

Overriding all the above factors, is the challenge of combining the availability of liquid debt and equity markets with the ability of the investment community to understand, assess and structure financial instruments to deal with the risks associated with the development of the industry sector.

2.1 The Project Scope

As we move into the second quarter of 2011, the economy is slowly beginning to show some early signs of improvement and the outlook in the bio-energy sector is generally very positive.

Measures are being taken to deal with the financial crisis that has gripped the UK, and although public sector spending is facing huge challenges, this is being partly offset by incentives broadly in line with the European Framework – the Renewable Energy Directive (RED), which are designed to stimulate growth in the private sector.

Political instability in oil producing regions is expected to see prices continue to rise through 2011 and the supply situation may tighten at the same time.

All of these factors combine to produce a situation where local, national, and global energy demand will stimulate greater interest in renewable energy sources than ever before.

Opportunities for growth in alternative energy solutions are, therefore, very prevalent and present some excellent business opportunities for companies in the North East of England to capitalise on the skills and expertise, which exist as a legacy from the traditional engineering chemicals and construction industries.

NEPIC is looking to encourage the development of an integrated, waste based, supply chain for the North East of England to help enable companies/businesses benefit and grow, and for the sector to demonstrate sustainable growth.

Within the North East, we have many of the necessary resources we need on the doorstep. All that remains to be done is to integrate the efforts of all of those companies and individuals involved in the supply chain, to produce an all-inclusive result for the region which will enable all participants to benefit and grow, and for the sector to demonstrate sustainable growth.

This report will examine a fully integrated approach, which could be developed within a North Eastern waste biomass to energy strategy.

The proposed waste biomass to energy strategy is based on a range of activities. Each of the activities is specifically included because it provides a feedstock, a finished product, or a co-product, each of which can have a number of end uses, depending on the relative profitability of each of the options.

Across the production of a range of energy products, it could bring together the strengths of established specialists including grain merchants, food manufacturers, chemical suppliers, waste collectors, and a fuel off-taker. Each of these companies could make a major contribution to the project through contractual obligations designed to benefit all parties in the supply chain.

These obligations could be negotiated by the parties and may be in the form of a conventional supply contract, a strategic alliance, a merger or an acquisition, which is part of the overall vertical integration strategy of the concept. These strategies and benefits will be explored further in this paper.

The activities all dovetail into each other to provide these options. They combine the manufacture of products which can be used within the region, or traded on the open market. These products include:

- Virgin Oils for the food industry;
- Waste Oil processing;
- CHP from liquid biomass;
- Biodiesel;

This report will analyse the means by which the integration of the supply chain can be developed into a mutually profitable business strategy for all of the participants, and how the business activities can also combine to provide optional routes to market for each of the participants's products and services.

3.0 Global Supply Chains

Over recent years there has been a clear trend to source goods and raw materials from great distances, as buyers scoured the globe for the cheapest supply routes in order to gain an advantage over their competitors and increase profit margins. In some industries this gathered a great momentum and led to sourcing from various “new” locations. As the momentum grew, sourcing moved from country to country as buyers found cheaper commodities, cheaper labour, and cheaper feedstocks. Most of these new sources were found in developing industrial countries, and tended to be smaller organisations which were less robust.

But while this global exploration and evaluation took place, corporate supply chains became very vulnerable to logistical risk, oil price movements, and political instability. Supply chain management became a much more complex function and the whole process of getting goods from supplier to customer became more difficult.

Add into this scenario the global volatility and uncertainty since 2008, when the recession hit the world’s economies, and oil prices became unpredictable. The result is that planning and forecasting are no longer of any value in managing supply chains on a global scale.

Many companies that moved their suppliers offshore to reduce costs are now reviewing the decision. Costs in China are rising for example, but organisations are also starting to assess the risks and the total costs associated with offshore supply. In recent years, the risks have included extreme weather, political unrest, and economical uncertainty. Geopolitical risk has become prominent in the Middle East and North Africa, and there are issues relating to labour rights, child labour, forced labour, corruption and discrimination.

All of the problems caused by supply chain breakdown will become apparent in the electronics industry in wake of the Japanese earthquake disaster. For example, there will be a shortage of electrical components and microprocessors which will be felt around the world. So much stock has been stripped out of the supply chain that the effects will be immediate and rapidly increasing. Prices will increase sharply due to demand, and stock shortages will occur at precisely the time when there is normally a stock build towards increased sales in the last quarter of the year.

Companies wishing to be successful in the future must change their supply chain policies and procedures. They must design new supply networks based on the ability to access capacity as defined by demand.

