Biofuels for the Fishing Industry – Final Report

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Working with the seafood industry to satisfy consumers, raise standards, improve efficiency and secure a sustainable future.

The Sea Fish Industry Authority (Seafish) was established by the Government in 1981 and is a Non Departmental Public Body (NDPB).

Seafish activities are directed at the entire UK seafood industry including the catching, processing, retailing and catering sectors.

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Seafish Research and Development

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Summary:

Since 2004 the price of diesel fuel oil has increased significantly, causing many fishing vessels to become unprofitable. At the same time biofuels has increased in prominence as a long-term replacement for non renewable fossil fuels. This report details a research and development project to investigate the potential of biofuels for the fishing industry, which took place between October 05 and Jan 08. In the project two types of fuel are studied, biodiesel and pure plant oil. Over the course of the study both fuels were tested on land and at sea and proved to be technically successful. The main driver for uptake of the alternative technology in the fishing industry is economic and our study found that in most cases fossil fuels will remain more cost effective for fishing business in the short to medium term. That said there may be some opportunities in more remote communities where used vegetable oil is available and the cost of transporting diesel oil into the area push the price above that of locally produced biofuels. In terms of environmental credentials biofuels are generally sustainable but there are a number of issues which prospective purchasers need to consider which may overall green credentials of their biofuel.

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1. Introduction

From the earliest days of the diesel engine it has been known that they can be run on fuels from renewable sources. The original engine produced by Rudolf Diesel was designed to run on peanut oil. The economics of the day however dictated that fossil fuel was a much cheaper fuel source and the technology developed around diesel and petrol.

Several aspects of the fishing industry are undergoing changes with one of the greatest being a paradigm shift from cheap and plentiful fossil fuel. The project “biofuels for the fishing industry” was developed to investigate the potential of biodiesel and vegetable oil as feasible alternatives specifically for the fishing industry.

This report provides a top level overview of the very large project and will give the reader a basic understanding of the research and the technologies. Additional detailed information is available in the additional reports and supporting documentation.

1. Biofuels for the fishing industry : Biodiesel study
2. Biodiesel at sea
3. Biodiesel test engine cell facility
4. Design of a containerised biodiesel production facility
5. Biofuels For the fishing industry: An investigation into the use of pure plant oils

2. Background

During 2005 it became apparent that fossil fuel oil in the long term would become more expensive. Up until this point, whilst the price of oil was rising many hoped that the market was following a cycle and prices would return back to around the $30 a barrel mark. A number of factors led to this gradual change in outlook. Political unrest continued to persist in many of the important oil producing regions and this despite considerable international pressure and action. Secondly, demand was steadily growing with the Indian and Chinese economies expanding at double digit rates and being fuelled by oil. The final driver was simply a limited supply. OPEC continued to maintain their position of tight control of outputs, the US production had peeked and elsewhere supply was increasingly limited as stocks decreased.