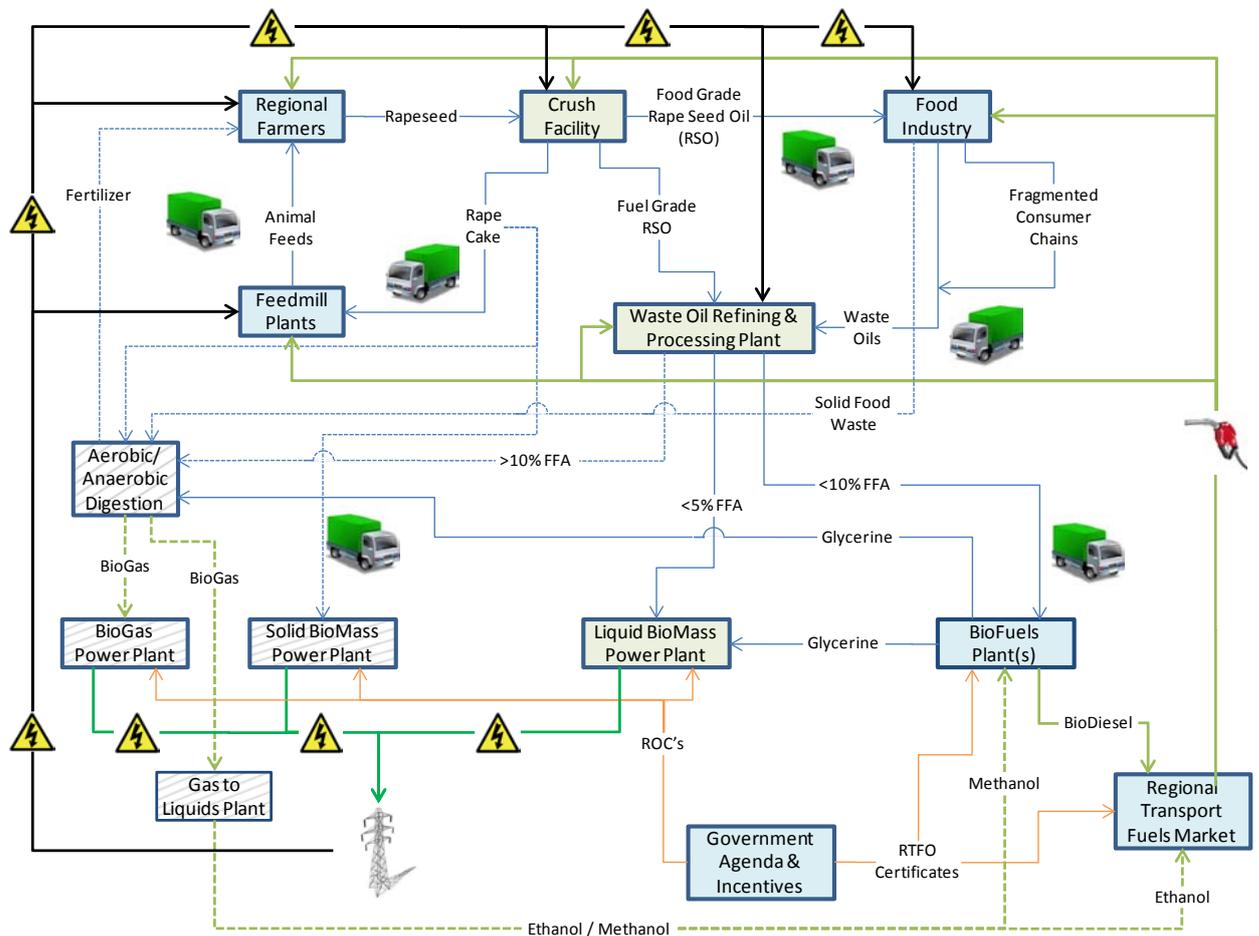
Against this background, there are many advantages which could result from the development of a strategy which incorporates elements of vertical integration into the supply chain. The new network should be based on suppliers and customers operating in close proximity to each other, and they should work together to produce a strategic fit with scope for future growth through coordination of all of the members of the chain.

This can extend into pricing policy; IT links between supply chain companies, and relationship management, where the members of the supply chain work to benefit the whole network of members. This will also achieve better customer value at less cost to the supply chain as a whole.

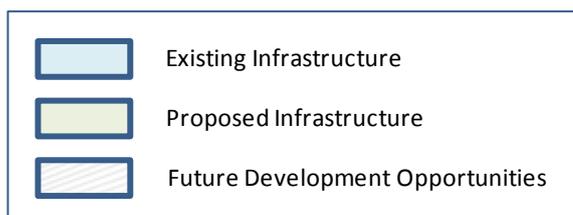
The value of the whole supply chain will be greater than the sum of the parts.

If the strategy is executed effectively, the supply chain network will build to become a strong, long lasting alliance, which should be difficult for non-participants to compete against. Members of the supply chain network will gradually build confidence in each other, and will deliver either a cost advantage or a service advantage to other members. Logistical benefits will increase the service reliability, lower costs, and reduce stockholdings throughout the supply chain without increasing any of the risks associated with global networks.

4.0 Integrated Regional Supply Chain Concept



Key



As illustrated in the above diagram, there are a number of the businesses established independently in the North East region, which will be currently buying from, and supplying to other organisations further afield in the UK, Europe, and beyond. Some may already be trading with each other, but there is not necessarily a deliberate effort to collaborate.

There are also some gaps in the chain, notably there is no regional Crush Plant, no established large scale waste oil refining processing plant, and no large scale liquid biomass power plant.

The global waste to energy and BioResources sector is evolving very rapidly, but during the evolution process there have inevitably been some challenges, primarily as a result of the following:

- A rush for growth in an emerging business sector;
- High capital investment immediately prior to the global economic downturn;
- A lack of established or co-ordinated transport, logistics, and stock holding facilities within the supply chain;
- Little or no risk assessment and risk management strategy;
- Macro-economic volatility.

The various stakeholders have to learn lessons from these failures and change the way business is conducted within the sector and develop a collaborative approach between companies to form strategic alliances within the agricultural, biomass, fuel, and energy sectors. This will enable the participants to:

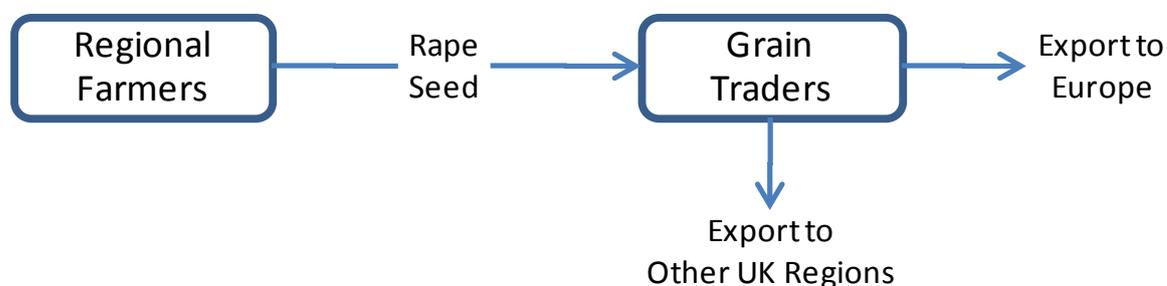
- Reduce inefficiencies in the supply chain by better use of resources;
- Cut operating costs due to proximity of suppliers and customers effecting transport costs and stock levels;
- Improve information flow between partners;
- Manage risk more effectively through regional trading which is not effected by volatility in other regions of the world;
- Improve profitability for all participants in the supply chain;
- Opportunities for centralising management services to provide access to real time information through shared data, and reduce operating costs;
- Controlled growth opportunities will emerge as the chain develops and becomes stronger, and companies from outside of the region will not be able to compete.