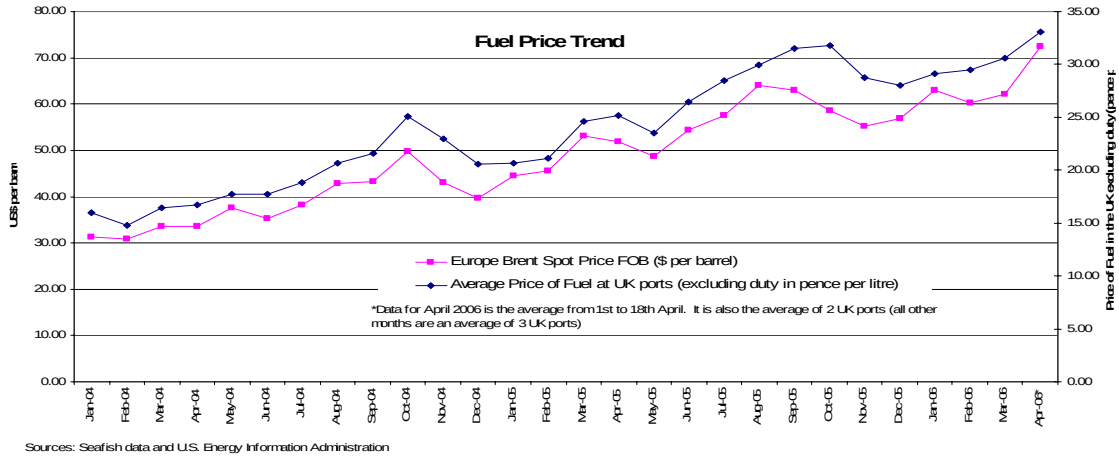

Figure 1. Fuel price changes Jan 04 to April 06

It is important to appreciate the position the fishing industry found itself in at this time. Opportunities were being limited through quotas and days at sea. The registration of buyers and sellers was on the horizon and profitability in the fleet was low (Seafish stats) and the outlook was not good. Add to this the increasing price of fuel and it comes as no surprise that the industry should call for action. At the time the situation was being labelled a fuel crisis, however this is somewhat misleading. There was no crisis of fuel supply, rather the crisis lay in the low profit levels in the industry and they were further pressurised by increasing cost base.

Fuel costs as a percentage of earnings vary greatly throughout the different sector of the industry. In general terms the lowest ratios are to be found amongst the small static gear vessels (5-10%) and the highest amongst the large beam trawlers (~50%) (Curtis et. al). It is also important to understand the fiscal system within which fishing vessels operate. Fishing businesses generally speaking do not pay fuel duty or vat on marine diesel, so for all intents and purposes fuel is tax free to fishermen. In comparison to the domestic motorist any increase in real fuel prices is therefore acutely felt by the fishing industry.

Intense political pressure was being placed on the EU and national governments to support the fishing fleets. Calls were being made for the provision of subsidies to fishermen however the UK government resisted and preferred a long term approach to the issue. Focus was placed on how to reduce the UK industry reliance on fossil fuels into the future and a study into the potential of biofuels for the fishing industry fitted well with this strategy.

In 2005 biofuels was being promoted as a potential solution to the growing fuel crisis. Whilst there were issues of supply and technical challenges to be surmounted biofuels were been touted as sustainable and economic option to fossil fuels. The government were setting targets (RTFO) for their use and engine manufacturers were beginning to take the technology seriously.

There are 3 main renewable fuels in ready supply: bio-ethanol, biodiesel and PPO. Bio-ethanol is used as a fuel extender or replacement for petrol. Biodiesel most closely resembles the physical properties of conventional diesel and is used by many road going vehicles. PPO is not commonly used as an energy fuel due to it viscous

nature however, PPO is generally cheaper than biodiesel thus making it economically attractive.

At this time Seafish were approached by DEFRA to help manage a project to study the application of two biofuels; biodiesel and Pure Plant Oil (PPO) for use in the fishing industry. The project required the coordination of two similar work programs, ensuring synergies were realised and replication avoided, whilst applying the best interests of the fishing industry.

3. Aims and Objectives

This final report brings together the two separate projects with their differing but complementary objectives and methodologies. For the purpose of clarity the aims and objectives of the two projects will be split.

3.1. Camborne School of mines – Biodiesel

- To test BS 14214 biodiesel and other varieties of biodiesel for performance as compared to marine diesel.
- To demonstrate that fishing vessels can be operated using biodiesel without major engine modifications.
- To apply these developments firstly to the Newlyn fishing fleet and then make the technology available for application through the fishing industry.
- To develop a biodiesel fuel produced locally, suitable for use in fishing vessels that is optimised for cost.

3.2. Regenatec – SVO

- Demonstrate the potential of vegetable oil; both fresh and processed used together with performance enhancing additives and smartveg™ technology as a viable alternative to marine diesel onboard fishing vessels
- Demonstrate that smartveg™ technology mitigates the potential for engine damage
- Investigate whether plant oil offers a lower emission & commercially viable alternative to mineral diesel that does not compromise engine performance or function
- Investigate whether existing additives can be safely and economically used to address the long term concerns of using vegetable oil as a fuel substitute.

4. Methodology

For of a full and detailed explanation of the two project methodologies please refer to the project reports “Biodiesel for the fishing industry” & “Biofuels for the fishing industry – An investigation into the use of pure plant oil”.

Briefly, both projects applied similar methodologies. There was a land based investigation phase which investigated closely the properties and performance parameters of the fuels in a test engine. In addition, both research teams considered the benefits of different additives which could be added to the fuels to address certain technical difficulties such as biocidal growth in the same what the large oil companies do for petrol or diesel.

A shore base study alone would not be sufficient to investigate the potential for these revolutionary fuels. From the outset Seafish stressed the importance of robust sea trials in full view of the industry. To this end both projects included extensive sea trials to test the technology in the real environment, with over 1,000 hours amassed between the two studies.

As part of the “biodiesel for the fishing industry” project it was agreed that the project would develop, test and produce its own fuel. A modular biodiesel production unit was sourced and commissioned for this purpose. It was located at the onshore test facility at Holman Mine outside Camborne.

5. Results

5.1. Camborne School of Mines – Biodiesel

Objective 1. ***To test BS 14214 biodiesel and other varieties of biodiesel for performance as compared to marine diesel.***

The project achieved its aims albeit, there were some changes made throughout the project as can be expected with all research and development projects. The research team carried out a number of tests on different grades of biodiesel produced in the lab. These tests showed variation in terms of performance of the engine. On the test bed engine performance of two biodiesel fuels were tested, BS 14214 quality fuel and a home made quality fuel. The calorific values of these fuels were found to be 15% and 20% below that of standard red diesel. When tested on the vessel in real working conditions and on the test bed engine no lag in performance was found with the biodiesel usage per hour being lower that that or red diesel. It is worth noting that any number of factors such as tide or wind will have influenced the at sea results.

Figure 2 MFV Ma Gondole

Overall our trials concurred with the accepted scientific wisdom. Biodiesel per litre has a lower calorific value than red diesel. However biodiesel has lubrication properties which red diesel lacks. By lubricating the moving parts of the engine, friction is reduced and this helps biodiesel to close the gap on diesel in terms of power output. Our trials also tested torque (pulling power) and found the biodiesel to yield slightly lower values than red diesel as would be expected, but the differences were small and did not overly affect the performance of the engine on the test rig or at sea.

Under the prolonged extremely high duty of the trawl stages of the day trawler test cycle, the test bed engine exhibited progressive deterioration in performance when run with the self-manufactured biodiesel. However the testing was completed successfully and the engine delivered the required performance using the fuel – but not without problems.

After the test had completed, the engine was stripped down and had been found to have suffered a piston ring fracture in one cylinder and piston rings seized in their grooves in two other cylinders. This outcome is attributed to the fuel's different ignition characteristics in comparison to fossil diesel. This difference is not great, but its significance and consequences are much more pronounced when the engine is operating at very close to full load at the specified engine speed.

In an engine optimally timed for fossil diesel, the ignition characteristics of the self manufactured fuel lead to irregular combustion pressures. Irregular combustion pressures are the frequently cited reason for piston ring fractures. A piston ring fracture allows combustion gas by-pass into the crankcase. The evidence recorded in the data logged during the testing and the remaining problems identified upon strip down are corollaries of this event. It is worth noting that even after the phase of

engine deterioration experienced (it is identifiable in the data recorded), the self-manufactured biodiesel still recorded the highest engine efficiency figure for the simulated return trip to port.

Objective 2. ***To demonstrate that a fishing vessels can be operated using biodiesel without major engine modifications.***

The sea trials were carried out on a ~10 m class potting vessel running comparative fuel consumption tests using red (fossil) diesel and biodiesel. The vessel, FV Ma Gandole, was powered by a 20 year old Volvo MD70B 6 cylinder, normally aspirated, 120 hp diesel engine coupled to a 3:1 reduction gearbox, assumed to be fairly typical of that class of vessel.

The sea trials demonstrated that both fuels started the engine equally well, and the vessel was felt to handle and perform equally well with either fuel. Fuel consumption trials were conducted on 46 separate days with weather conditions ranging from flat calm to unpleasantly heavy seas. At no time during the sea trials did the engine cause any concern but it should be noted that precautions were taken whilst fitting out the vessel.

Two new fuel tanks were fitted and the fuel lines were checked for any rubber fittings which would be degraded by the biodiesel which could ultimately lead to air or fuel leakage issues. Whilst problems were identified on the test bed engine when the engine was operated under high load and for a considerable time, no such issues were encountered during the at sea testing phase of the project.