5.0 Existing Supply Chains in the North East of England

The current market is fragmented and in some instances the feedstocks being produced in the North East are leaving the region, and in some being exported, for processing. This is clearly the case with Oil Seed Rape, where there is no crush facility in the region although there is large volume grown in the region.

5.1 Rapeseed Market

The current rapeseed market in the East of England and Scotland can be generically depicted as follows:



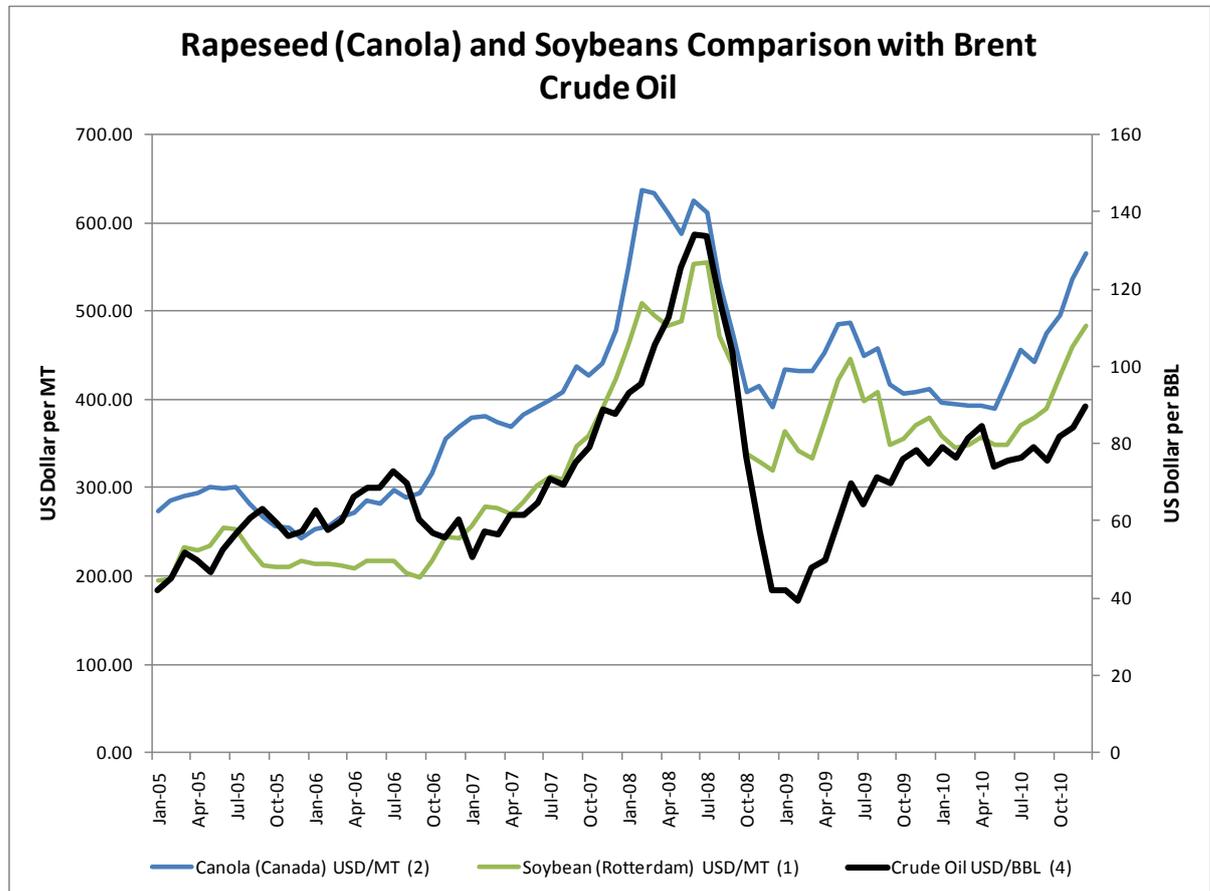
i.e. The East of England and Scotland produces large quantities of oil seed rape, much of which is surplus to current regional demand. Therefore, a large tonnage of rapeseed is exported to Europe through North East ports every year and to other regions in the UK. Some of this grain is supplied by North East grain merchants and is grown on North East farms.

In an integrated regional supply chain concept, the rapeseed produced locally could be used to provide a feedstock for a regional rapeseed crush plant.

The outputs from such a crush plant could also provide feedstocks for the regional food industry, the biofuels market and the animal feed markets.

There are deep markets in the United States and Canada for both products and a well established, futures trading platform exists, which essentially sets a global market price, subject to transport and logistics costs for end users.

The graph below shows the way in which Rapeseeds and Soybeans – two of the primary commodities used in a crush operation, correlate with Brent Crude Oil prices for the period January 2005 to December 2010.



Source: Chicago Board of Trade

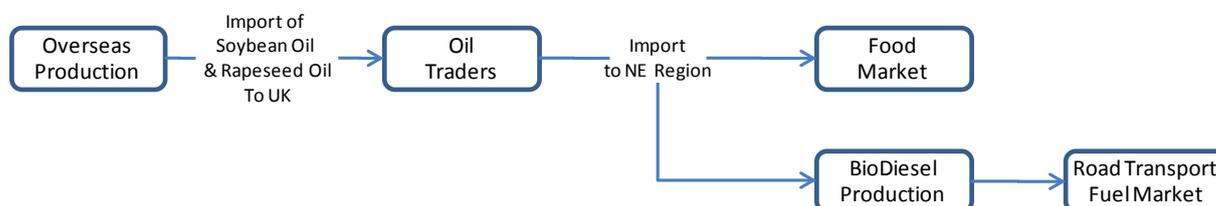
As illustrated above, there is a relatively high correlation to Oil prices albeit not quite as volatile as oil prices.