As a precaution, the fuel priming system on the engine was upgraded to a more modern arrangement. This was not done out of concern for potential damage, but was motivated by a desire to improve the efficiency of fuel priming in the event of problems at sea. When switching from fossil diesel to bio-diesel in road vehicles it is widely advised to change the fuel filters shortly after making the change. This is because bio-diesel tends to dislodge accumulated deposits from the walls of the fuel tank and fuel lines. Once the system has been cleaned out by the action of the bio-diesel there is no further hazard, but it is wise to take precautions in the first instance. All of the alterations made to the vessel to accommodate the use of biodiesel were low cost and straight forward.

Average fuel consumption when running on red fossil diesel was measured at 3.82 litres per hour, varying between 3.48 to 4.19 litres per hour. For the biodiesel, average fuel consumption was recorded at 3.41 litres per hour, ranging between 3.45 to 3.73 litres per hour. The project team believe that the differences in average fuel consumption should not be over-interpreted. The differences in sea conditions, and the excursions to specific sites to recover pots, etc., mean that the fuel consumption of the engine between the two fuels is concluded to be ‘comparable’ at best.

Objective 3. ***To apply these developments firstly to the Newlyn fishing fleet and then make the technology available for application through the fishing industry.***

The sea trials were carried out on a ~10 m class potting vessel, FV Ma Gandole based out of Newlyn in Cornwall. The vessel was located in the fishing harbour throughout the trial period and the project attracted a lot of media attention, not least a visit by the EU Energy minister in 2006. Over the period local fishermen took a keen interest in the project and in particular the feasibility of a cheaper alternative fuel.

It is fair to say that objective 3 was poorly worded and its aim goes beyond the scope of the project. The application of the technology did take place in Newlyn, but it was confined to the testing and production of the fuel locally and demonstrating its application on the Ma Gondole which was based in the harbour. It was never the projects aim to carry out testing on additional vessels. That said the project has been produced 4 reports which make the technology available for application through the fishing industry.

Objective 4. ***To develop a biodiesel fuel produced locally, suitable for use in fishing vessels that is optimised for cost.***

At an Early stage of the project it was agreed with MFA and Seafish that an additional objective should be set for the project. It was felt that in order to make the technology available for application through the industry the project team would need to develop and commission a biodiesel production plant locally.

After considerable research a biodiesel batch plant with a maximum production capacity of approximately 210,000 litres per annum was sourced and constructed. The cost of this plant was around £15,000 and was financed by savings made elsewhere in the project. The infrastructure requirements comprise the provision of: i) a 32 amp, 3 phase power supply, ii) adequate exclusions of unauthorised personnel, iii) adequate movement areas for materials handling and iv) suitable mechanised handling equipment (a fork lift). The containerised reactor unit is self-bunded to contain inevitable spillages that occur while processing the fuel. This design makes the facility extremely flexible and ideal for local fishermen wanting to make their own fuel.

Discussions with fishermen during the study revealed that they view reduced cost of fuel as main driver of such work although they are also aware of the environmental benefits, and the potential for increased engine life. The cost of biodiesel depends heavily on the cost of vegetable oil feedstock used to produce it. Ma Gandole was operated with self-manufactured biodiesel, prepared by the project team at a cost of 50p/litre before labour (5p/ltr) and overheads using commercial grade recovered vegetable oil. A minimum marginal cost of 23p/litre was determined using low grade locally sourced, self-collected recovered vegetable oil, including the costs of labour, maintenance, collection, power and overheads.

Assuming a biodiesel self-manufacturing scenario for a fishing vessel operator leads to an estimate of annual savings of around £1,360 or £1,650 if labour is excluded. Publicity associated with the project also led to the development of several contacts from potential marine (non-fishing) users of the fuel, seeking to add ‘green credentials’ to their products. These contacts are being followed up, now that the main project work has completed. Assigning ‘green credentials’ to seafood products

caught by vessels running on biofuels has also been identified as a possible mechanism to add value through price premiums and also to increase market volume by appealing to the ethical shopper.