The UK Market tends to operate more like a spot market at present and is therefore more prone to market fluctuations due to influence in continental Europe.

A more regionally based market could allow a more mature pricing environment to develop with the added advantage that the net back price to the regional farmer will be higher due the transport differential of product not being exported to reach a liquid market.

5.2 Virgin Oils Market

The Virgin Oils market in the North East of England can be generically depicted as follows:



The Virgin Oil market is dominated by two large organisations with crush plants capable of producing sufficient oil for the whole of the UK food industry. They could easily defend their positions as grain buyers and oil suppliers as they have been established for a number of years.

Most of the Virgin Oil produced and sold by these organisations in the UK is crushed form imported product sourced in North and South America and Canada.

The cost to consumers in the UK is therefore at a premium as a result of the transportation costs to import vast quantities of Virgin Oil feedstocks, which will only continue to increase in a higher oil price environment.

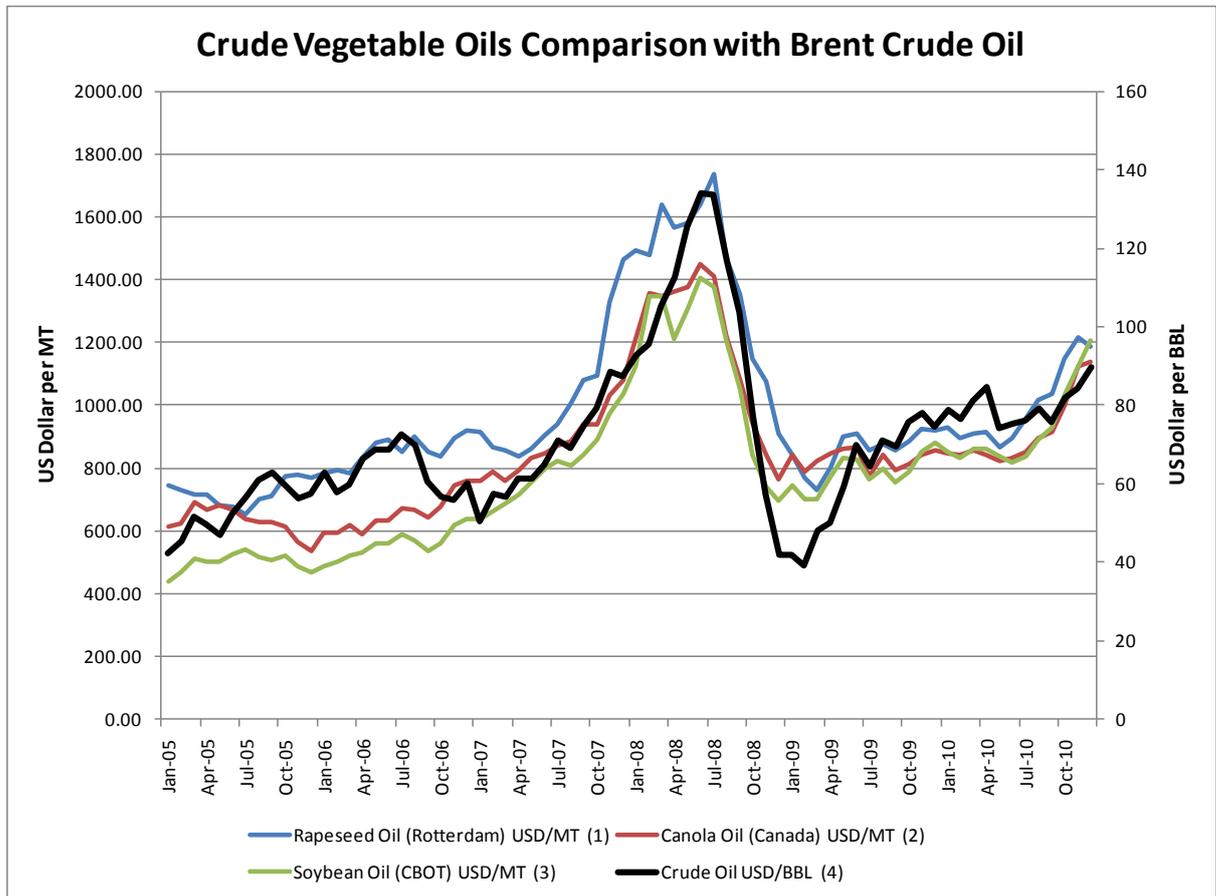
However, any issues around this are likely to be short term as supplies of grain can be sourced through North East grain merchants and the requirement for imported grain supplies will reduce progressively as regional markets are developed.

Therefore, a regional Crush plant would eliminate a large proportion of the transportation costs for consumers and reduce reliance on global players in favour of the regional economy.

The Virgin Oil produced at the crush plant can be sold to food manufacturers, in either bulk tankers, in IBC's or palletised cartons for wholesale distribution, or bottled for retail sale. Virgin Oil can also be used in the BioFuels market as a prime feedstock or as a blended feedstock with waste oils.

If waste oils from the food industry, is also integrated into the regional supply chain, then this will assist in consolidating the waste oil industry and provide feedstock for a regional Oil Processing and Refining business.

The graph below illustrates the way in which Rapeseed Oil and Soybean Oil – two of the primary commodities produced by a crush operation, correlates with Brent Crude Oil prices for the period January 2005 to December 2010.