5.2. Regenatec – Pure Plant Oil

Objective 1 ***Demonstrate the potential of vegetable oil; both fresh and processed used together with performance enhancing additives and smartveg™ technology as a viable alternative to marine diesel onboard fishing vessels***

This project investigated the use of Pure Plant Oil (PPO) in a trawler, the Jubilee Quest, based in Grimsby, operated on PPO during the Autumn of 2006. The aim of this trial was a technical investigation of the technology and PPO: it was not designed to be a commercial deployment. The use of PPO and Used Cooking Oil (UCO) is currently commercial unviable in UK marine applications due to the economies of scale enjoyed by the petrochemical industry. (The use of PPO and UCO is only viable for land based vehicles because of a duty rebate currently enjoyed by bio-fuels.)

Figure 3 MFV Jubilee Quest

As a key part of this project, Regenatec developed their technology into a system to be used at sea by a trawler. Their dual tank system under electronic control to automate the use of PPO in a diesel engine was adapted to meet the logistics of a deep sea fishing vessel. An additional “day service” tank was fitted so as to accommodate both red diesel and PPO. The engine was started on conventional red diesel (or biodiesel) and then automatically switches over to the more environmentally friendly PPO. The Smartveg control system was fitted to the fuel line and this unit controlled the fuel feed, sending PPO when the fuel was heated to

60^{o}C. During the course of a fishing trip over 99% of the fuel used by the Jubilee quest was PPO.

A standard bollard pull test was performed to establish 'real world' power performance. Four to five runs were performed on diesel and then this was repeated on PPO. The vessel was tied to the dock by a strain gauge and then engine revs built up until maximum power is achieved. On the test Regenatec witnessed, the Jubilee Quest pulled 6 tonnes on diesel which was then matched by PPO.

Objective 2. ***Demonstrate that smartveg™ technology mitigates the potential for engine damage***

During the sea and laboratory trials the Smartveg technology was tested for over 1,500 hours. In addition the technology is employed by numerous land based vehicles and the instances of engine damage are few and far between. Being a true research and development project new ground was broken whilst carry out the project and potential for engine damage was uncovered, and in this instance the turbo charger was damaged.

From Regenatec's land based experience, it was known that the temperatures of certain key components on the engine, as well the fuel oil, are critical to successful and reliable operation on PPO. As part to the monitoring procedure temperature readings were taken of the engine. These results showed some erratic fluctuations, one such instance saw a drop in coolant temperature of 30 ^{o}C for a period of 20 hours. This subsequently led to a drop in the temperature of PPO below the 60 ^{o}C critical point. From our investigation this then lead to the fuel not forming a fine enough mist when pumped through the injectors. Once in the cylinder the fuel failed to combust as it would normally and unburned PPO was carried out of the cylinder in the exhaust gases.

The Jubilee Guest's Caterpillar engine was fitted with a turbo charger. This works by passing the exhaust gases through a turbine which in turn compresses the air being passed into the cylinder for combustion of the injected fuel. From the investigation of the turbo charger failure PPO was found in the unit and it is believed that the presence of the unburned fuel in the exhaust gas led to a build up of PPO in the unit, which in turn and once in sufficient volume created a drag force on the turbine and led to the turbo shaft breaking.

Aside from the turbo damage no other mechanical issues were found. This fault has led to Regenatec redesigning their Smartveg unit and the trial served its purpose.

Objective 3 ***Investigate if plant oil offers a lower emission & commercially viable alternative to mineral diesel that does not compromise engine performance or function***

Sea trials took the form of using the vessel in normal commercial activity, i.e. guard ship duty, towing and fishing. It is hard to accurately spot measure fuel consumption per se of a fishing vessel due to variables that are hard to measure and quantify against the simple metric of fuel used over a given period of time. Factors such as wind speed, tide, state of sea, air temperature, vessel load and even age of engine all affect measurement. Fuel consumption monitoring took the form of comparing

consumption records over a number of sailings. During the trial any difference in the performance of the PPO was so small as not to be noticeable. This result matches similar results found on land based trials. PPO has a lower calorific value than red diesel but its lubricisity tends to increase the efficiency of the engine and yielding a similar net performance.