Source: Chicago Board of Trade

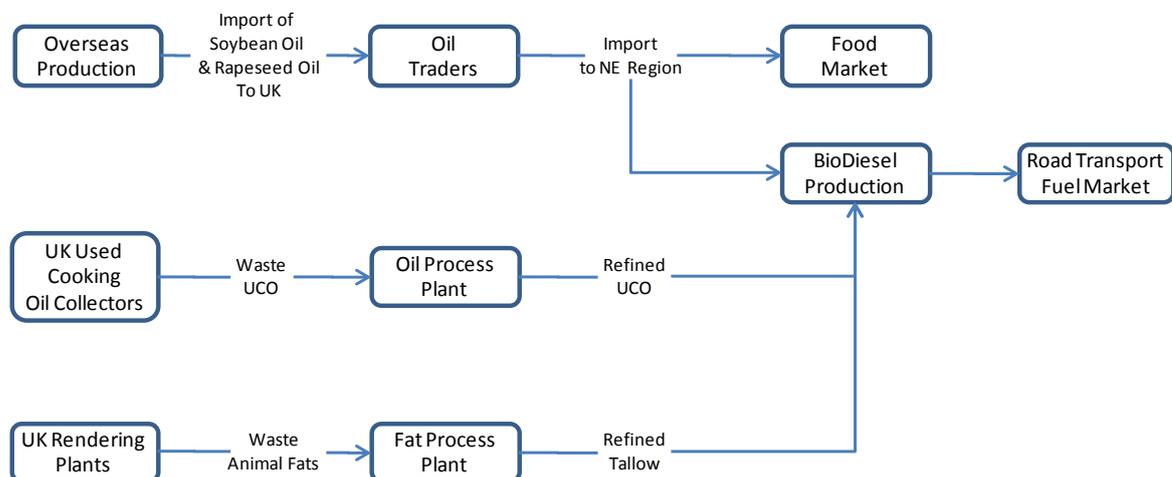
The Virgin Oil products are very highly correlated with Brent Crude Oil prices, which is a reflection of the maturity of the supply chains globally and the dominance of two players in the market which enables them to effectively to hedge their selling prices synthetically to prevailing oil prices.

A further point to note is the fairly consistent premium of Rapeseed Oil in Rotterdam versus Canada, which principally reflects the transport cost differential of an average of \$130 per MT over the period, notwithstanding periodic arbitrages due to temporary supply-demand balances.

This presents further evidence that a regional market would eliminate a large proportion of inefficiencies in the global supply chain.

5.3 BioFuels Market

The current Biofuels market in the North East of England can be generically depicted as follows:



The North East region has enjoyed mixed fortunes in the BioFuels sector, with first generation developers, owners and operators experiencing a number difficulties in biodiesel production compared with the successful completion and commissioning of Europe’s largest ethanol plant.

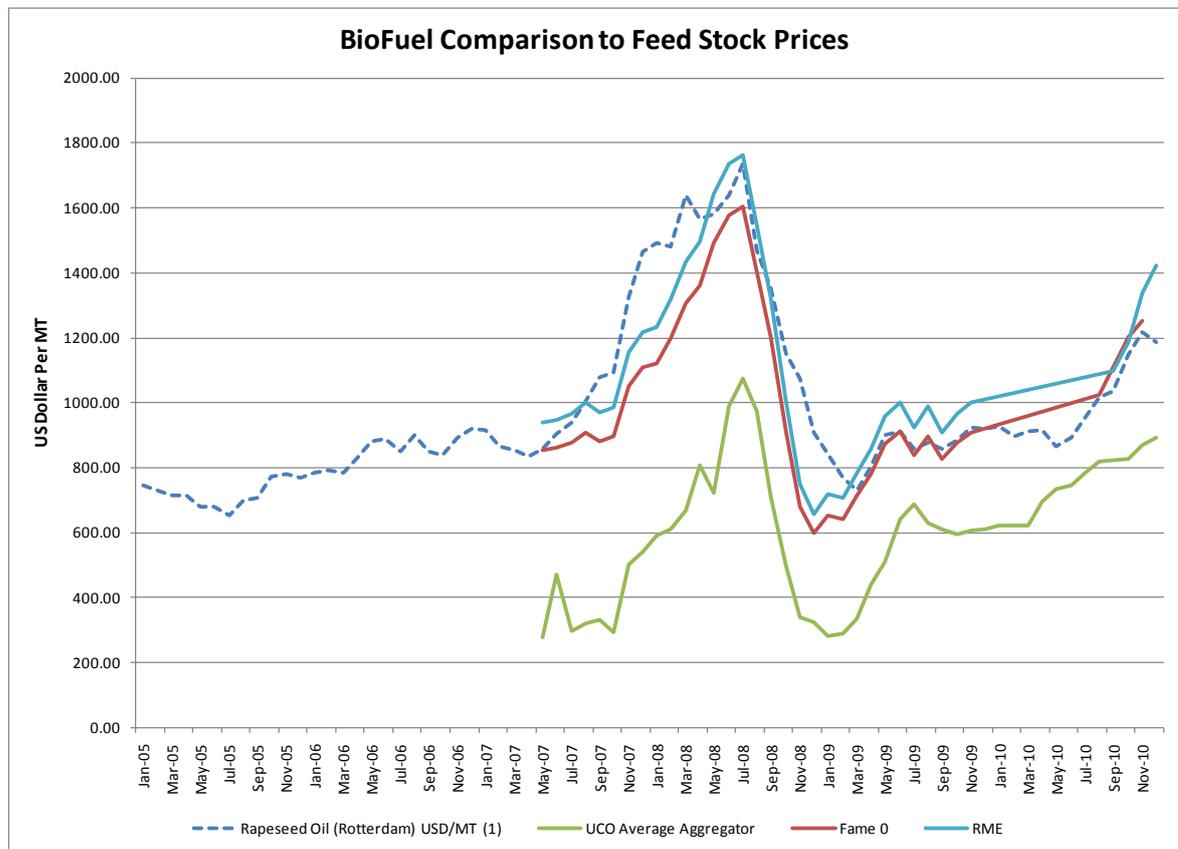
Second and (in some cases), third generation owners and operators of biodiesel plants in the North East are looking to rejuvenate the market opportunity by adopting a more diverse feedstock strategy.

Many of the first generation biodiesel plants across the globe were designed and built to process Virgin Oils such as Soybean Oil, Rapeseed Oil and Palm Oil.

Plants were built using highly leveraged financial structures, which was put in place prior to the financial crisis of 2008 using project financing, which became stressed for a variety of commercial reasons. When this was combined with highly volatile commodity markets and primarily single product feedstocks, meant that such plants rapidly became uneconomic.

Moves towards a more diverse range of feedstocks, such as Used Cooking Oils (UCO) and Animal fats (Tallow) from the rendering industry can reduce the cost base of biodiesel production, however, they bring more challenges to the producer in meeting EN14214 specification for road fuel transport purposes, which was effectively designed around biodiesel produced from Rapeseed Oil. Fatty Acid Methyl Ester (FAME 0), which is biodiesel produced from these feedstocks and liquid at 0 degrees Celsius is currently deemed by the markets as an inferior product due to the lower Cold Flow Plug Point (CFPP) of 0 degrees versus Rape Methyl Ester (RME), which has a CFPP of circa -12 degrees Celsius.

The graph below illustrates the point, whereby RME trades on average at a premium to FAME0 of around 10%.



Source: Chicago Board of Trade, PCF Solutions Limited

The historic price graph demonstrates that feedstock costs of Rapeseed Oil to RME prices shows a negative or at best marginal gross product margin spread, whereas FAME0 to UCO prices show a relatively good gross product margin spread. All of which, is shown before production costs, and costs to service finance.

As can be seen from the graph above, whilst the example of UCO prices versus Virgin Oil prices shows a clear correlation between the two products, as the need for more diverse feedstocks has permeated through the biofuels supply chain, the discount to Virgin Oils of UCO has narrowed from around 50% on average to around 30%, this is particularly evident during 2009-2010.

One reason for this could be attributed to the change in government policy in April 2010, with respect to fuel duty relief on biodiesel produced from feedstocks other than UCO, which is 20 pence per litre or approximately \$350 per Metric Tonne (currently in place until April 2012). Fuel duty relief on biodiesel produced from other feedstocks, which had also been 20 pence per litre was abolished in April 2010.

The knock on effect of this was to increase demand from the refiners for FAME0 products, with limited production capacity and resulted in an increase the price of both FAME0 and UCO and a corresponding drop in the price of Virgin Oils.

The feedstock chain in UCO as alternative to Virgin Oil is highly fragmented and has many layers of inefficiency and “profit taking” with the Biodiesel producer ultimately being the price taker in the equation.

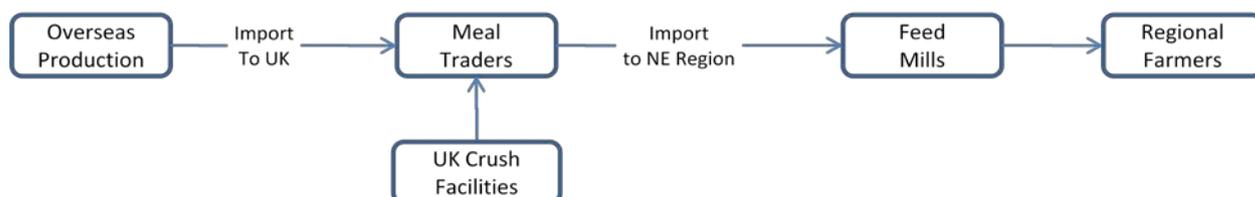
There is a strong argument that if the supply chain of UCO can be rationalised into a regional market with appropriate storage, logistics and centralised processing and refining capability, many of the current inefficiencies can be taken out of the system.

By integrating into the feedstock supply chain, the BioFuel manufacturer can establish exclusivity and security of supply, quality and pricing stability, which will allow much better risk management policies to be adopted.

This concept reinforces the requirement for a regional Waste Oil Refining and Processing Plant.

5.4 Animal Feeds

The current Animal Feed market in the North East of England can be generically depicted as follows:



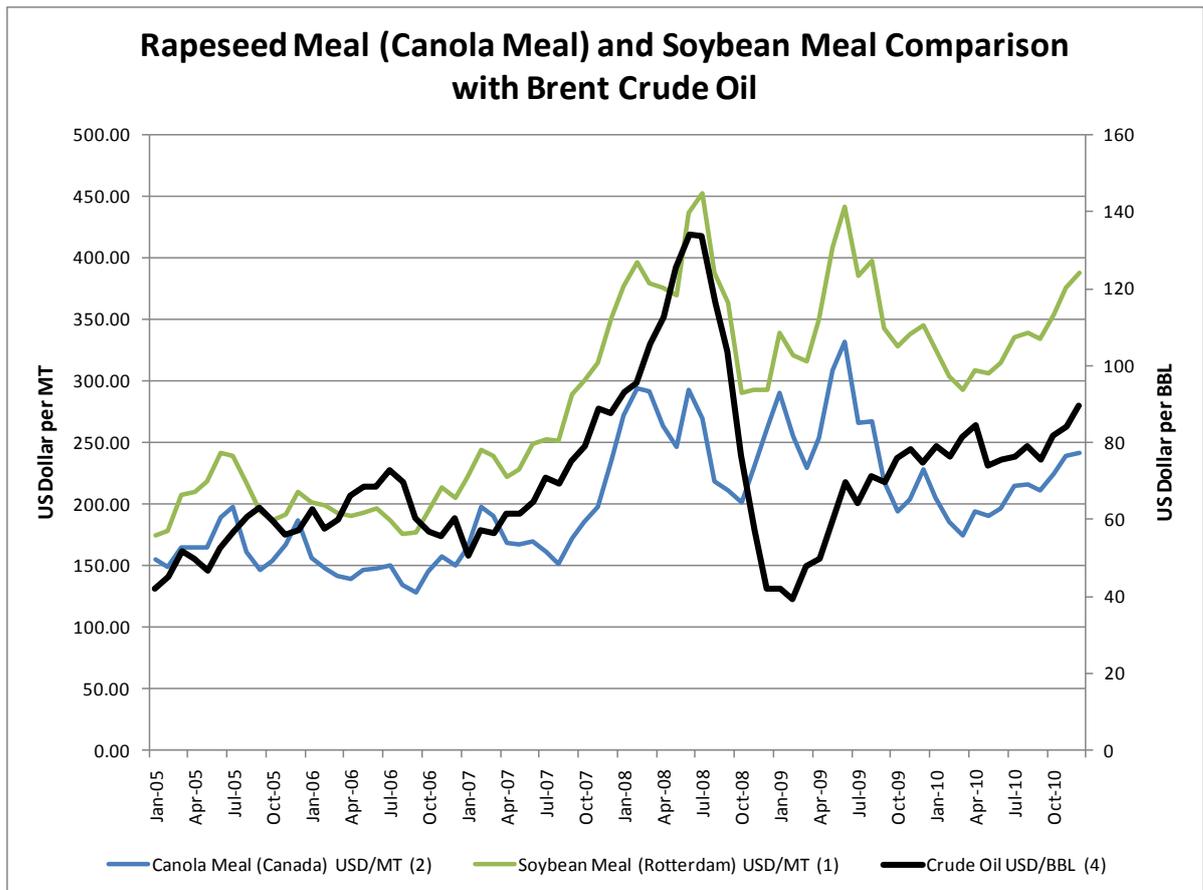
The co-product from crushing Seeds or Beans is the residual meal, which is high in protein and has a small oil content left after crushing. The properties of the meal make it a valuable feedstock for use in animal feed manufacture for cattle and pigs.