As part of the project in situ analysis of the exhaust gas was carried out to ascertain if the burning of PPO could produce lower emission levels to that of red diesel. The tests were followed up by lab tests. The results below are taken from the in situ trials but do not show a reduction in gas emissions. Results take from the laboratory tests do show a considerable reduction in PPO compared to red diesel.

Emitted gas	@ 1300rpm red diesel	@ 1300rpm PPO
CO	0.04	0.05
CO_2	7.4	7.7
O_2	10.75	10.26
NO	1076	1386
NO_x	1123	1483`
COk	n/a	n/a

Objective 4. ***Investigate if existing additives can be safely and economically used to address the long term concerns of using vegetable oil as a fuel substitute.***

Additionally, Regenatec were heavily involved in fuel additive work investigating what fuel additives commonly used to enhance the technical and environmental performance of mineral diesel are applicable to PPO and UCO. An 'additive pack' was not fully developed and therefore not available for field deployment during this project (due in part to the trial being cut short after a turbo failure). During the sea trials, Regenatec made considerable headway in its parallel land based fuel additive work as a result of signing an NDA with a leading fuel additive manufacturer. This partnership, in conjunction with work at Oxford Brookes University, has yielded a nascent fuel additive pack technology programme. This has resulted in a first generation proprietary additive pack that will make PPO more tolerant to the conditions experienced in trial vessel's main engine.

In terms of the project the fact that a suitable additive pack was not deployed did not adversely affect the performance of the fuel. One of the main reasons for this is the fact that on UK fishing boats, fuel temperatures are never likely to drop below 5 ^{o}C, hence one of the key drivers for an additive is removed.

6. Discussion

Through the project "Biofuels for the fishing industry" we have demonstrated that it is possible for UK fishing vessels to operate on Biofuels. As this project was a Research and Development project, we fully expected to uncover issues and problems throughout and we were not disappointed. Another key aim of the project was to focus on the development of two fuel types which would offer UK fishermen

the potential to reduce the fuel bills whilst improving their environmental credentials and overall reputation.

In relation to the cost effectiveness of the two types of bio-fuels, it is fair to say that neither will undercut fossil diesel in the short term, and therefore will not be used by the fishing industry. There are however exceptions or opportunities, but these will require local enterprise and can not be driven by subsidy or government support.

Currently the Price of Crude is hovering around the $100/ barrel mark (www.oilprice.com) and this translates to a Quay side price of around £0.50/ ltr for large quantity users. When the project commenced the price of fossil diesel was about 50% lower than present, however the price of vegetable oil on the commodity markets was about 35% lower than the £0.50/ ltr it currently sits at. This price increase has been driven by government policy and consumer demand for biofuels amongst other things. It is predicted that in the future this will continue to grow and as such there will be a significant differential between the two fuels driven by demand and tax structures.

At the outset of the project waste animal fat (Tallow) was identified as a cheap feedstock material which may be suitable for conversion to biofuels for fishing boats. At the time tallow was very cheap and in some cases free upon uplift as it was a waste stream from abattoirs and meat processing factories. Since then the value of tallow has shot up and in some cases suppliers are charging prices for animal fat based on the price of fossil fuel oils. The reason for this has been the technological development and it is now possible for animal fat to be used to substitute fossil fuel in energy generation industry.

In the UK there has been another policy change which will affect the use of Biofuels in the fishing fleet. Up until this year leisure vessels could purchase subsidised fossil diesel, similar to fishing boats. This is no longer the case and they now pay the full rate of tax on their fuel. Biofuels receive a £0.20 tax reduction in comparison to fossil fuels and given that both vessel types use the same fuel there is a much stronger incentive for pleasure craft users to purchase biofuels over the tax exempt fishing industry.

There are however opportunities for the fishing fleet. With the growing consumer demand for environmentally friendly and sustainable products and lifestyles, vessels using “green” biofuels may find that they can demand a higher premium. This may be supported by certification bodies such as the MSC or schemes like the Responsible Fishing Scheme. Here the fishermen may be able to offset the added cost of running on biofuels against the increased premiums they receive for their fish.