As shown above, the North East region is a net importer of animal feed (notwithstanding the volume now being created by the wheat based ethanol plant in the form of Dried Distillers Grain).

The price of meal in the UK is, to a large extent, dominated by the two large crushing organisations, which is primarily based upon imported seed or beans. The primary drivers for price to the animal feed market are the protein content and the oil content of the meal.

Due to the nature of these two organisations as primarily Virgin Oil producers, the oil content tends to be low and the feed mills need to add oil and in some cases molasses to assist their production processes.

The graph overleaf shows the relationship between Rapeseed Meal and Soybean Meal in the US and Canada which shows a high correlation between the two products, however, unlike many of the commodities analysed in this paper the correlation of these products to Crude Oil is fairly low.



Source: Chicago Board of Trade, Canola Council of Canada

Rapeseed Meal tends to trade at a discount to Soybean meal due to the protein content differential, which is approximately 5-10% less.

There are deep markets in the United States and Canada for both products and a well established, futures trading platform exists, which essentially sets a global market price, subject to transport and logistics costs for end users.

Again, the UK Market tends to operate more like a spot market at present and is therefore more prone to market fluctuations due to influence in the US and Canada, but without the futures trading platform in place.

A more regionally based market could allow a move toward longer term contracting opportunities, providing visibility of revenue streams to the regional farming community facilitating better planning and devotion of land to such crops.

This contracting structure could also be combined with the logistics of rapeseed movements to back haul the rape cake to the feed mills and ultimately the farming community, saving on time and cost, presenting a closed loop system.

By acting collaboratively, the crush plant and the feed mills could work together to develop a variety of seed to deliver the optimum mix between oil yield and rape cake characteristics to optimise residual oil and protein content.

6.0 Current Gaps in the Supply Chain for the North East of England

As can be seen from the existing supply chains, there is a lack of integration and collaboration and therefore the opportunity to create a mutually beneficial supply chain strategy clearly exists.

At the core of the strategy is the development of 3 key elements, which will enable an integrated supply chain to be developed for the benefit of the North East region:

- A Rapeseed Crush plant;
- A large scale Oil Refining and Processing plant;
- A Liquid BioMass Power plant.

6.1 Regional Rapeseed Crush Plant

It is, therefore, potentially feasible to secure grain supplies and set up a crush plant in the North East to produce Virgin Rapeseed oil for use in the food industry, biofuel production, and ultimately as a fuel for power generation (through waste oils).

The meal produced during the process would go into animal feeds, or alternatively it could be dried and used as a fuel to fire boilers.

The technology used to crush grain is well established and has no technical risk. In production terms the process is very simple, and can be either a cold, two stage pressing method, or a hot single stage pressing followed by Hexane solvent extraction to maximise oil output.

The capital expenditure will vary significantly depending on the process, plant configuration, and the source of the equipment. Presses are available from various manufacturers in Europe and the Far East. Obviously there are price advantages in buying from the Far East.

The difference between the Regional Crush Facility and conventional requirements of the two key players in the industry is that, as part of an integrated strategy, the focus on Virgin Oil as the profit driver is diluted somewhat due to the ability to share profit throughout the supply chain. Therefore, a potentially lower cost capital solution can be used, which strikes the right balance for the supply chain between oil extraction, protein content of meal, management of waste oils and the production of energy.

By integrating the supply chain it is also possible to provide a sustainability audit trail from the field to the end user.

6.2 **Waste Oil Processing plant**

Waste oil from the food industry and its fragmented consumer chain, can be processed to clean and remove moisture and impurities.

Relatively inexpensive plant can be designed to heat, separate, filter, and dry the oil leaving a refined product that can either be used to power an engine, or be used as a feedstock in biodiesel manufacture. Although it must be noted that the process plant may be inexpensive, but the product handling and refining to create a suitable fuel source, is not without its challenges.

The waste oil is almost 100% used cooking oil (UCO), although other oils can be used such as Tallow.

The UCO sector is relatively immature, undeveloped and unsophisticated, with many layers of “profit taking” throughout its own fragmented supply chain.

This waste product is variable in quality, price, and availability, making it essential that some form of integration takes place between the end user and the UCO supplier.

The opportunity exists to develop a regional Waste Oil Processing plant, which would help to professionalise the industry, eliminate inefficiencies and provide a closed loop solution between the food industry and energy production, through effective waste handling and management.

If the food producers, are being provided Virgin Oil from the integrated supply chain and waste oils are being collected for continued use further down the chain then the sustainability audit can also be continued.