Another opportunity may exist in rural and remote parts of the country. For example fishermen operating from the islands around the British coast pay a significantly higher price for their fuel than those operating out of the main ports (Personal Communication, Scottish Fishermen’s Federation). Much of this price increase is taken up by added transportation costs and in some cases can add 50% to the standard costs. In these instances the economics of the fishermen producing their own fuel become attractive and may offer opportunities for local farmers too.

Biofuels have over the past few years received a lot of media attention. Two years ago the whole concept was presented very positively by the media. Over the period there have been a number of studies and reports published questioning the viability of the future of the planet with biofuels as its primary fuel source.

Given current technologies and biological processes, experts estimate that the planet could only sustain about 10% of our energy needs. In addition there is serious concern about the process of deforestation to make way for arable land to grow the feed crops. Concern also surrounds the conversion of land which is currently producing subsistence crops in poorer areas of the world being turned over to producing now valuable biofuel crops. All these concerns are serious and real. They need to be addressed, if not we face the prospect creating bigger problems to solve our fuel problems.

These issues do not excuse inaction on the subject of biofuels. As is common the bad news stories all too regularly appear on the TV and in our news papers. There are some very good news stories out there. For example Jatropha is a wild bush which grows in extremely arid conditions and up until recently was treated as a nuisance plant. Through research and breeding programs Jatropha is now being farmed in previously inhospitable areas (Gubitz et. al, 1999) offering local farmers a good income and producing much needed plant oil to the biofuels markets.

In the US and New Zealand and Europe a number of research (http://www.biofuels-news.com/) programs are underway looking at the potential for producing oil from algae, the most efficient oil producing plant life on earth. These studies so far have demonstrated that the process is possible however it is difficult to maintain optimum growing conditions. With further research and investment these problems will undoubtedly be over come. Provisional results from the US estimated that an area of desert 100 miles by 100 miles (National Renewable Energy Lab, 1998) may be adequate to produce enough oil to power the US economy alone.

Other positive benefits of biofuels often overlooked include the environmental effects of oil spills and exhaust gas emission levels. These are well documented (Ryan et al., 2006) but generally ignored in favour of habitat loss or the wider issue of global warming. In the UK the press interest in the project has been high. In itself this is important as it demonstrates that the fishing industry and fishermen do take their environmental responsibilities very seriously. From a reputation perspective this project along with other high profile initiatives has helped to improve public opinion of fishermen and fishing.

7. Conclusion

Whilst the price of fossil fuels rise, the search for a substitution fuel source will continue, in much the same way that necessity has become the mother of invention. Rarely if ever does the fishing industry lead in such developments, but over the past three years this project has propelled the UK fishing industry to the cutting edge. Unfortunately not all the answers have been positive, however the feasibility and technical difficulties are now much better understood and this knowledge is available for a time in the future when the transition to biofuels is more economically feasible.

Seafish and the UK industry are not alone in identifying the opportunities which lay in biofuels. Big businesses are now taking the issue seriously. BP and other fuel producers have their own research programs underway and a number of the large engine manufacturers are conducting research into the use of biofuels onboard maritime vessels.

In a recent report commissioned by the Australian Government (FRDC, 2006), researchers concluded that Biofuels and in particular SVO and Biodiesel are the best substitution fuels for fossil diesel in the fishing industry. They point out that there are other options but given the nature of the industry, issues such as infrastructure, safety, available space all preclude the alternative technologies from at this moment being considered realistic alternatives.

It is worth noting that after this research project Seafish has received numerous enquiries from industry and we are currently working with a group of fishermen to help them establish their own Biodiesel production unit. If this project proves successful further applications will be investigated. In terms of pure plant oil technology, Regenatec are continuing to increase their customer base on land and have recently received an enquiry from a large African fishing company who are interesting in employing the technology in their fleet. If this work is successful the UK fleet will be sure to benefit from the lessons learned.

The desired solution to our fuel needs for many is an engine which will run on fresh air. Unfortunately such a solution is ever likely to materialise. Biofuels is being proposed by some as a panacea and this is not the case either. The solution is more complicated than simply finding a new fuel and for the foreseeable future we will continue to use a wide variety of fuel sources. Going forward the fishing industry like all other industries needs to examine its usage and aim to improve fuel efficiency or achieve a reduction in fuel dependency.

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