6.3 **Liquid BioMass Power Plant**

The principle of this plant is that it could use conventional diesel engines (in conjunction with a suitable fuel handling system) to convert waste to energy by using refined waste oils as the feedstock.

There are many types of power generators available on the market, and a huge diversity in the capacity of units ranging from small output diesel generators producing 10 KW to CHP units capable of producing up to 5MW. They can be used for emergency back-up, to cover peak loads, or as in this strategy to sell electricity into the national grid.

7.0 Future Development and Integration Opportunities

7.1 Anaerobic Digestion

Work has recently commenced on Northumbrian Water’s second anaerobic digester at Howdon on Tyneside. This will use thermal hydrolysis advanced digestion and will digest domestic sewage and trade effluent. This compliments their other AD plant at Bran Sands on Teesside.

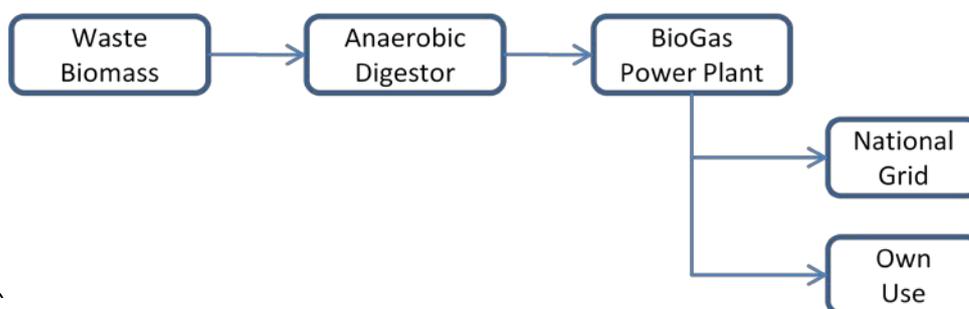
On a smaller scale, Newcastle University have developed an AD plant at Cockle Farm near Morpeth, with the aim of promoting understanding and potential uptake of AD within the region. In addition, the anaerobic digestion development centre (ADDC) is an open access asset based facility operated by the Centre for Process Innovation (CPI) at Wilton, designed to help organisations of all sizes develop tailored processes quickly and cost effectively.

There are a number of other AD projects at various stages of design and development in the region operated by farming businesses and local authorities.

7.2 BioGas Power Plant

Bio-methane produced by the anaerobic digestion process can then be used as a fuel to drive gas fuelled engines to generate heat and power for own use and for export to the grid.

The technology is now well proven and presents no risk from an investment point of view. Several companies can provide a complete biogas power plant installation as a turnkey project.



7.3 **Solid BioMass Power Plant**

Subject to the relative economics in the supply chain, it may be possible to use the Rape Meal as a feedstock or as a blend feedstock for Solid BioMass Power plants.

The energy produced by the system can then be used to produce renewable heat and used in steam powered generators to create power for own use and for export to the grid.

8.0 Additional benefits to the North East

There is a genuine opportunity for compatible businesses within the North East to jointly develop this project, with all of the partners sharing information and sharing the benefits available from such a localised collaboration. By linking all of these compatible businesses in an area with all of the resources needed for future growth, companies can take advantage of the logistics, the skilled people, the agriculture, and the technical know-how and work together to create a strong and successful cluster.

8.1 Skills

Renewable energy and biofuels industries are complimentary to the Oil and Gas and Chemical sectors presenting numerous opportunities for skills and technology transfer across the industrial sectors.

There is also strong research in the region through universities working on the development of biomass and sustainable/renewable energy systems, and the area is also home to several local and national technology innovation facilities.

8.2 Infrastructure

The North East has well developed transport links operating locally, nationally, and internationally. There is easy access to excellent road and rail links, and deep water ports for the movement of goods. There are also two international airports serving the region.

8.3 Regional Benefits

This report demonstrates a major strategic fit into the North East region, which continues to grow in importance as a hub for biofuels, renewable and sustainable energy businesses.

8.4 Job Creation – Direct

Job creation will follow directly in all participating companies as productivity increases. The crush plant will require construction staff, as will waste management and power generation. Permanent jobs will be created in operating the crush plant and refinery.

There will be secondary job creation in transport, supply chain management, and possibly agriculture. There will be a small number of additional permanent jobs in centralised management services if this option is selected.

8.5 Job Creation – Indirect

Community job growth will inevitably occur into businesses providing services and support to the main supply chain partners. These will be in specialist chemicals, equipment supply, maintenance, and distribution. There will be work created during the construction phase of the new plants required to complete the supply chain e.g. the crush plant, oil processing plant etc. There will also be a ripple effect of new money into the local economy relating to the increase in direct and indirect employment and a corresponding decrease in unemployment.

9.0 Conclusions

This report identifies the opportunity for the North East Region to be the leader in Supply Chain Management for the Waste to Energy sector and set the standard for others to follow.

In a high oil environment and the requirement to move towards a low carbon economy, the integration of the supply chain allows the participants to reduce exposure to global market pressures and create a regional market opportunity, which will reduce the logistics, transportation and storage costs across the board.

By carrying out a staged development, behaviour and culture of trading in the region can be transformed for the benefit of all participants.

With the infrastructure already in place and the key components for success identified, the execution of the strategy can be established in the short term.

The dynamics of the proposed regional supply chain are complicated and the management of the chain will be equally complex, but not insurmountable. This merely reinforces the thought that a professional Management Services organisation, and / or a Risk Management & Trading Entity should be at the centre of the strategy to manage the execution phase to deal with contracts, logistics, and the dispersal of real time information on behalf of all members.

As one would expect, there are a number of optional routes available to take this forward.

Major capital expenditure is needed for investment in:

- A regional Rapeseed Crush plant;
- A large scale Oil Refining and Processing plant;
- A Liquid BioMass Power plant.

For this to become a successful reality, a collaborative approach to the way the sector operates regionally, will have to be agreed by all participants, as well as having the financial wherewithal to deliver the strategy.

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